MULTILEVEL INVESTIGATIONS OF STUDENTS' COGNITIVE AND AFFECTIVE LEARNING OUTCOMES AND THEIR RELATIONSHIPS WITH PERCEIVED CLASSROOM LEARNING ENVIRONMENT AND TEACHER EFFECTIVENESS

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This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Doctor of Philosophy.

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ABSTRACT

MULTILEVEL INVESTIGATIONS OF STUDENTS' COGNITIVE AND AFFECTIVE LEARNING OUTCOMES AND THEIR RELATIONSHIPS WITH PERCEIVED CLASSROOM LEARNING ENVIRONMENT AND TEACHER EFFECTIVENESS

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The purpose of this study was to investigate the interrelations among 7th grade students' Science Achievement, self-regulation in science class, perceptions of classroom learning environment, and science teachers' beliefs and occupational well-being. This was a nationwide cross-sectional study in which 8198 seventh grade students and their 372 science teachers in Turkey participated.

Several Hierarchical Linear Modelling analyses were employed to analyze the student-level and teacher-level variables. While student-level variables included Science Achievement, self-regulation in science (i.e., Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Mastery Avoidance Goals, Performance Approach Goals, and Performance Avoidance Goals), perceived classroom learning environment (i.e., Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity) and Gender, teacher-level variables included science teachers' beliefs (i.e., Efficacy for Student Engagement, Efficacy for Classroom Management, Efficacy for Instructional Strategies, and Implicit Theories about Ability in Science), occupational well-being (i.e., Emotional Exhaustion, Personal Accomplishment, and Job Satisfaction), Experience, and Gender. It was hypothesized that teacher-level variables had influence on all continuous student-level variables; student-level variables influenced Science Achievement; self-regulation variables mediated the association between classroom learning environment and Science Achievement; and teacher-level variables interacted with student-level variables. Results indicated that perceived classroom learning environment variables were good predictors of students' cognitive and affective outcomes. Moreover, it was found that students' self-regulation variables mediated the association between perceived classroom learning environment and Science Achievement. Finally, at the student-level, self-efficacy beliefs in learning science and at the teacher-level science teachers' self-efficacy for student engagement were found to be best predictors of Science Achievement.

Keywords: Science Education, Classroom Learning Environment, Self-Regulation, Self-Efficacy, Multilevel Analysis

ÖZ

ÖĞRENCİLERİN BİLİŞSEL VE DUYUŞSAL ÖĞRENME ÇIKTILARI VE BUNLARIN SINIFTAKİ ÖĞRENME ORTAMI ALGISI VE ÖĞRETMEN VERİMLİLİĞİ İLE İLİŞKİSİNİN ÇOK DÜZEYLİ İNCELENMESİ

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Bu çalışmanın amacı Türkiye'deki 7. Sınıf öğrencilerinin Fen Başarısı, fen dersine yönelik öz-düzenleme becerileri, sınıftaki öğrenme ortamı algıları ve fen öğretmenlerinin inançları ve işteki iyilik durumu arasındaki ilişkileri araştırmaktır. Bu çalışma ülke çapında tarama yöntemi kullanılarak yapılmıştır ve çalışmaya 8198 yedinci sınıf öğrencisi ile bu öğrencilerin 372 fen öğretmeni katılmıştır.

Birçok Hiyerarşik Lineer Model analizi yürütülerek öğrenci ve öğretmen düzeyindeki veriler analiz edilmiştir. Öğrenci değişkenlerini Fen Başarısı, fen dersinde kullanılan öz-düzenleme becerileri (Öz-Yeterlik, Üst Biliş stratejileri, Öğrenme Yaklaşma Hedefleri, Öğrenme Kaçınma Hedefleri, Performans Yaklaşma

Hedefleri ve Performans Kaçınma Hedefleri), öğrencilerin sınıftaki öğrenme ortamı algısı (Öğrenci Yaklaşımı, Öğretmen Desteği, Katılım, Araştırmalar, Ödevler, İşbirliği ve Eşitlik) ve Cinsiyet oluştururken, öğretmen değişkenlerini ise inançlar (Öğrenci Katılımını Sağlama Öz-Yeterliği, Öğretim Stratejilerini Kullanma Öz-Yeterliği, Sınıf Yönetimi Öz-Yeterliği ve Fen Yeteneğine Ilişkin Örtülü Teoriler), işteki iyilik durumu (Duygusal Tükenmişlik, Kişisel Başarı ve İş Tatmini), İş Deneyimi ve Cinsiyet oluşturmaktadır. Bu çalışmada kurulan hipotezler şu şekildedir: öğretmen düzeyindeki değişkenler öğrenci düzeyindeki bütün sürekli değişkenlerle ilişkilidir, öğrenci düzeyindeki değişkenler öğrencilerin Fen Başarısını etkiler, öz-düzenleme değişkenleri sınıftaki öğrenme ortamı ve Fen Başarısı arasındaki ilişkide aracı değişken rolü oynamaktadırlar, öğrenme çıktılarını açıklayan modellerde öğretmen düzeyindeki değişkenler ile öğrenci düzeyindeki değişkenler arasında etkileşim vardır. Bulgular sınıftaki öğrenme ortamı algılarının öğrencilerin fen dersine yönelik bilişsel ve duyuşsal öğrenme çıktılarının iyi yordayıcıları olduğunu göstermiştir. Ayrıca öğrencilerin fen dersindeki öz-düzenleme becerilerinin sınıftaki öğrenme ortamı algısı ve Fen Başarısı arasında aracı değişkenler olduğu bulunmuştur. Son olarak, öğrenci düzeyinde öğrencilerin fen öğrenmeye yönelik Öz-Yeterlik algıları ve öğretmen düzeyinde öğretmenlerin Öğrenci Katılımını Sağlama Öz-Yeterlik algıları, öğrencilerin Fen Başarısının en iyi yordayıcıları olarak bulunmuştur.

Anahtar Kelimeler: Fen Eğitimi, Sınıftaki Öğrenme Ortamı, Öz-Düzenleme, Öz-Yeterlik, Çok Düzeyli Analiz

To my beloved family,
for their endless love, and encouragement

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LIST OF ABBREVIATIONS

AGQ: Achievement goal questionnaire

CFA: Confirmatory factor analysis

CFI: Comparative fit Index

GFI: Goodness-of-fit index

HLM: Hierarchical Linear Modelling

ICC: Intra class correlation

ITIS: Implicit theory of intelligence scale

ITSAS: Imlicit theory of science ability scale

MBI: Maslach burnout inventory

MSLQ: Motivated strategies for learning questionnaire

NFI: Normed fit fndex

RMR: Root-mean-square residual

RMSEA: Root-mean-square error of approximation

SAT: Science achievement test

SRMR: Standardized RMR

TSES: Teachers' sense of self efficacy scale

T_FEMALE: Teacher gender

WIHIC: What is happening in this class

ZBUPA: Teacher burnout – personal accomplishment

ZSAS: Science achievement score

ZSGOMAP: Mastery approach goals

ZSGOMAV: Mastery avoidance goals

ZSGOPAP: Performance approach goals

ZSGOPAV: Performance avoidance goals

ZSMC: Metacognitive self-regulation

ZSSE: Self-efficacy for learning and performance.

ZSWHCOOP: Cooperation

ZSWHEQU: Equity

ZSWHINVE: Investigation

ZSWHINVO: Involvement

ZSWHSC: Student cohesiveness

ZSWHTO: Task orientation

ZSWHTS: Teacher support

ZTBUEE: Teacher burnout – emotional exhaustion

ZTITSA: Teacher implicit theories about science ability

ZTJS: Teacher job satisfaction

ZTSECM: Teacher sense of efficacy for classroom management

ZTSEIS: Teacher sense of efficacy for instructional strategies

ZTSESE: Teacher sense of efficacy for student engagement

ZT_EXPER: Teacher experience

CHAPTER I

INTRODUCTION

To understand how learning occurs, various factors should be considered. Learning is a multidimensional process, and it does not only depend on the learner's personal characteristics, but also on social and physical environment, their behaviors, and interaction of these factors (Bandura, 1986). Recently, a growing number of studies have focused on the factors that influence students' learning. Although, these studies might be classified into several strands, three main strands come into prominence: (1) research on students' personal characteristics, (2) classroom learning environment research, and (3) teacher effectiveness research. More specifically, according to these three veins of research, students' learning is mainly influenced from their characteristics such as background characteristics, beliefs, and self-regulation (Bandura, 1986; Pintrich, 2000; Zimmerman, 2000); the quality of learning environment such as teacher supportive, peer supportive and task oriented (Fraser, 1990; Trickett & Moss, 1973; Walberg & Anderson, 1968; Walberg, Fraser, & Welch, 1986); and effectiveness of teacher such as showing no symptoms of burnout, having high teaching efficacy beliefs, and satisfaction with job (Kyriciou, 2001; Maslach & Leither, 1999; Tschannen-Moran & Woolfolk Hoy, 2001). This study is an attempt to expand these research areas by considering the intercorrelations among them, and investigating the factors influencing student achievement.

Students' self-regulation is one of the important characteristics that are at the base of their learning processes. Self-regulated learners personally activate and sustain behaviors, cognitions, and affects which are systematically oriented toward the attainment of learning goals (Zimmerman, 2000). Self-regulation includes cognitive, and metacognitive processes, affective processes, and behavioral processes. Cognitive processes emphasize the skills that are necessary to memorize and recall the information. Metacognitive processes emphasize planning and monitoring one's learning and selecting appropriate strategies to use across academic tasks. Affective processes emphasize goal orientation, self-efficacy, and students' causal attributions. Finally behavioral processes refer to individuals' activities to regulate their behaviors (Pintrich, 2000). Self-regulation of learning processes has substantial influence of learners' academic success (Ee, Moore, & Atputhasamy, 2003; Pintrich, Simith, Garcia, & McCeachie, 1993; Sungur & Gungoren, 2009; Yerdelen, Sungur, & Klassen, 2012; Zimmerman & Martinez-Pons 1986). According to Risemberg and Zimmerman (1992) students who plan their learning, choose appropriate strategies to reach the goals that they set, and then monitor and evaluate their learning processes are more likely to be successful than students who rely on teachers' directions for performing the same functions. Self-regulated students are also self-efficacious about their abilities to master a learning task (Pintrich, 2000). Accordingly, self-efficacy, metacognitive self-regulation, and goal orientation are the most frequently studied components of self-regulation. Among these components, self-efficacy influences individual's feelings, thinking, motivation, and behaviors (Bandura, 1993). For example, while people with strong self-efficacy are more likely to approach to challenging tasks to accomplish, those with lower level of self-efficacy tend to avoid challenging tasks (Bandura, 1994). According to Bandura (1977, 1997), individuals' efficacy beliefs are developed by gaining successful experiences, by observing and comparing the performance of others, by receiving verbal praise from others, and by their physiological and emotional states. Several studies revealed that students' academic efficacy belief is a strong indicator of their achievement (Bandura, 1986; Bandura, Barbaranelli, Caprara, & Pastorelli, 1996; Britner & Pajares, 2006; Greene, Miller, Crowson, Duke, & Akey, 2004; Klassen & Kuzucu, 2009; Linnenbrink & Pintrich, 2002; Schunk & Pajares, 2005; Yildirim, 2012; Zhang & Zhang, 2003).

The second important component of self-regulation is metacognitive self-regulation (Pintrich, 2000). Metacognition deals with individual's knowledge and regulation of their own cognition (Flavell, 1979). Metacognitive learning strategies help students plan and monitor cognitive activities and check whether the cognitive goal is accomplished or not (Schraw & Moshman, 1995). Although students' metacognitive self-regulation has been regarded among the educational researchers as an important issue for success in school, its effect on academic achievement is not clear yet. Studies on the relation of metacognitive self-regulation to academic achievement yielded inconsistent results (Sperling, Howard, Miller, & Cherly, 2002). That is, while some of the studies found positive relation of metacognition, some of the studies found no relation of metacognition to achievement.

The other self-regulation component is goal orientation (Pintrich, 2000). The focus of the achievement goal theory is the reasons of students' desire to accomplish a specific task (Anderman, Urdan, & Roeser, 2003; Pntrich, 2000). Achievement goal theory suggests four types of achievement goals: mastery approach goals, mastery avoidance goals, performance approach goals, and performance avoidance goals (e.g., Elliot & McGregor, 2001; Pintrich, 2000). Students who set mastery approach goals focus on learning, understanding, and mastering task while students who set mastery avoidance goals focus on avoiding misunderstanding, not learning, or not mastering task. Moreover, when students set performance approach goals, they compare their performance with other students, and try to superior and to beat others, while students with performance avoidance goals avoid inferiority, looking stupid or dumb in comparison to others (Pntrich, 2000). Although past research found mixed results for the association between achievement goals and academic achievement (Limenbrink-Garcia, Tyson, & Patall, 2008), some researchers reported that mastery goal oriented students prefer more challenging tasks, use more effective learning strategies, and have higher confidence in learning than performance goal oriented students (Ames, 1992; Ames & Archer, 1988; Pntrich, 2000; Wolters, 2004). Therefore, investigation of the linkages between academic achievement and students' self-efficacy, metacognitive self-regulation, and achievement goals are necessary to understand the effective learning processes of students. Moreover, as stated below, the classroom context and teacher characteristics have influence on these student outcomes as well.

The classroom context has also been regarded as one of the most important factors affecting student outcomes (Fraser & Walberg, 1991; Walberg et al. 1986). Researchers' interest to examine the psychosocial aspects of classroom environment has been increased by development of some instruments. While the early instruments focused on teacher-centered classrooms, the focus of more recently developed instruments has been student-centered classrooms based on students' and teachers' perceptions (Fraser, 2012). Among these instruments, What is Happening in This Classroom (WIHIC) (Fraser, McRobbie, & Fisher, 1996) is one of the most widely used scales to assess students' and teachers' perceptions of psychosocial features of the classrooms. WIHIC includes most salient scales which had been found as significantly associated with student's learning outcomes in previous research. Additionally, by considering latest issues and innovations in the field of education such as equity and constructivism, new scales were also included in WIHIC (Fraser, 1998; Fraser et al. 1996). WIHIC also reflects the contemporary cognitive approach to science learning (Kim, Fisher, & Fraser, 2000). Since the aspects of classroom learning environment emphasized in WIHIC are consistent with the current Turkish Elementary Science Education Curriculum which is mainly focus on student centered learning, it might be considered as the most appropriate questionnaire to investigate the psychosocial atmosphere in science classes in Turkey. WIHIC questionnaire includes 7 dimensions. WIHIC consisted of 7 subscales: Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity (Waldrip, Fisher, & Dorman, 2009). Waldrip et al. (2009), suggested using WIHIC when examining learning environments for identifying and describing teacher effectiveness and predicting student outcomes. Past research (by using WIHIC) revealed that classroom learning environment was a strong predictor of students' academic achievement (den Brok, Telli, Cakiroglu, Taconis, & Tekkaya, 2010; Chionh & Fraser, 1998; Snyder, 2005; Wolf & Fraser, 2008). Moreover, in the classrooms that students are support to use autonomy, complex thinking skills, variety of strategies, and work cooperatively, students are expected to develop self-regulated learning strategies (see Haertel, Walberg, & Haertel, 1981; Sungur & Gungoren, 2009; Paris & Paris, 2001; Ross, Salisbury-Glennon, Guarino, Reed, & Marshall, 2003). However, in science education, empirical studies on the relation of classroom learning environment and self-regulation dimensions are so rare that a few studies on the association between perceived classroom learning environment and self-efficacy (e.g., Arisoy, 2007; Dorman, 2001; Dorman, Adams, & Ferguson, 2003; Dorman, Fisher, & Waldrip, 2006; Sungur & Gungoren, 2009), achievement goal orientation (e.g., Arisoy, 2007; Allen & Fraser, 2007; Church, Elliot, & Gable, 2001; Gherasim, Butnaru, & Mairean, 2012; Sungur & Gungoren, 2009), and metacognition (e.g. Ozkal, Tekkaya, Cakiroglu & Sungur, 2009; Schraw, Crippen, & Hartley, 2006; Yilmaz-Tuzun & Topcu, 2010) are found. Besides, WIHIC was not used to measure classroom learning environment in all of these studies. According to Wolters, Pintrich, and Karabenick (2003), most of the self-regulation models assume that the relationship between personal and contextual characteristics and actual achievement or performance is mediated by individuals' self-regulation, and they stated that "it is not just individuals' cultural, demographic, or personality characteristics that influence achievement and learning directly, nor just the contextual characteristics of the classroom environment that shape achievement, but the individuals' self-regulation of their cognition, motivation, and behavior that mediate the relations between the person, context, and eventual achievement" (p.4). Some empirical studies found that the relationship between perceived classroom learning environment and achievement is influenced from students' self-regulation (e.g., Church et al. 2001; Fast et al., 2010; Patrick, Ryan, and Kaplan, 2007; Peters, 2013; Sungur & Gungoren, 2009; Yildirim, 2012). Therefore, in order to improve the quality of instruction and reach educational goals, investigating the features of classroom learning environment that positively affecting students' cognitive and affective learning outcomes is crucial.

Teacher effectiveness research also focuses on the teacher characteristics that have potential to influence students' learning outcomes (e.g., Bolyard & Moyer-Packenham, 2008; Patrick & Smart, 1998). Although past research on teacher effectiveness mostly focused on teachers' personal characteristics and teacher practices and behaviors in learning environment (Patrick & Smart, 1998), and occupational well-being (Klusmann, Kunter, Trautwein, Ludtke, & Baumert, 2008; Kyriacou, 1987; Lee & Ashforth, 1996; Maslach & Jackson, 1881), teachers' beliefs (Deemer, 2004; Lee, 1996; Lynott & Woolfolk, 1994; Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998) are also important variables that influence students learning processes and should be involved in the teacher effectiveness research.

Regarding teacher beliefs, according to Tschannen-Moran and Woolfolk Hoy (2001), teachers' effort, goal orientation, persistence, and resilience in teaching are influenced from their efficacy beliefs. Teachers' self-efficacy beliefs affect their behaviors in the classroom (Ashton & Webb, 1986). Although many researchers assumed a positive association between teacher self-efficacy and student outcomes (e.g., Ashton & Webb, 1986; Tschannen-Moran et al. 1998), empirical studies examining these associations are so rare (see Klassen, Tze, Betts, & Gordon, 2011; Vasquez; 2008), and they yielded either positive or no significant relationship. Moreover, some studies showed that teachers' self-efficacy beliefs influences the association between classroom environment and students' academic gains (e.g., Guo, McDonald Connor, Yang, Roehring, & Morrison, 2012; Guo, Piasta, Justice, & Kaderavek, 2010; Woolfolk Hoy & Davis, 2005).

Being another teacher belief factor, teachers' implicit theories about intelligence (intellectual ability) influence their behaviors and attitudes in the classroom (Deemer, 2004; Lee, 1996; Lynott & Woolfolk, 1994; Shim, Cho, & Cassady, 2013). According to Dweck and Leggett (1988), people may have implicit theories about personality, ability, motivation, and morality, as well as intelligence. Teachers who hold incremental theory believe that students' intelligence is malleable, and they attribute students' success and failure to the degree of effort students exert for learning. Teachers who hold entity theory, on the other hand, believe that intelligence is fixed and they attribute students' success and failure to their intelligence (see Dweck, 1996; Dweck, Chiu, & Hong, 1995; Dweck & Leggett, 1988). Therefore, teachers with incremental theory are more likely to create more qualified classroom environment and to contribute to students' learning outcomes.

Regarding occupational well-being (see Klusman et al., 2008) some researchers identify effective teachers as those who experience low level of burnout and high satisfaction with job (Kyriacou, 2001; Maslach & Leiter, 1999). According to Farber and Miller (1981), a burned out teacher "may be less sympathetic toward students, may have a lower tolerance for frustration in the classroom, may plan for their classes less often or less carefully, may fantasize or actually plan on leaving the profession, may feel frequently emotionally or physically exhausted, may feel anxious, irritable, depressed, and in general, may feel less committed and dedicated to their work" (as cited in Farber, 1982, p.2). Moreover, teachers' instructional performance and student outcomes are negatively associated with teacher burnout (Klusmann et al. 2008). Schools that have teachers highly satisfied with teaching profession are expected to provide qualified education and to be successful in enhancing students' educational gains (Demirtas, 2010). Past research on teacher job satisfaction indicated positive relationship between job satisfaction and performance at work (e.g., Ololube, 2006), extra-role behaviors toward students and organization (e.g., Somech & Drach-Zahavy, 2000), self-regulation (e.g., Klusmann et al. 2008), self-efficacy (e.g., Caprara, Barbaranelli, Steca, & Malone, 2006; Klassen & Chiu, 2010; Skaalvik & Skaalvik, 2010), collective efficacy (e.g., Klassen, Usher, & Bong, 2010), life-satisfaction (see Ho & Au, 2006), and student achievement (Klusman et al., 2008; Michaelowa & Wittmann, 2007) However, little is known about the influence of teacher burnout and job satisfaction on classroom environment and student outcomes.

Lastly, teacher gender and experience are also regarded as important variables that affect students' learning processes and classroom environment in various domains and grade levels across the world. Majority of the studies in science education revealed no significant relation of teachers' gender to students' science achievement (e.g., Ehrenberg, Goldhaber, & Brewer, 1995; Forslund & Hull, 1988; Harp, 2010; Smith, 1970), and of experience to students' science achievement (e.g., Goldhaber & Brewer, 2000; Harp, 2010; Monk, 1994; Zhang, 2008; Zuelke, 2008). Regarding perceived classroom learning environment, results generally indicated that, in some dimensions of classroom environment, female teachers were perceived as providing more favorable classroom learning environment than male teachers (e.g., den Brok, Fisher, Rickards, & Bull, 2006; Levy, den Brok, Wubbels, & Brekelmans, 2003). Besides, for the association between teacher experience and classroom learning environment in science education, past research showed mixed results (e.g., Brekelmans, Wubbels, & den Brok, 2002; Flinn, 2004; Levy et al. 2003). Moreover, teacher gender and experience were rarely studied with students' self-regulation. Thus, in the field of science, there is a need to investigate the role of teachers' gender and experience in students' achievement, self-regulation, and perceived classroom learning environment to make a clear conclusion on these relationships.

1.1 Purpose of the Study

The purpose of this study was to investigate the ways in which the class (or teacher) level factors influence student level factors, and in turn affect 7th grade students' science achievement in Turkey. Student-level variables included self-regulation (i.e., Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Mastery Avoidance Goals, Performance Approach Goals, and Performance Avoidance Goals), dimensions of classroom learning environment (i.e., Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity), Science Achievement, and Gender. Teacher-level variables included beliefs (i.e., Efficacy for Student Engagement, Efficacy for Classroom Management, Efficacy for Instructional Strategies, and Implicit Theories about Ability in Science), occupational well-being (i.e., Emotional Exhaustion, Personal Accomplishment, and Job Satisfaction), Experience, and Gender. Accordingly, current study aimed to investigate interrelationships among 7th grade Turkish students' self-regulation, classroom learning environment perceptions, science achievement, and their science teachers' beliefs and occupational well-being. Several Hierarchical Linear Modelling analyses were employed to analyze the student and teacher level variables. The general proposed model is presented in Figure 1.1. As Figure 1.1 indicates, class level variables have influence on all student level variables, and both student level and class level factors directly influence students' science achievement. It is further hypothesized that self-regulation variables mediated the association between classroom learning environment and science achievement. Lastly, class level variables hypothesized as interacting with student level variables. Details of the previous studies in the literature that guided to conceptualize this model are discussed in Chapter 2.

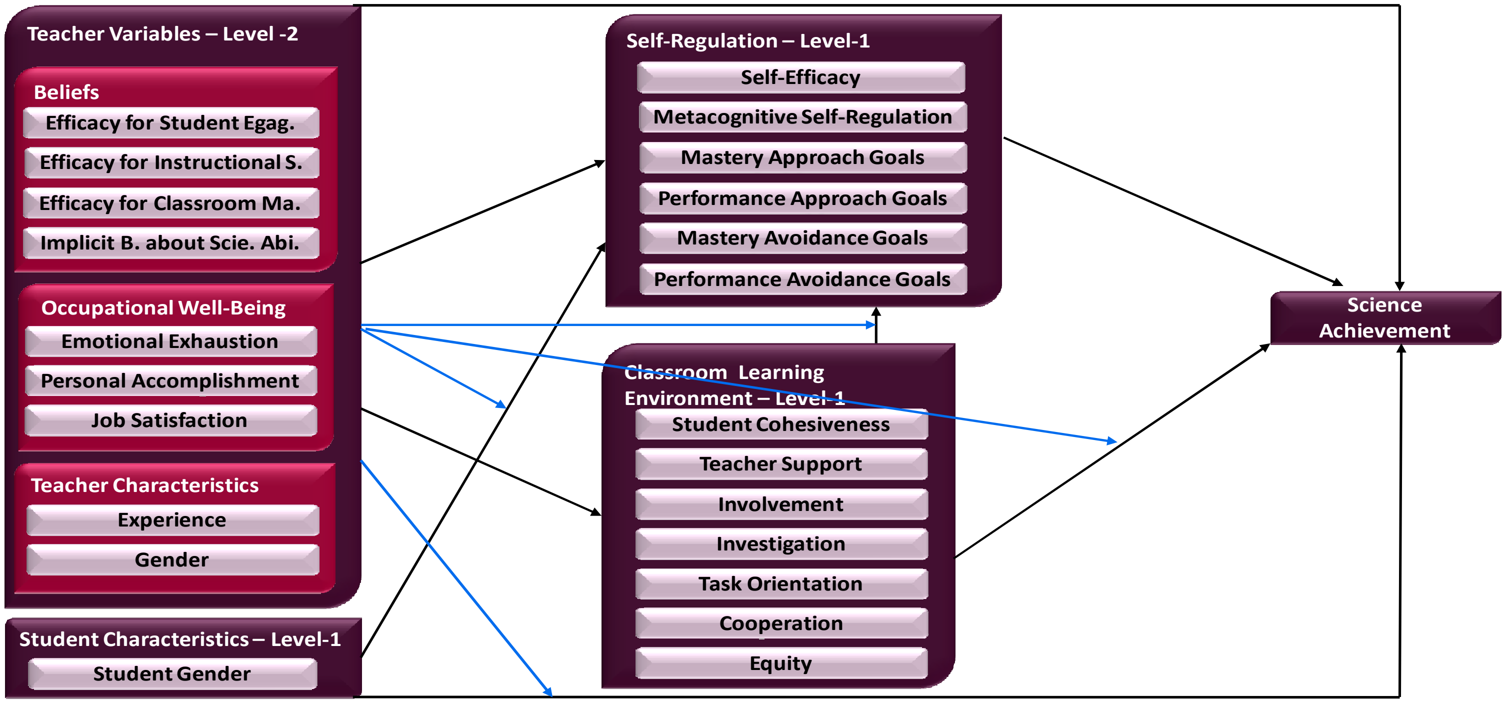

Figure 1.1 The general proposed model of the relationship between science achievement and student level (level-1) and class level (level-2) variables

Note. Arrows do not indicate causal relationships. Their directions are from predictors to outcome variables. Blue arrows indicate interaction of level-1 and level-2 variables.

1.2 Significance of the Study

Over the decades, there has been growing body of research examining the learning phenomena from various perspectives in several domains. According to Social Cognitive Theory, human functioning can be explained as the reciprocal interactions between personal, behavioral, and environmental factors, and these factors both affect and are affected from each other (Bandura, 1986). Namely, Bandura (1986) suggested that (1) individuals' behaviors are shaped by their beliefs, thoughts, and affect; and these behaviors, in turn, influence their cognitive and affective reactions, (2) while individuals' beliefs, expectations, and cognitive competences are affected (apart from behaviors) from environmental factors, they may differently influence their social environment depending on their physical (e.g., race, age, and gender) and social (prestige and status) characteristics, and (3) individuals' specific actions have influence on their environment and they are also affected from environment. Accordingly, to better understand how learning occurs, it is useful to consider personal, environmental, and behavioral factors together. When examining students' success, past research mostly focus on students' personal characteristic (e.g., beliefs, attitudes, and behaviors), learning environments (e.g., classroom, school, and home), and effectiveness of teacher (e.g., beliefs, behaviors, motivation, and background characteristics). However these three veins of research have never been studied in a single research in which all variables are simultaneously analyzed and hierarchical structure of the data is considered. Considering these three research approach while investigating the factors affecting students' learning would provide more holistic perspective and shed light on the relative importance of these factors in explaining achievement. Additionally, although there are several studies that examined the relationship between self-regulation and academic achievement (e.g., Ee et al. 2003; Pintrich et al. 1993; Sungur & Gungoren, 2009; Yerdelen et al. 2012; Zimmerman & Martinez-Pons 1986) and between classroom learning environment and student outcomes (e.g., den Brok et al. 2010; Chionh & Fraser, 1998; Snyder, 2005; Wolf & Fraser, 2008), little is known about the influence of teacher beliefs and occupational well-being on these variables and these associations. Thus, by considering students' self-regulation, perceived learning environment, and teacher beliefs and occupational health into account, the present study is expected to extend the information about the variables that influence elementary students' science learning.

The present study specifically focused on the science domain. Understanding of the factors affecting students' learning science is important. Because, the results of many international studies such as Programme for International Student Assessment (PISA) 2003 (Ministry of National Education [MONE], 2005a), PISA 2006 (MONEa, 2010), PISA 2009 (MONEb, 2010) and Trends in International Mathematics and Science Study (TIMSS) 1999 (MONE, 2003), TIMSS 2007 (MONE, 2011) showed that the average science achievement score of students from Turkey were below the average scores which were obtained from all of the countries participated in these exams. It indicated that Turkish students' science achievement is lower than those from a lot of countries. By aiming to increase students' achievement in science, Turkish elementary science curriculum has been revised in 2004 (MONE, 2005). The new curriculum mainly focuses on student centered learning in which students take active role in their learning and responsible for constructing their understanding. Accordingly, the present curriculum is suggesting various strategies including self-regulation strategies. According to Wolters and Pintrich (1998), there are mean level differences in the motivational and cognitive components of self-regulated learning across different domains. Therefore, it is thought that the linkage between students' self-regulation and students' science achievement and teacher variables are different than those in different domains such as language and math course. Therefore, examining the factors that are helpful to increase students' use of these self-regulation strategies and the role of using these strategies in students' achievement in science course is expected to contribute to our understanding of the nature of students' science learning in Turkey.

Besides, although over the past few decades learning environment research exhibited a remarkably growth across the world (Fraser, 2002), it is relatively new in Turkey

(Telli, Rakici, & Cakiroglu, 2006). Only a few studies in Turkey examined classroom learning environment in science education over the previous decade (e.g., Arisoy, 2007; Rakici, 2004; den Brok et al. 2010; Telli et al. 2006; Sungur & Gungoren, 2009). However, none of these studies in Turkey examined the role of teacher beliefs and occupational well-being in classroom learning environment. By investigating the association of classroom learning environment with student outcomes and teacher variables, in this study, it was aimed to initiate and support the activities in elementary science classrooms in Turkey.

The data set obtained from students in the present study has a nested structure. Namely, students are nested in the classrooms. Therefore, students' responses to the instrument might be influenced by their classmates, which should not be ignored to obtain more precise results from the analyses. It has been considered essential to use multilevel analysis methods when working with nested data (Raudenbush & Bryk, 2002). Moreover, multilevel analysis methods give chance to test the cross-level interactions among the variables (Raudenbush & Bryk, 2002). However, in science education, previous studies examining the influence of class variables on student outcomes rarely used appropriate analysis method to take nested data structure into consideration (e.g., Kaya, 2008; Tas, 2008; 2013; Xin, Xu, & Tatsuoka, 2004). Recently, in learning environment research, there is an increasing attention among the researchers to use Hierarchical Linear Modeling analysis method (e.g., den Brok et al. 2006; Goh & Fraser, 1998; Wong, Young, & Fraser, 1997), where relatively few studies use this method in self-regulation research (e.g., Church et al. 2001; Peters, 2013, Yildirim, 2012, Fast et al., 2010; Tas, 2008; Tas, 2013). Therefore, this study has a potential to make a unique contribution to the growing body of literature investigating the intercorrelations among students' self-regulation, classroom learning environment, academic achievement, and teacher beliefs and well-being within the elementary science classroom context by employing multilevel analysis. Moreover, the results of this study are expected to provide comprehensive information about the student and teacher related variables that affect students' learning. This information might be used to increase the quality of science education.

In sum, this study aimed to contribute to the literature by 1) being based on social cognitive theory, 2) providing a comprehensive approach to learning by combining the three research strands; research with learner's personal characteristics, beliefs and behaviors, learning environment research, and teacher effectiveness research, 3) extending the learning environment research in Turkey, 4) being science subject specific, and 5) using multilevel analysis method to deal with the nested data.

1.3 Research Questions

In this study, there were 4 main research questions to be addressed:

1 The first research question (see Figure 1.2) consisted of 2 sub-questions:

1.a. To what extent do students in different classes vary in perception of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity*)?

1.b. To what extent do class (teacher) level variables (i.e., *Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment,* and *Implicit Theory of Ability in Science*) predict students' perceptions of the each dimensions of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity*)?

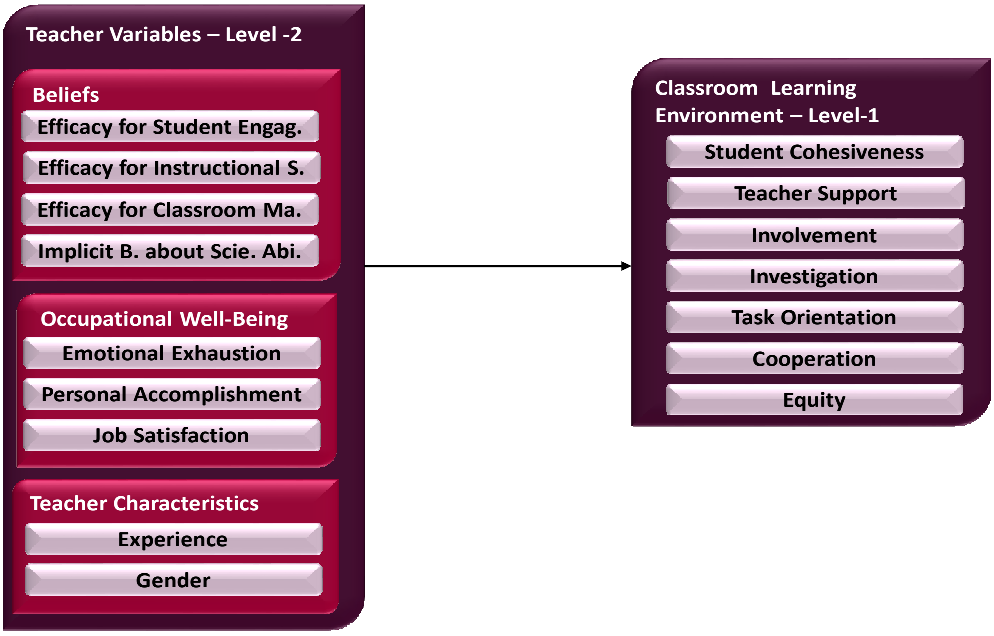

Figure 1.2 The proposed model predicting classroom learning environment by teacher variables (level-2).

Note. Arrows do not show causal relationship. Its direction is from predictors to outcomes.

2. The second research question (see Figure 1.3) consisted of 4 sub-questions:

    2.a To what extent do students in different classes vary in self-regulation dimensions (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*)?

    2.b To what extent do class (teacher) level variables (i.e., *Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies,* *Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Science Ability*) predict students' self-regulation (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*)?

2.c To what extent do student variables in terms of *Gender* and perception of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity)* predict students' self-regulation (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*)?

2.d To what extent do class (teacher) level variables (i.e., *Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Ability in Science*) influence the relationship between students' self-regulation (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*), and students' *Gender* and perception of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity)*?

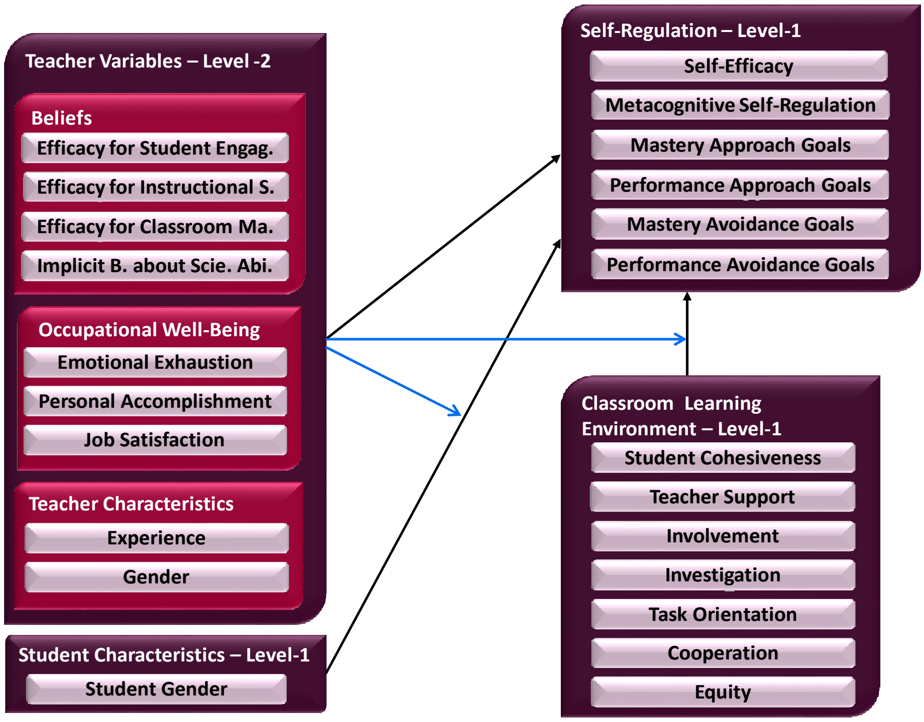

Figure 1.3 The proposed model for predicting self-regulation variables by classroom learning environment variables (level-1), student gender (level-1) and teacher variables (level-2).

Note. Arrows do not indicate causal relationships. Their directions are from predictors to outcome variables. Blue arrows indicate interaction of level-1 and level-2 variables.

3. The third research question (see Figure 1.4) consisted of 4 sub-questions:

   3.a. To what extent do students in different classes vary in *Science Achievement*?

   3.b. To what extent do class (teacher) level variables (i.e., *Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional*

Exhaustion, Personal Accomplishment, and Implicit Theory of Ability in Science) predict students' *Science Achievement*?

3.c. To what extent do student variables in terms of *Gender* and perception of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity)* predict students' *Science Achievement*?

3.d. To what extent do class (teacher) level variables (i.e., *Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Ability in Science*) influence the relationship between students' *Science Achievement,* and students' *Gender* and perception of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity)*?

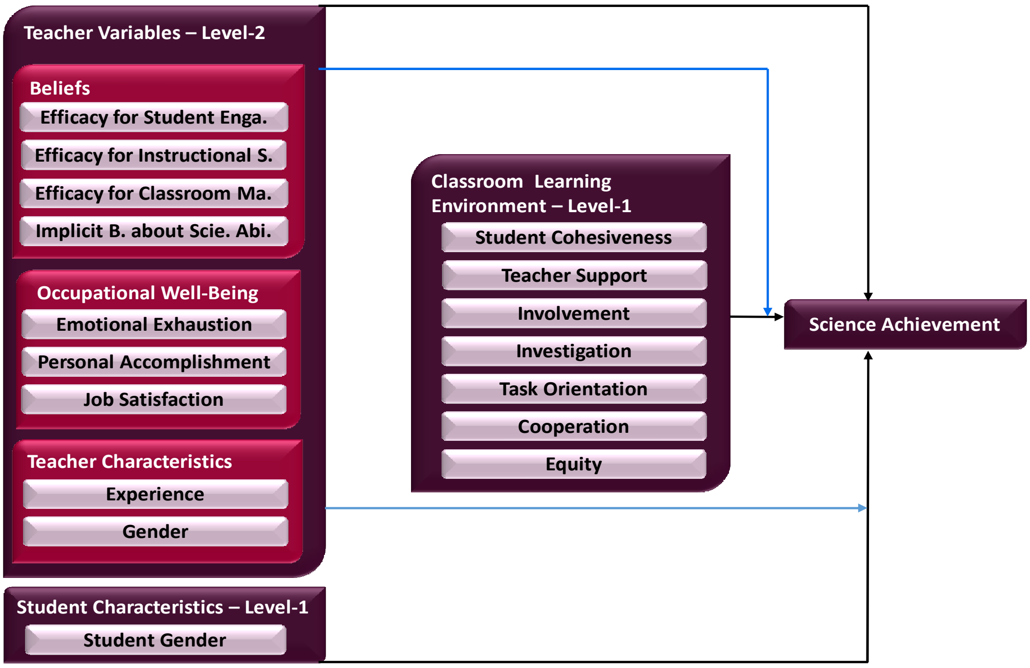

Figure 1.4 The proposed model for predicting science achievement by classroom learning environment variables (level-1) and student gender (level-1) and teacher variables (level-2).

Note: Arrows do not indicate causal relationships. Their directions are from predictors to outcome variables. Blue arrows indicate interaction of level-1 and level-2 variables.

4. Do students' Self-Regulation variables (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*) mediate the relationship between students' *Science Achievement,* and students' *Gender* and classroom learning environment variables (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity*)? (See Figure 1.5).

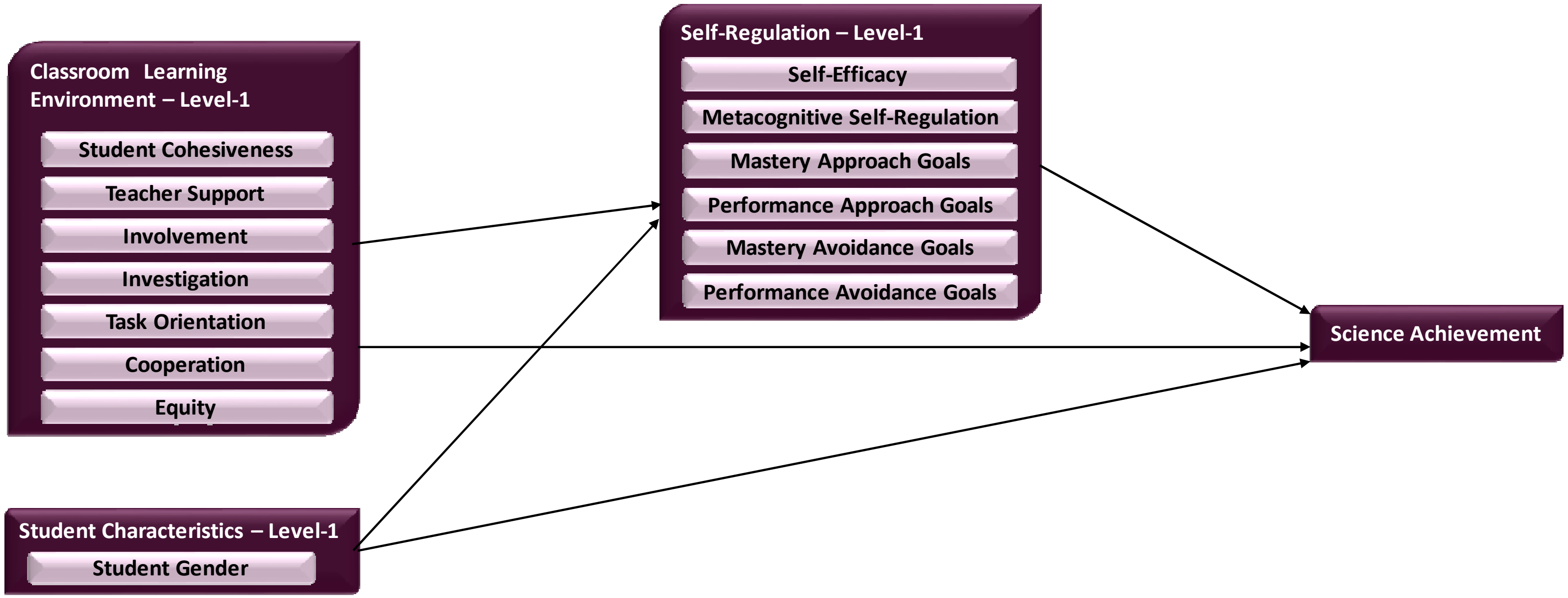

Figure 1.5 Predicting science achievement (Model 2)

Note: Arrows do not indicate causal relationships. Their directions are from predictors to outcome variables.

1.4 Definition of Important Terms

In this section, some important student level and teacher level variables were defined.

1.4.1 Student-Level Variables

1. Student Self-Efficacy

Students' self-efficacy emphasizes their judgments about their ability and confidence in skills to be successful in science class.

2. Metacognitive Self-Regulation

Students' metacognitive self-regulation emphasizes their possessing planning, monitoring, and regulating activities during learning processes in science class.

3. Mastery Approach Goals

Mastery approach goals emphasize the purpose of students' to succeed in science class that focus on mastering the tasks, develop their skills, and understanding the science subjects.

4. Performance Approach Goals

Performance approach goals emphasize the purpose of students' to succeed in science class that focus on comparing their performance with other students, beating others, gaining approval from others, and getting high grades in science class.

5. Mastery Avoidance Goals

Mastery avoidance goals emphasize the purpose of students' to succeed in science class that focus on avoiding misunderstanding, not learning, or not mastering the subjects in science class.

6. Performance Avoidance Goals

Performance approach goals emphasize the purpose of students' to succeed in science class that focus on avoiding inferiority, looking stupid or dumb in comparison to others, and getting worse scores in science class.

7. Student Cohesiveness

Student cohesiveness refers to the students' perception of the extent students in their science class are friendly and supportive of each other.

8. Teacher Support

Teacher support refers to the students' perception of the extent their science teacher helps, be friends, and is interested in students.

9. Involvement

Involvement refers to the students' perception of the extent they have attentive interest, participate in class, and share their ideas in class discussions.

10. Investigation

Investigation refers to the students' perception of the extent they develop inquiry skills and use them in solving science problems and investigations.

11. Task Orientation

Task orientation refers to the students' perception of the extent they think completing planned activities and staying on the subject matter in science class is important.

12. Cooperation

Cooperation refers to the students' perception of the extent they work cooperatively with other students rather than compete with others in learning science and participate in group works.

13. Equity

Equity refers to the students' perception of the extent they are treated equally by science teacher and have the same learning opportunities in class.

14. Science Achievement

Science achievement refers to students' performance on the 14-item multiple choice science test including the first three units of seventh grade curriculum: 1) Body system, 2) Force and Motion, and 3) Electricity.

1.4.2 Class-Level (Teacher-Level) Variables

E. Teacher self-efficacy:

Teachers' sense of efficacy refers to teachers' "judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (Tschannen-Moran & Woolfolk Hoy, 2001, p.783).

F. Efficacy for Student Engagement:

Efficacy for student engagement refers to teachers' confidence in engaging all students and encouraging them to do well in school work.

G. Efficacy for Instructional Strategies:

Efficacy for instructional strategies refers to teachers' confidence in using variety of instructional strategies and providing alternative explanations for better teaching,

H. Efficacy for Classroom Management:

Efficacy for Classroom Management emphasizes the level of confidence in managing classroom effectively and controlling disruptive behavior.

I. Emotional Exhaustion:

Emotional exhaustion refers to individuals' feeling of being depleted of personal emotional resources and being more susceptible to stressors.

J. Personal Accomplishment

Personal accomplishment refers to individuals' positive self-evaluations and self-efficacy on the job.

K. Job Satisfaction

Job Satisfaction refers to teachers' positive affective reaction to their job in general manner.

L. Implicit Theories about Ability in Science

Implicit theoriess about ability in science refers to teachers' incremental theory that they hold about students. The high scores on this variable indicate that teachers believe that students' ability in science is not fixed and can be developed.

CHAPTER II

LITERATURE REVIEW

In this chapter, the previous studies providing theoretical and empirical background for the current study are presented. The related literature is classified under two sections: (1) Student Variables and (2) Teacher Variables.

In the Student Variables section, after briefly explaining the self-regulated learning theory, the effect of three self-regulation variables (i.e., self-efficacy, metacognitive self-regulation, achievement goal orientation) on students' academic achievement are reviewed under subsections. In these subsections, the gender effect on self-regulation variables is also reviewed. Then, after examining the research on classroom learning environment, the influences of students' perceived learning environment on the self-regulation variables are stated, and previous studies focusing on the direct and indirect effects of perceived learning environment variables on academic achievement are reviewed, and the mediator role of self-regulation variables is explained. Finally, gender difference in science achievement is examined.

In the Teacher Variables section, definitions of teacher characteristics that are teachers' efficacy beliefs, burnout, job satisfaction, and implicit theories of intelligence are briefly provided. In each subsection, the definition of each variable is followed by the summary of the previously conducted studies. These studies focus on the role of these teacher characteristics on students' perception of learning environment, dimensions of students' self-regulation and students' academic achievement. Moreover, the influences of teacher gender and experience on students learning are also be examined with the related literature.

2.1 Student Variables

In this section, student variables include three components of self-regulated learning (i.e., self-efficacy, metacognition, and achievement goals), students' perceptions of classroom learning environment, and student gender.

2.1.1 Self-Regulated Learning

Self-regulated learning is considered to be highly related to quality of learning and positive academic outcomes. In fact, it is a good predictor of academic achievement, and the use of internalized self-regulatory strategies help students achieve in school. For example, Pintrich et al. (1993) and Zimmerman and Martinez-Pons (1986) indicated that components of self-regulation were strongly related to achievement. Moreover some studies reveled that high achieving students were more likely to use self-regulated learning strategies than low achievers (e.g., Ee et al. 2003; Sungur & Gungoren, 2009; Yerdelen et al. 2012).

Self-regulated learning has been the topic of educational psychology for a few decades. Researchers have conducted several studies on self-regulated learning by using different research methods, and they developed different models (Boekaerts, 1999). Although several researchers explain self- regulation proposing different models from different theoretical perspectives, they have also some common assumptions and features (see Pntrich, 2000). Among these models, Zimmerman's (2000) and Pintrich's (2000) models of self-regulated learning based on social-cognitive theory are the most well-known models.

Social Cognitive Theory explains the human functioning as the triadic reciprocality of personal, behavioral, and environmental factors (Bandura, 1986). Here, the term of reciprocality emphasizes the mutual action between causal factors. That is, human functioning is the consequence of the reciprocal interactions between personal, behavioral, and environmental factors and these factors both effect and are affected from each other (Bandura, 1986) (see Figure 2.1).

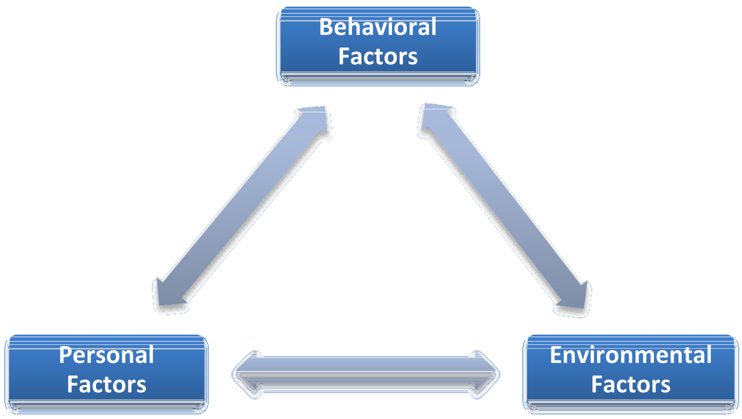

Figure 2.1 Theoretical model of triadic reciprocal determinism
Source: Bandura, 1986, p.24

In this model, the first segment of reciprocality between personal and behavioral factors suggests that individuals' behaviors are shaped by their beliefs, thoughts, and affect; and these behaviors, in turn, influence their cognitive and affective reactions (Bandura, 1986). The next interactive relation between the personal and environmental factors takes place in the sense that while individuals' beliefs, expectations, and cognitive competences are affected (apart from behaviors) from environmental factors, they may differently influence their social environment depending on their physical (e.g., race, age, and gender) and social (prestige and status) characteristics. The last segment of interaction between behavioral and environmental factors indicates that individuals' specific actions have influence on their environment and they are also affected from environment (Bandura, 1986). According to social cognitive perspective, these interactions do not emerge simultaneously, that is, the influence of a causal factor needs time to exert, and the strength of these interactions is influenced by activities, individuals, and circumstances (Bandura, 1986).

Social cognitive theory assumes self-regulated processes as the interaction of personal, behavioral, and environmental triadic processes (Bandura, 1986). As stated before, one of the self-regulated learning models based on social cognitive theory (Bandura, 1986) is Zimmerman's (2000) model. Zimmerman (2000) defined self-regulation as "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals" (p. 14). From Zimmerman's (2000) perspective, self-regulation processes can be described in three cyclical phases: forethought (e.g., setting goals and planning actions), performance or volitional control (e.g., monitoring performance and adjusting strategies), and self-reflection (e.g., self-evaluation and self-reaction of performance). Zimmerman (2000) also included affective, metacognitive, and behavioral components into these processes (see Figure 2.2).

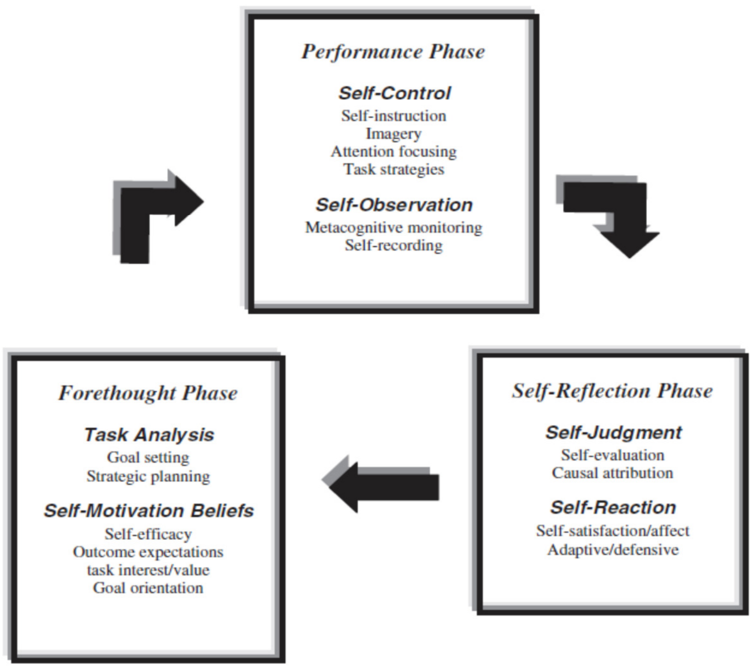

Figure 2.2 Phases and sub-processes of self-regulation

Source: Zimmerman &. Campillo, 2003, p.239

As another well-known model on self-regulated learning based on social cognitive perspective (Bandura, 1986), Pintrich's (2000) model provides more detailed information about self-regulation of learning. Pintrich (2000) classified common features of existing self-regulation models under 4x4 matrix emphasizing phases and areas of regulation (see Table 2.1). While the four phases include Forethought, Monitoring, Control, and Reaction and Reflection, the four areas of regulation include Cognition, Motivation, Behavior, and Context. Pintrich (2000) suggested that these four phases are not followed in all academic learning processes and do not have to be in a hierarchical order. Based on these common features, on the other hand, the four areas of this model suggests: (1) In the Cognition area, people may use different cognitive strategies to learn and perform a task, and may use different metacognitive strategies to control and regulate their cognition, (2) In the Motivation, area, people's various motivational beliefs about regulating their learning such as self-efficacy, goal setting, task value and attributions were placed in the motivation area. Learners may regulate their motivation and affect by setting goals, judging their confidence in succeeding a task and difficulty of task, selecting and adapting the appropriate strategies to manage motivation, and giving affective reactions, (3) In the Behavior area, regulation of behaviors includes the behaviors such as time planning, help seeking, and effort, (4) finally, in the Context area, features of the learning environment or contexts are taken into account.

Based on his model, Pintrich (2000) generated a more general definition of self-regulated learning as "an active, constructive process whereby learners set goals for their learning, and then attempt to monitor, regulate, and control their cognition, motivation and behavior, guided and constrained by their goals and the contextual features in the environment" (p. 453). Each of these components is considered as necessary but not sufficient by itself to self-regulated learning. For example, students who have cognitive skills and highly motivated to use them in a learning process are more likely to be successful than students who have the same cognitive skills but not motivated to use them (Schraw et al. 2006; Zimmerman, 2000).

Table 2.1 Phases and areas for self-regulated learning

Phases	Areas for Regulation			
	Cognition	Motivation/Affect	Behavior	Context
1. Forethought, planning, and activation	Target goal setting Prior content knowledge activation Metacognitive knowledge activation	Goal orientation adoption Efficacy judgments Ease of learning judgments; perceptions of task difficulty Task value activation Interest activation	(Time and effort planning) (Planning for self-observations of behavior)	(Perceptions of task) (Perceptions of context)
2. Monitoring	Metacognitive awareness and monitoring of cognition	Awareness and monitoring of motivation and affect	Awareness and monitoring of effort, time use, need for help Self-observation of behavior	Monitoring changing task and context conditions
3. Control	Selection and adaptation of cognitive strategies for learning, thinking	Selection and adaptation of strategies for managing, motivation, and affect	Increase/ decrease effort Persist, give up Help-seeking behavior	Change or renegotiate task Change or leave context
4. Reaction and reflection	Cognitive judgments Attributions	Affective reactions Attributions	Choice behavior	Evaluation of task

Source: Pintrich, 2000, p.454

While comparing Pintrich's (2000) and Zimmerman's (2000) models, it is obvious that Pintrich's (2000) model is more comprehensive than Zimmerman's (2000). Although the both models have taken a number of motivational and cognitive processes that are related to self-regulated learning into account, Pintrich's (2000) model have more emphasis on goal orientation. Accordingly, in the scope of this study, based on the Pintrich's (2000) model, elementary science students' self-regulation is investigated in terms of metacognitive self-regulation (from cognitive area), and self-efficacy and goal orientation (from motivation and affective area).

Pintrich (2000) stated that the self-regulatory processes are potential factors to mediate the relationship between individuals and the context and their overall achievement. According to Pintrich and De Groot (1990), "knowledge of cognitive and metacognitive strategies is usually not enough to promote; student achievement; students also must be motivated to use the strategies as well as regulate their cognition and effort" (p.33). Therefore, self- regulated students set goals effectively, plan and use strategies to realize their goals, manage resources and monitor their progress. They are self-efficacious about their abilities to master a learning task. From this perspective, the importance of self-regulation in schools is readily obvious. Students who can initiate learning tasks, set their own goals, decide on appropriate strategies for the realization of the goals, and then monitor and evaluate their own progress tend to be more successful than students who rely on teachers for performing these same functions (Risemberg & Zimmerman, 1992).

Besides, students' background characteristics such as gender, prior achievement, and socioeconomic status are potential factors to influence students' learning processes (Pintrich, 2000). Thus, understanding the role of gender in students' self-regulation of their learning processes is to be useful for teachers to provide appropriate learning opportunities to male and female students.

Accordingly, in the following sections, self-efficacy, metacognitive self-regulation, and achievement goal orientation are defined, and their associations with achievement and gender differences are explained in the light of the related literature. Moreover, in the following section, how these self-regulation components mediate the association between students' perception of classroom learning environment and achievement is addressed.

2.1.1.1 Students' Self-Efficacy

Sense of Self-Efficacy is one of the fundamental concepts of the Social Cognitive Theory which mainly focuses on human functioning (Bandura, 1986). Within the framework of Social Cognitive Theory, Bandura (1986) defined Self-efficacy as “people’s judgments of their capabilities to organize and execute courses of action required to attain designed types of performance” (p.391). More generally, self-efficacy emphasizes how confident people believe they are or how much control they believe they have in their ability to master a task and reach a goal (Bandura, 1997). Bandura (1986) addressed four sources from which self-efficacy beliefs are developed, namely mastery experiences, vicarious experience or role modeling others, social persuasion, and physiological states. Accordingly, people develop efficacy beliefs by gaining successful experiences on a specific task, by observing and comparing the performance of others who they feel as in similar position, by receiving verbal praise from people they value, and by their physiological states in self-judgments of their capabilities (Bandura, 1977; 1997). Peoples’ feelings, thinking, motivation, and behaviors are affected from their efficacy beliefs (Bandura, 1993). For instance, self-efficacious people are more likely to approach to challenging tasks to accomplish, while lower level self-efficacy cause people to avoid challenging tasks (Bandura, 1994).

In that manner, self-efficacy has a critical role in academic achievement. Students’ belief about their confidence in performing an academic task is a strong indicator of their achievement (Bandura, 1986; Britner & Pajares, 2006; Schunk & Pajares, 2005). Students who feel more confidence in controlling their own learning and in mastering coursework present higher success in academic tasks (Bandura et al. 1996). In other words, students who feel more confident in his/her academic abilities are more likely to successfully accomplish a task. Results of many research showed a positive association between students’ perceived academic efficacy and academic achievement across several domains and grades (Bandura et al. 1996; Greene et al. 2004; Klassen & Kuzucu, 2009; Linnenbrink & Pintrich, 2002; Schunk & Pajares, 2005; Yildirim, 2012; Zhang & Zhang, 2003). For example, in their meta-analysis study, Multon, Brown, and Lent (1991) examined 38 studies conducted with 4998 students between 1981 and 1988 in terms of the relationship between students’ self-efficacy and academic performance. They included three conceptual categories for academic performance: (1) standardized tests (e.g., Iowa Test of Basic Skills), (2) classroom-related tests (e.g., self-rated course performance, course grades, cumulative grade point average), and (3) basic skill tasks (e.g., subtraction problems, reading comprehension problems). Of the 38 studies, 23 were conducted with elementary school students while others with high school and college students. Results indicated a positive association between self-efficacy and academic performance with the moderate effect size (r=.38). Efficacy beliefs accounted for about 14% of the variance in students' academic performance. The effects were found as weaker for the elementary students than high schools and college students.

Relevant research also demonstrated that people's self-belief about their abilities is task-specific, and based on personal accomplishments and previous success and failures (Linnenbrink & Pintrich, 2002). For instance, a student who has high efficacy for solving algebra problems might have lower self-efficacy for geometry problems or other subject areas depending on his/her past experiences about succeeding in similar subjects (Linnenbrink & Pintrich, 2002). Therefore, it is important to examine self-efficacy separately across the different domains (such as language, math, and science) and subject areas.

In the domain of science education, students' efficacy beliefs about their capabilities in science related tasks are found to have substantial effect on their effort that they expend to succeed these tasks, on the ways which they choose to alter challenges, and, in turn, on their science achievement (Bandura, 1997; Britner & Pajares, 2006). Accordingly, students who believe they can successfully accomplish a task in science class tend to exert higher effort on the task, work harder, and persist in the face of obstacles instead of giving up (Britner & Pajares, 2006). Therefore, in order to enhance students' success and engagement in science, students' efficacy beliefs should be considered as an important factor (Britner, 2008). Many researchers exploring the association between self-efficacy and science achievement indicated positive correlation between these two variables (Areepattamannil, Freeman, & Klinger, 2011; Britner, 2008; Britner & Pajares, 2001; Britner & Pajares, 2006; Chen & Usher, 2013; Kupermintz, 2002; Pintrich & De Groot, 1990). For example, in a wide-ranging study conducted with 13,985 15-year-old students from 431 schools across Canada, Areepattamannil et al. (2011) examined the effect of motivation to learn science, science self-beliefs, and science instructional practices on science achievement based on PISA 2006 data. The authors analyzed the data by using hierarchical linear modeling analysis, and results of the final model revealed that only 8% of the variance in science achievement was between schools, while 92% of the variance was within students. Among the student variables (i.e., gender, immigration status, occupational status of the student, parental occupational status, number of books at home, enjoyment in science, general interest in science, instrumental motivation to learn science, future-oriented motivation to learn science, self-efficacy in science, and self-concept in science) and school variables (i.e., school location, school size, science teaching with a focus on models or applications, science teaching using student investigations, science teaching using hands-on activities, and interactive science teaching), self-efficacy in science was found to have the highest positive predictive power on the science achievement. On the other hand, while immigration status, general interest in science, and science teaching using student investigations had negative predictive power on science achievement; gender, instrumental motivation to learn science, future-oriented motivation to learn science, school size, and school location were not found as statistically significant predictors of science achievement.

Moreover, in a study conducted by Yerdelen et al. (2012), Motivated Strategies for Learning Questionnaire (MSLQ) were administered to 252 high school students in Turkey to examine which of the self-regulatory processes predict whether students' were high or low achiever in biology course. Results showed that among 15 constructs including intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy for learning and performance, test anxiety, rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, and help seeking; self-efficacy was found as the best predictor of being high or low achiever in biology. Namely, high achiever students had more confidence in learning biology. The similar results were found in Meece and Jones' (1996) study with 213 Grade 5 and Grade 6 students. The authors formed three achievement groups as low, average, and high based on students' composite scores on a basic skill test and a science achievement test. Results revealed that high achievers reported higher confidence in science.

Self-Efficacy and Gender

Studies on self-efficacy suggested that students' gender should be considered as an important factor in students' self-efficacy. Indeed, Pajares (1996) and Britner and Pajares (2001; 2006) reported that male and female students might have different efficacy beliefs. Although many studies examined gender differences in science self-efficacy, there are some contradictory findings that need further investigation. While some studies reported no gender differences (e.g., Arısoy, 2007; Kiran & Sungur, 2012), in some studies, either males or females reported higher efficacy in science (e.g., Britner & Pajares, 2006; Guvercin, Tekkaya, & Sungur, 2010). For example, in a recent study, Kiran and Sungur (2012) investigated the gender differences in middle school students' science self-efficacy and its sources. 1972 Grade 8 students were administered MSLQ to assess self-efficacy beliefs. Results revealed no gender difference in science self-efficacy. Regarding sources of self-efficacy, while mastery experience, vicarious experience, verbal persuasions were not significantly related to gender, girls reported significantly higher emotional arousal than boys A similar study was previously conducted by Britner and Pajares (2006) with 319 middle school students, boys reported higher self-efficacy in science than girls.

Additionally, Britner (2008) examined the effect of gender on science across three different categories of science courses: life science classes (biology, life science, anatomy, and physiology), physical science classes (physics and chemistry), and Earth/environmental science classes (Earth science, ecology, environmental science). Participants included 502 high school science students. While the author analyzed the data by combining all classes, no gender difference was found for self-efficacy. However, while data were analyzed for each subfield separately, although the same results were found for life science and physical science classes, in Earth/environmental science, female students reported higher self-efficacy than boys.

In a more recent study, Guvercin et al. (2010) investigated the effect of grade level and gender on 6^{th} and 8^{th} grade students' motivation. They administered Students' Motivation toward Science Questionnaire to 2231 students. Results revealed that, in both grade levels, female students reported higher level of efficacy toward learning science.

Arisoy (2007) also examined the effect of gender on four adaptive motivational beliefs including intrinsic goal orientation, task value, control of learning beliefs, and self-efficacy for learning and performance. MSLQ was administered 956 8^{th} grade students and results showed that although male and female students differed in their scores on intrinsic goal orientation, task value, and control of learning beliefs, no gender difference were found for self-efficacy. Similarly, in their study with 145 elementary school students from 5^{th}, 6^{th}, 7^{th} and 8^{th} grade levels, Karaarslan and Sungur (2011) found no significant gender difference toward efficacy in learning science across all grades.

To sum up, research related to self-efficacy indicated strong relationship between students' perceptions of their capabilities in learning science and science achievement (e.g., Britner, 2008; Britner & Pajares, 2006; Yerdelen et al. 2012). Therefore, in this study it is expected to find out higher science achievement for the students with higher self-efficacy in learning science. Regarding gender, since the findings of the studies on the gender effect on efficacy in science were inconsistent, there was a need to conduct a new study to gain deeper understanding. Moreover, in all of the studies reviewed above, the clustered structure of the student samples was ignored. Yet, the responses to self-efficacy scale of the students in the same classroom should not be regarded as independent since each student's responses would be affected from others. Thus, in the present study the influence of students in the same classroom on other students' responses to self-efficacy scale was taken into account, and multilevel analysis method was performed to obtain more robust results.

2.1.1.2 Metacognitive Self-Regulation

Metacognitive self-regulation is one of the important aspects of self-regulated learning. According to Pintrich's (2000) self-regulation model, metacognitive awareness and monitoring of cognition takes place in monitoring phase of cognitive area. Metacognition was firstly defined by Flavell in 1976 as follows:

> Metacognition refers to one's knowledge concerning one's own cognitive processes or anything related to them, e.g. the learning-relevant properties of information or data. For example, I am engaging in metacognition... if I notice that I am having more trouble learning A than B; if it strikes me that I should double-check C before accepting it as a fact; if it occurs to me that I should scrutinize each and every alternative in a multiple-choice task before deciding which is the best one.... Metacognition refers, among other things, to the active monitoring and consequent regulation and orchestration of those processes in relation to the cognitive objects or data on which they bear, usually in the service of some concrete [problem solving] goal or objective (cited in Schoenfeld, 1992, p. 38).

Afterwards, several definitions of metacognition emerged in the light of the increased attention to metacognition in the fields of psychology and education. For example, it was defined by Brown (1987) as "one's knowledge and control of own cognitive system" (p.66) and by Kuhn and Dean (2004) as "awareness and management of one's own thought" (p.270). Although there are different definitions of metacognition, it deals with, in general manner, individual's knowledge about cognitive processes and about consequences of these processes in terms of monitoring and controlling.

Flavell (1979) classified metacognition into two components: metacognitive knowledge and metacognitive regulation. Metacognitive knowledge emphasizes the knowledge acquired by the people through various cognitive tasks, goals, actions, and experiences. That is, metacognitive knowledge includes three categories of the factors influencing knowledge or beliefs: knowledge of person, knowledge of task, and knowledge of strategy. Knowledge of person indicates the knowledge of individuals' learning processes regarding how they learn. It also takes individual differences into account. Being the second factor, knowledge of task refers to the available information about the features of the task such as familiar or unfamiliar, well or poorly organized, interesting or dull, etc. Finally, knowledge of strategy concerns knowledge about which strategies are appropriate to accomplish a task, and what the correct time and place to use them are. According to Flavell (1979), metacognitive knowledge is best acquired through interaction or combination among the three categories of factors that were knowledge of person, knowledge of task, and knowledge of strategy.

Metacognitive regulation (or experiences) emphasizes the regulation of cognition and hence learning processes. It is used to control cognitive activities and to check whether the cognitive goal is accomplished or not. There are three stages followed for regulation of cognitive processes: planning, monitoring, and evaluation (Schraw & Moshman, 1995). In the planning stage, individuals try to decide on the appropriate strategies before starting to do task in terms of goal setting, task analysis, and strategy choosing. In the monitoring stage, individuals judge their learning process and test their learning skills. Finally, in the evaluation stage, individuals evaluate the results of the learning process, and make adjustments on cognitive activities.

Boekarerts (1997) indicated that metacognitive knowledge facilitates comprehension, monitoring, or assessing conceptual and procedural knowledge related to the context. According to Boekarerts (1997) the level of students' metacognitive skills such as planning, monitoring, reflection, and self-testing distinguishes them from the other students.

Students' metacognitive skills and awareness of their actions have been regarded as an important topic among the educational researchers. In various areas including science education, several studies have examined the association between the use of metacognitive strategies in learning process and students' academic achievement. However, findings of these studies are inconsistent (Sperling et al. 2002), that is while some of these studies found positive relation of metacognition, some of the studies found no relation of metacognition to achievement. Sperling et al.'s (2002) review of the literature on the relationship between achievement and metacognition across the studies using different measures of metacognition and different methods, it was reported that relationship between metacognitive skills and achievement was complicated and not clear.

For example, in order to find out the effect of using metacognitive strategies on solving mathematical problems, Ozsoy and Ataman (2009) conducted an experimental study with 47 fifth grade students during 9 weeks. While the experimental group received a metacognitive instruction through metacognitive problem solving activities, no additional activities except from their regular lesson were received by control group. Comparison of students' pre- and post-test scores on Mathematical Problem Solving Achievement Test indicated that students who received the instruction based on metacognitive skills outperformed the students in the control group. In another study with 3th and 4^{th} grade students, van Kraayenoord and Schneider (1999) examined the relationship between students' reading comprehension and metacognition based on self-report questionnaires. Results of the structural equation modelling revealed that, in both grade levels, students who had higher reading achievement scores exhibited greater metacognitive knowledge about memory. Moreover, the authors formed two groups of students based on their total score on a reading exercise test. Good readers were determined as students whose reading score were in top quartile, and poor readers were the students whose reading scores in the bottom quartile. Results revealed that good and poor readers significantly differed in metacognitive knowledge about reading and memory: good readers outperformed poor readers.

On the other hand, Al-Harthy and Was (2010) found no relation between the use of metacognitive strategies and students' academic achievement. More specifically, in their study, the researchers explored the relationship between self-efficacy, task value, goal orientations, metacognitive self-regulation, and self-regulation and learning strategies, and investigated the unique contribution of each of them to the variability in students' achievement. With this aim, they administered MSLQ to 625 undergraduate students enrolled in educational psychology course. As an achievement score they used the total score of 12 exams and 12 quizzes. Result of the path analysis demonstrated that mastery goals, metacognitive self-regulation, and deep learning strategies did not have a significant direct effect on achievement. Accordingly, the effect of metacognition on achievement was fully mediated by time, study environment, and effort regulation.

In science education, while some of the studies used experimental methods to find out causal relationship between metacognition and achievement by designing instructions addressing metacognitive strategies, other studies used self-report questionnaires to assess students' metacognitive strategy use and investigated its relation to science achievement based on standard tests or course grades. Several researchers who examined the effect of using metacognitive strategies on understanding of science topics through experimental research designs found positive effect (Beeth, 1998a; 1998b; Georghiades, 2004; Mason, 1994a; 1994b; Yuruk, 2007). For example, White and Fredriksen (1998) developed a ThinkerTools Inquiry curriculum that emphasized a constructivist, inquiry-oriented approach to science education. Participants of this study included middle school students and Force and Motion topic of the physics was selected as the subject. While the treatment groups who were taught with ThinkerTools Curriculum by which students engaged in monitoring and evaluating their own and each other's research, in control group, although they were taught with the same curriculum, no intervention was received in terms of metacognition. Students who participated in ThinkerTools inquiry-based curriculum designed and carried out experiments using hands-on materials and computer simulations and developed laws, models, and theories based on their findings. Results showed that supporting this curriculum with metacognitive activities made the difficult subject of physics more understandable and interesting for many students. Moreover, low achieving students more benefited from metacognitive processes and gained higher scores on inquiry test. Similarly, Georghiades (2004) investigated the role of situated metacognition in the durability of primary pupils' conceptions of science. Researcher defined situated metacognition as "metacognition practiced in the current context of normal lessons and within the time allocated for the teaching of curriculum subject matter, aimed at improving learners' performance in the specific content taught by facilitating better understanding" (p.87). Researcher conducted a quasi-experimental study with 60 5th grade students studying the unit 'Current Electricity'. He divided the students into two groups: one experimental and one comparative group. Each group included 30 students. The only difference between the instructions they received was that metacognitive instruction was implemented at selected points of the teaching procedure in the experimental group. Each 80-minute lesson included 5 or 6 metacognitive activities such as class discussion, annotated drawing, keeping diary-like notes, and concept-mapping. The same written test focusing on the concepts related to the electricity was applied to students at three times: 1 week (Phase 1), 2 months (Phase 2) and 8 months (Phase 3). The research demonstrated that metacognitive practices were useful for primary school pupils, and children who experienced situated metacognition retained taught concepts for a longer period of time. The longitudinal data collection revealed that although the amount of the subject matter learned was same for both groups, experimental group who engaged in metacognitive activities achieved more permanent re-structuring of their understandings,

On the other hand, results of the studies using self-report questionnaires to examine the relationship between metacognition and achievement in science are not consistent. For example, Yumusak, Sungur, and Cakiroglu (2007) examined the contribution of motivational beliefs, and cognitive and metacognitive strategy use to biology achievement with 519 tenth grade students. Students were administered the

MSLQ and a 20-item biology achievement test developed by researchers. The data were analyzed through two multiple linear regression analysis for motivation section and learning strategies section. Results of multiple linear regression analyses for learning strategies section suggested that metacognitive strategy use was not a significant predictor of biology achievement. Similarly, in Yerdelen et al.'s (2012) study in which MSLQ was administered to high school students, no significant association was found between metacognitive strategy use and biology achievement.

In another study, Topcu and Yılmaz-Tuzun (2009) examined the association between science achievement and metacognitive skills with two groups of students: (1) 4^{th} and 5^{th} graders, (2) 6^{th}, 7^{th}, and 8^{th} graders. In order to assess students' metacognitive skills, Junior Metacognitive Awareness Inventory (Jr. MAI) was used. Jr. MAI consists of two subscales: Knowledge of Cognition and Regulation of Cognition. As a science achievement score, students' grade point averages referring to the last semester were used. Results showed that Knowledge of Cognition and Regulation of Cognition were significantly and positively related to science achievement in both groups of students. Moreover, in a similar study, Sperling et al. (2002) found a significant correlation between metacognition and achievement for grades 3 through 5, but no significant correlation for grades 6 through 8.

In addition to experimental and survey studies, there are also studies on metacognition and achievement relationship utilizing different methodologies. For example, in order to clarify the metacognitive processes in conceptual learning in science, Yuruk (2007) conducted a case study using one student in a classroom. In that study, the aim was to describe the changes in students' ideas about force and one-dimensional motion concepts, and to portray the relevant metacognitive process. The metacognitive activities included poster drawing, concept mapping, group debate, journal writing, and group and class discussions. Data were collected by using video-recordings of classroom discussions, audio-recordings of group discussions, and journal writings. It was found that after this instruction, all alternative ideas of student determined before the instruction was changed with the scientifically accepted conceptions. The study supported the claim that metacognitive processes had positive effect on changing students' conceptions of physical world.

Metacognitive Self-Regulation and Gender

Students' gender is considered as one of the factors that may influence their learning strategies (e.g., Akyol, Sungur, & Tekkaya, 2010; Wolters & Pintrich, 1998; Zimmerman & Martinez-Pons, 1990). Zimmerman and Martinez-Pons (1990) stated that although female students were less self-efficacious than male students, they use learning strategies such as record keeping and monitoring, environmental structuring, and goal setting and planning more than male students. Past research on gender differences in using metacognitive strategies produced mixed results. While some studies revealed no gender difference in metacognitive self-regulation, others revealed significant gender differences in favor of female students. For example, utilizing MSLQ with a sample of 76 undergraduate students enrolled in a physics course, Lynch (2010) found no gender differences for mean scores of metacognitive self-regulation subscale. The similar results were found in Akyol et al.'s (2010) study with 1517 seventh grade students. In another study conducted with undergraduate students enrolled in an online programming course, male and female students reported using same level of metacognitive strategies (Yukselturk & Bulut, 2009). On the other hand, in Al Khatib's (2010) study, female college students reported significantly higher score on metacognitive self-regulation subscale of MSLQ than males. Similarly, in Topcu and Yilmaz-Tuzun's (2009) study, female students had higher scores on metacognitive self-regulation across the all grades from 5th to 8th. This study also revealed that, in both grade levels, girls developed better metacognition in their science courses.

In sum, related literature showed that the association between metacognition and achievement is not clear and needs further investigation. Although positive effect of metacognition is generally found in experimental designs focusing on the effect of metacognitive instructions on achievement, results obtained from self-report questionnaires are inconsistent. Additionally, the role of gender in metacognitive self-regulation, which results in inconsistent findings, is another issue requiring further investigation. Thus, there was a need to conduct a new study to shed light on these relations. In the present study, it is aimed to investigate the association between metacognitive self-regulation and science achievement as well as the role of gender in metacognitive self-regulation in a different context and understand more deeply by utilizing multilevel modelling method which is a more robust statistical method.

2.1.1.3 Achievement Goal Orientation

Achievement goals are one of the key components of self-regulation (Pintrich, 2000). Over a few decades, achievement goal theory has received increasing attention among educational psychologists to understand the role of goals in students' learning process (Anderman et al. 2003; Pintrich, Conley, & Kempler, 2003). Achievement goal theory deals with the reasons of students desire to accomplish a specific task (Anderman et al. 2003; Pntrich, 2000). Researchers who work on achievement goals mostly focus on the quality of motivation, not on how much motivated an individual to achieve a task (Anderman et al. 2003). Anderman et al. stated that even when two students have same amount of motivation to complete a task, their reasons might be different for doing that.

The early achievement goal theorists proposed two types of achievement goals: mastery goals and performance goals (e.g., Ames, 1992; Ames & Archer, 1988; Elliot & Church, 1997). While mastery goals were defined as "to reflect a focus on developing competence, learning, and understanding the task and the use of self-referenced standards of improvement", performance goals were defined as "to reflect on orientation to demonstrating competence, being superior to others, and the use of social comparative or normative standards" (Pintrich et al. 2003, p.321). Accordingly, students who set mastery goals value learning and focus on improving competence skills while students who set performance goals focus on comparing their performance or ability with others (Church et al. 2001; Linnenbrink & Pintrich, 2002). However, according to Elliot and Harackiewicz (1996), these theorists either considered mastery and performance goals as approach forms of motivation or they did not differentiate approach and avoidance approach within the performance goal orientation. Therefore, Elliot and Harackiewicz (1996) proposed a new achievement goal orientation model in which performance goals included approach and avoidance distinction. According to this model, individuals who set performance approach goals are positively motivated to demonstrate their competence and try to be better than others, while individuals who set performance avoidance goals are negatively motivated to avoid failure and being relatively less successful than others.

Most recently, Pintrich (2000) and Elliot and McGregor (2001) criticized the existing models that these models considered mastery goals as if they were only approach goals. Pintrich (2000) and Elliot and McGregor (2001) suggested that although mastery goals were seen as approach goals, there might be students who avoid misunderstanding or not mastering the task since they set high standards for themselves. Therefore, by considering all different approaches, latest researchers (e.g., Elliot and McGregor, 2001; Pintrich, 2000) extended the achievement goal theory by inserting approach-avoidance approach into mastery-performance distinction of achievement goals. That is, the new model suggests four achievement goals: mastery approach goals, mastery avoidance goals, performance approach goals, and performance avoidance goals. As it can be seen in Table 2.2, while mastery approach goals "focus on mastering task, learning, and understanding", mastery avoidance goals "focus on avoiding misunderstanding, not learning, or not mastering task". Besides, performance approach goals "focus on being superior, beating others, being the smartest, best at task in comparison to others", while performance avoidance goals "focus on avoiding inferiority, not looking stupid or dumb in comparison to others" (Pntrich, 2000, p.477).

Table 2.2 Two goal orientation and their approach-avoidance forms

	Approach Focus	Avoidance Focus
Mastery orientation	Focus on mastering task, learning, understanding	Focus on avoiding misunderstanding, avoiding not learning or not mastering task
	Use of standards of self-improvement, progress, deep understanding of task	Use of standards of not being wrong, not doing it incorrectly relative to task
	(Learning goal, task goal, task-involved goal)	
Performance orientation	Focus on being superior, besting others, being the smartest, best at task in comparison to others	Focus on avoiding inferiority, not looking stupid or dumb in comparison to others
	Use of normative standards such as getting best or highest grades, being top or best performer in class	Use of normative standards of not getting the worst grades, being lowest performer in class
	(Performance goal, ego-involved goal self-enhancing ego orientation, relative ability goal)	(Performance goal, ego-involved goal, self-defeating ego orientation)

Source: Pintrich, 2000, p.477

According to Greene and Miller (1996), the empirical evidence of various studies revealed that when individuals adopt mastery goals, they use cognitive and metacognitive strategies at higher levels. Indeed, mastery goal oriented students prefer more challenging tasks, use more effective learning strategies, and have higher confidence in learning than performance goal oriented students (Ames, 1992; Ames & Archer, 1988; Pntrich, 2000; Wolters, 2004). On the other hand, related literature showed some inconsistent results for the effect of achievement goal orientation on academic achievement. Limenbrink-Garcia et al. (2008) conducted a literature review study addressing the relation of mastery and performance-approach to academic achievement. Researchers reviewed 90 studies that either used survey or experimental design, Investigation of the studies that assessing achievement goal orientation by self-report questionnaires showed that the association between mastery goals and academic achievement was positive in approximately 40% of the studies and negative in about 5% of the studies, no significant relation was reported in the rest of the studies reviewed. Nearly same results were also found for the relationship between performance approach goals and achievement. In experimental studies, the majority of the studies (70%) reported no effect of goal condition on achievement whereas about 20% favored mastery goals and 10% favored performance approach goals. Researchers examined the possible reasons of the differences in findings of the various studies, and they criticized the potential moderation effect of task characteristics (type of achievement task, task difficulty), psychological variables (perceived competence, multiple goals), and individual differences (ability, age, gender, culture) on the relation of goal conditions to academic achievement. For example, for low ability students, performance approach goals may negatively affect the achievement and they are only beneficial for easy tasks. Moreover, at elementary school level, whereas mastery goals were related to higher achievement, performance approach goals had negative effect on achievement in most studies. Conversely, in late adolescence and early adulthood, the positive effect of mastery goals diminished while student more benefited from performance approach goals. Lastly, researchers indicated that while performance approach goals might be more beneficial for male students, female students more tended to benefit from mastery goals.

In another study with 525 junior high school students, Wolters (2004) administered a self-report survey addressing students' perception of classroom goal structures; personal goal orientations; and a collection of outcomes including persistence, procrastination, choice, their use of cognitive and metacognitive learning strategies, and mathematics grade. As components of goal orientation, mastery goals, performance approach goals and performance avoidance goals were examined. Result of HLM analysis revealed that among the 3 goal orientation types, only performance approach goals significantly and positively predicted teacher-assigned grades. Although mastery goal orientation was found related to the use of cognitive strategies and metacognitive strategies, it was not significantly associated with course grade. On the other hand, although students' reported cognitive and metacognitive strategies were not significantly related to performance approach goals, teacher-assigned math grades were significantly linked to performance approach goals. Students who set performance avoidance goals received similar grades with others. Although some consistent results with some other studies were reported by the researcher, this study failed to consider approach-avoidance framework for mastery goals.

Elliot and McGregor (2001) conducted a study aiming to test the 2x2 framework of achievement goals. Unlike the previous research, mastery goals were regarded as approach and avoidance form. Students were administered achievement goal questionnaire, and their overall scores obtained from 34 multiple choice and 12 short answer/essay questions were used as the indicator of academic achievement. The data collected from 182 undergraduate students enrolled in an introductory psychology class were analyzed through zero order correlation and regression analysis. Results of the correlation analysis showed that mastery avoidance goals were positively associated with mastery approach and performance avoidance, while they were not related to performance approach goals. Moreover, results of the regression analysis indicated that performance approach goals positively and performance avoidance goals negatively predicted students' academic achievement, whereas mastery approach and mastery avoidance goals were not significant predictors of achievement.

Barzegar (2012) examined the relation between achievement goal orientation and academic achievement. 260 undergraduate psychology students were participated in the study, and they were administered achievement goal questionnaire. Results of correlation analysis showed that while mastery approach and performance approach goals were positively associated with academic achievement, mastery avoidance and performance avoidance goals were negatively related to academic achievement.

Moreover, in another study, Tas (2008) examined the relation of science achievement to achievement goals. 1950 7^{th} grade Turkish students were participated in the study, and they were administered Patterns of Adaptive Learning Scale (Midgley, et al., 2000) to assess goal orientation and a 15-multiple-choice item test was used to assess students' science achievement. Results indicated positive association for mastery goals and students' science achievement while no significant association was found between performance approach goals and science achievement. In another study, Tas (2013) examined the role of achievement goals that were specifically about homework in predicting 7th grade Turkish students' science achievement. Results of the HLM analysis showed that while mastery (approach) goals significantly predicted (γ= .039, *se*= .014) students' science achievement, performance approach goals were not significant predictor of science achievement.

Regarding gender differences, literature provides mixed results. For example, Tas's (2008) study with 7th grade science students in Turkey showed no gender effect on mastery goals, while female students were found to have significantly higher performance approach goals. On the contrary, Arisoy's (2007) study with 8th grade science students in Turkey indicated higher mastery goal orientation for girls than boys. Results of another study with college students (Finney & Davis, 2003), researchers found that while female students endorsed more mastery approach goals than males, male students' endorsement of performance approach goals was higher than females. This study partly supported the results of Elliot and McGroger's (2001) study which investigated the gender difference in mastery approach goals that favoring females, while no gender difference was found for other three components of achievement goals for the same sample. In another study, Gherasim, Butnanu, and Mairean (2012) examined the gender effect on goals among 7th grade students enrolled in a math class. Results revealed that female students reported higher mastery goals and lower performance avoidance goals than males.

To sum up, empirical evidences revealed that the relation of goals to academic achievement is not clear. In line with the related literature, since students who adopt mastery oriented goals tend to focus on mastering task, learning, and understanding, mastery goal oriented students are more tend to gain higher achievement (Barzegar, 2012). Thus, in this study, it is expected to find positive association between mastery approach goals and academic achievement. After all, the literature review study by

Limenbrink-Garcia et al. (2008) addressed the fact that nearly 40% of the studies revealed positive association between mastery approach goals and students' achievement. On the other hand, since the past research yielded inconsistent results for the relationship between academic achievement and other types of goal orientation (i.e., Mastery avoidance goals, performance approach goals, and performance avoidance goals), no previous hypotheses were generated for these relations. Moreover, studies also provided inconsistent results for gender effect on achievement goals. This study is expected to contribute to the findings of various results of other studies by considering goal orientation together with many student and teacher related variables. Additionally, investigation of goals in science education will also provide task specific information.

2.1.2 Classroom Learning Environment

The classroom has been regarded as one of the most important factors affecting student outcomes (Fraser & Walberg, 1991). Walberg's (1981; 1984) theory of educational productivity suggested a model describing three groups of factors that contribute to variance in students' cognitive and affective outcomes and behaviors: (1) Aptitude including ability, development, and motivation, (2) Instruction in terms of quantity and quality, and (3) Environment including home, classroom, peers, and media. Following tests of this model showed that classroom environment has an important effect on students' achievement and attitudes (e.g., Walberg et al. 1986). Therefore, investigating the features of learning environment that positively affects students' learning outcomes is crucial for improving instructional quality, and reaching educational goals.

Learning environment research is described by Fraser (1990) as the research on "Social, psychological and pedagogical context in which learning occurs and which affects students' achievement and attitudes" (p.3). The first attempts to explore learning environment were based on the Kurt Lewin's (1936) social-psychological framework suggesting that human behavior is a function of the interaction between the personal characteristics and the environment. Later, Murray (1938) extended Lewin's approach and proposed a need-press model which describes presses as the external factors that positively or negatively affect how successfully individuals meet their needs or achieve their goals. Murray also described two types of press: (1) alpha press; the environment as perceived by an external observer and (2) beta press; the environment as perceived by individuals who belong to this environment. These approaches to learning environment had been enriched with new perspectives of other educational researchers in the long run and provided a base for the recent learning environment research (e.g., Fraser, 1990; Trickett & Moss, 1973; Walberg & Anderson, 1968).

Studies on learning environment have been remarkably accelerated after 1960's by the development of several measures of classroom learning environment. The formers of these measures were Learning Environment Inventory (LEI) developed by Walberg and Anderson (1968) and Classroom Environment Scale (CES) developed by Trickett and Moss (1973). Afterwards, Fraser (1990) developed Individualised Classroom Environment Questionnaire (ICEQ). It was different than LEI and CES in the sense that while LEI and CES were focusing on teacher-centered classrooms, ICEQ was focusing on student-centered classrooms based on students' and teachers' perceptions (Fraser, 2012).

The examples of the later developed measures of learning environment include Science Laboratory Environment Inventory (SLEI; Fraser, Giddings, & McRobbie, 1992), Questionnaire on Teacher Interaction (QTI; Wubbels & Levy, 1993), Constructivist Learning Environment Scale (CLES; Tylor, Dawson, & Fraser, 1995; Taylor, Fraser, & Fisher, 1997), Computer-Facilitated Learning (CFL) Environments Instrument (Bain, McNaught, Mills, & Lueckenhausen, 1998), and What Is Happening in This Class (WIHIC) questionnaire (Fraser, Fisher, & McRobby, 1996) (see Fraser, 1998). All of these questionnaires focus on assessing perceptions of psychosocial features of the classrooms (Fraser, 1998). The subscales of these questionnaires are mostly different, although all of them originally based on Moss's

(1974) classification of human social environments: (a) relationship, (b) personal development, and (c) system maintenance and change. Subscales of the existing questionnaires commonly used in learning environment research were stated in Table 2.3 These subscales were generated depending on which social psychological aspects of the learning environment were aimed to assess.

Table 2.3 Subscales of some classroom learning environment instruments

Instrument	Year & Authors	Scales classified according to dimensions of Moos		
		Relationship dimensions	Personal Development dimensions	System maintenance and change dimensions
Learning Environment Inventory (LEI)	1968 Walberg & Anderson	Cohesiveness Friction Favoritism Cliqueness Satisfaction Apathy	Speed Difficulty Competitiveness	Diversity Formality Material Environment Goal Direction Disorganization Democracy
Classroom Environment Scale (CES)	1973 Trickett & Moss	Involvement Affiliation Teacher Support	Task Orientation Competition	Order and Organization Rule Clarity Teacher Control Innovation
Individualized Classroom Environment Questionnaire (ICEQ)	1990 Fraser	Personalization Participation	Independence Investigation	Differentiation
Science Laboratory Environment Inventory (SLEI)	1992 Fraser, Gidding, & McRobbie	Student Cohesiveness	Open-Endedness Integration	Rule Clarity Material Environment
Constructivist Learning Environment Survey (CLES)	1995 Taylor, Dawson, & Fraser	Personal Relevance Uncertainty	Critical Voice Shared Control	Student Negotiation
What is Happening in This Classroom (WIHIC)	1996 Fraser, Fisher, & McRobbie	Student Cohesiveness Teacher Support Involvement	Investigation Task Orientation Cooperation	Equity

Source: Adapted from Fraser 1998, p.10

Most recently, Fraser, Fisher, and McRobbie (1996l) developed WIHIC questionnaire by incorporating most salient scales which had been found as significantly associated with student's learning outcomes in previous research. The new scales were constituted by considering latest issues and innovations in the field of education such as equity and constructivism (Fraser, 1998; Fraser et al. 1996). WIHIC also reflects the contemporary cognitive approach to science learning (Kim et al. 2000). Since the aspects of classroom learning environment emphasized in WIHIC are consistent with the current Turkish Elementary Science Education Curriculum, it might be considered as the most appropriate questionnaire to investigate the social-psychological atmosphere in science classes in Turkey. WIHIC questionnaire includes 7 dimensions (see Table 2.3): (1) Student Cohesiveness, emphasizing the student-student interaction in terms of how friendly, helpful, and supportive they are to each other, (2) Teacher Support, concerning how helpful, friendly, and supportive teachers are to their students, (3) Involvement, emphasizing the extent to which students have attentive interest, participate in classroom activities, and enjoy the class, (4) Investigation, focusing on the skills and inquiry and to the extent that students use them in problem solving and investigation, (5) Task Orientation, involving whether students accomplish the given tasks and planned activities, and focus on the works they were expected to do, (6) Cooperation, emphasizing the students cooperation with each other while doing classroom activities, and (7) Equity, concerning whether teachers treat students equally in terms of feedback, prise, asking questions, and opportunities (Waldrip et al. 2009). According to Waldrip et al. (2009) using WIHIC when examining learning environments is beneficial for identifying and describing teacher effectiveness and predicting student outcomes.

Past research on classroom environment mostly addresses the association between students' cognitive and affective learning outcomes and their perceptions of social-psychological nature of the classroom (Fraser, 1998). The related findings indicated that substantial amount of variance in student learning outcomes is explained by students' perceptions of classroom learning environment (Wong et al. 1997). For example, Fraser and Fisher (1982) found a remarkable association between students' perception of learning environment and students' cognitive and affective outcomes in a study with 1083 junior high school students in 116 classrooms. In addition, Haertel et al.'s (1981) review of previous research showed that students' perceptions of social-psychological aspects of the classroom such as cohesiveness, satisfaction, goal direction, difficulty, and competitiveness were useful for using as independent, dependent, and mediating variables while working on educational issues and result of these self-report perceptions provided information for relevant educational processes such as teacher training, instructional innovations, and curriculum. Moreover in their meta-analysis study, Haertel et al. (1981) focused on the association between students' perceptions of classroom environment and student outcomes. These outcomes were classified in three categories: (1) Cognitive measures including conventional multiple-choice achievement tests, tests of understanding and critical thinking, and tests of formal reasoning, (2) Attitudinal criteria including instruments such as interest measures and motivation and self-concept tests, and (3) Behavioural criterion measures including self-report activity inventories and absence rates. The researchers analyzed 12 studies with data including 823 classes and 17805 students in four nations. This study revealed strong positive relation of several cognitive, affective, and behavioral learning outcomes to students' perceptions of the psychosocial characteristics of classroom learning environment in variety of samples, subject matters, and methodological approaches. Especially, positive correlations were found between student outcomes and cohesiveness, satisfaction, task difficulty, formality, goal direction, democracy, and material environment while these outcomes were negatively associated with friction, cliqueness, apathy, disorganization, and favoritism. They concluded that student's perception of classroom learning environment was a good predictor of students' cognitive, affective, and behavioral outcomes.

Studies on classroom learning environment and cognitive and affective student outcomes were investigated in various domain grade levels and countries by using various instruments focusing on various aspects of psychosocial aspects of learning environment, various motivational variables, and academic achievement (Fraser, 1998). Within the scope of the present research, the relation of classroom learning environment to some of the student learning outcomes including academic achievement, self-efficacy, metacognitive self-regulation, and achievement goals were examined. In the following paragraphs, the past studies on these relations are presented.

Classroom Learning Environment Perceptions and Academic Achievement

The research on the association between perceived classroom learning environment and students' academic achievement generally indicated that perceived social psychological aspects of the classroom learning environment are good predictors of students' achievement although some studies found no relationship between them. For example, Baek and Choi (2002) conducted a study with 1012 high school students who enrolled in English class in Korea. Classroom learning environment was measured by Korean version of CES (KCES) and students' scores on a 25 multiple-choice items English test were used as achievement scores. Results of Pearson's simple correlation analysis indicated significant correlation between achievement and 7 subscales of KCES, namely, involvement, affiliation, competition, task orientation, order and organization, rule clarity, and teacher control, Teacher support and innovation were not significantly associated with achievement. The authors also conducted a multiple regression analysis, and they found the multiple correlation (R) as .27 between achievement and 9 subscales of KCES indicating that these 9 subscales of KCES explained 7% of the variance in student's English achievement. Moreover, Goh and Fraser (1998) conducted a study with 1512 primary school students from 39 classes and examined the association between students' perception of learning environment (measured by using My Class Inventory), and attitude and achievement in maths. The researchers performed simple, multiple, and canonical correlation analyses and multilevel (HLM) analyses by using two units of analysis: individual student and class mean. Fairly consistent (in both patterns of significance and the direction of relationships) associations were found between classroom environment and student outcomes across different methods. Better student outcomes were found in the classrooms with showing more cohesion and less friction. The author suggested using HLM analysis in classroom learning environment as potentially useful.

Snyder (2005) explored the association between middle school students' perception of classroom learning environment and science achievement. Participants were about 840 students from 24 classrooms. Result of the bivariate correlation analysis showed that intercorrelations among the 7 dimensions of classroom environment (assessed by WIHIC) were positive, statistically significant, and ranged from a low of .423 (between Investigation and Student Cohesiveness) to a high of .674 (between Investigation and Involvement). On the other hand, relationship between achievement and each dimension of classroom environment was weaker, ranging from .167 (Investigation) to .314 (Task Orientation). Snyder (2005) stated that each of these domains individually explained less than 10% of the achievement. Then, it was decided to include only Task Orientation and Involvement in multiple regression analysis. Results revealed that Task Orientation (Beta = .275) and Involvement (Beta = .085) were both significant predictors of student achievement, and these variables account for 10% of the variation in achievement scores. In another study, 2310 tenth grade students' perception of classroom learning environment was assessed by using WIHIC (Chionh & Fraser, 1998). Results indicated that higher achievement was related to student cohesiveness, whereas attitudes and self-esteem were higher in classrooms perceived as more teacher supportive, task orientated, and equal in opportunities. On the other hand, Allen and Fraser (2007) did not found a significant correlation between science achievement and any scale of WIHIC. Furthermore, den Brok et al. (2010) identified six distinct classroom learning environment profiles based on the levels of students ratings of the different scales of WIHIC: self-directed learning classroom, task oriented cooperative learning classroom, mainstream classroom, task-oriented individualised classroom, low-effective learning classroom, and high-effective learning classroom. Results indicated that no significant difference was found among groups for the biology achievement.

Wolf and Fraser (2008) conducted another study with 1434 middle-school science students from 71 classes. Result of simple correlation showed that, regardless of the unit of analysis, all 7 scales of WIHIC were positively and significantly associated with attitude towards science. On the other hand, results of the multiple correlation analysis indicated that, where the unit of analysis was the individual, student attitudes were significantly predicted by six WIHIC scales: Teacher Support (β = .21), Involvement (β = .14), Investigation (β = .21), Task Orientation (β = .23), Cooperation (β = -.07), and Equity (β = .07). With the class mean as the unit of analysis, four WIHIC scales (Student Cohesiveness, Teacher Support, Investigation, and Cooperation) were found as significant predictors of student attitudes. Similarly, for science achievement, the results of the simple correlation indicated positive and significant relation of science achievement to 3 scales of WIHIC (Investigation, Task Orientation, and Equity) where the individuals was the unit of analysis, but no significant correlation was found when the class mean was the unit of analysis. On the other hand, result of the multiple correlation analysis with the individuals as unit of analysis indicated that Teacher Support (β = -.15), Task Orientation (β = .08), Equity (β = .16), and Cooperation (β = -.10) were significant independent predictors of achievement while no significant correlation was found when the class mean was the unit of analysis. Additionally, while most of the significant relations were positive, the association between Cooperation (at both levels of analysis) and attitudes to science, and between science achievement and Teacher Support (both levels of analysis) and Cooperation (with the student as the unit of analysis) were negative. Moreover, in the analysis with science achievement as dependent variable, β coefficients were higher than zero order correlation coefficients. This might indicate a statistical issue such as negative suppression effect (see Tabachnick & Fidell, 2007). In their study, Wolf and Fraser (2008) tried to explore the possible reasons of this unexpected result by conducting a series of interviews with students, instead of considering it as a statistical issue.

To sum up, although studies showed significant association between students' perception of some dimensions of classroom learning environment and achievement, with some dimensions, no significant associations were found. Since the studies in the literature employed different measures to assess classroom learning environment, it is believed that it is not surprising to come up with mixed results. In some of the studies using WIHIC scale, generally positive association was found between students' perceptions of classroom learning environment and academic achievement (e.g., Chionh & Fraser, 1998; Dorman, 2001; Snyder, 2005); although in some studies using WIHIC (e.g., Wolf & Fraser, 2008) that compare the coefficients obtained from different statistical methods that were correlations and regressions, they found contradictory results within a study (e.g., opposite coefficient signs). Thus, in the present study, in the light of the literature, it is expected to find positive correlation between classroom learning environment and science achievement by employing multilevel analysis that is more robust than bivariate correlation and regressions which based on Ordinary Least Square (OLS).

Classroom Learning Environment Perceptions and Students' Self-Regulation

According to Patrick et al. (2007) and Ames (1992), despite the fact that students share the same classroom, their perceptions of classroom environment differ depending on their prior experiences and what do they mean for them. Additionally, students' motivation and engagement are affected from students' these subjective perceptions of dimensions of their classroom social environment (Ames, 1992; Patrick et al. 2007). Some researchers proposed a link between perceived classroom learning environment and self-regulation. Namely, classroom environments which support student autonomy, complex thinking skills, use of variety of strategies, cooperation, and involvement are expected to encourage students to use self-regulated learning strategies (see Haertel et al. 1981; Sungur & Gungoren, 2009; Paris & Paris, 2001; Ross et al. 2003). Moreover, Schraw et al. (2006) reviewed the research on self-regulated learning in science education. The researchers identified six areas of instructional strategies improving self-regulation in science education: (1) inquiry based learning, (2) collaborative support, (3) strategy instruction to improve problem solving and critical thinking, (4) strategies for helping students construct mental models and experience conceptual change, (5) the use of technology, and (6) student and teacher beliefs (especially, high self-efficacy and epistemological beliefs). According to Schraw and his colleagues, using these strategies in the classroom enhance students' cognitive, metacognitive, and motivational skills in several ways which they summarized the main ways as presented in Table 2.4.

Table 2.4 Ways the six instructional strategies increase cognitive, metacognitive, and motivational processes

	Cognitive processes	Metacognitive processes	Motivational processes
Inquiry	Promotes critical thinking through experimentation and reflection	Improves explicit planning, monitoring, and evaluation	Provides expert modeling
Collaboration	Models strategies for novices	Models self-reflection	Provides social support from peers
Strategies	Provides a variety of strategies	Helps students develop conditional knowledge	Increases self-efficacy to learn
Mental Models	Provides explicit model to analyse	Promotes explicit reflection and evaluation of the proposed model	Promotes radical restructuring and conceptual change
Technology	Illustrates skills with feedback. Provides models and simulates data	Helps students test, evaluate, and revise models	Provides informational resources and collaborative support
Personal beliefs	Increases engagement and persistence among students	Promotes conceptual change and reflection	Promotes modeling epistemology characteristic of expert scientists

Source: Schraw, Crippen, & Hartley, 2006, p.131.

On the other hand, empirical studies on the relation of perceived classroom learning environment and self-regulation dimensions regarding self-efficacy, metacognitive self-regulation, and goal orientation are so rare.

Regarding *self-efficacy*, according to Dorman (2001) and Dorman et al. (2006), although some of the four sources of self-efficacy such as observing peers succeeding a task and getting verbal praise from teacher can be experienced in the psychosocial learning environment such as classroom and schools, the effect of learning environment on academic self-efficacy was not explicitly recognized by efficacy theorists. Dorman (2001) claimed that he conducted the first study exploring the effect of psychosocial dimensions of learning environment on students' academic self-efficacy. In Dorman's (2001) study, the participants were 1055 secondary students from grade 9, 10, and 11 in Australia. In order to assess classroom learning environment, they used 7 scales of WIHIC namely Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity; and 3 scales of CLES namely Personal Relevance, Shared Control, and Student negotiation. For self-efficacy, Midgley and Urdan's (1995) seven item scale was adapted for efficacy in mathematics. The researchers performed simple correlation analysis and multiple correlation analysis for two different units of analyses that were students and school year. Results of the simple correlation analysis, where the unit of analysis was students, showed that all variables were significantly and positively associated with academic efficacy. However these correlations were weak ranging from .17 (for Student Cohesiveness and Academic Efficacy) to .38 (for Task Orientation and Academic Efficacy), and among the subscales, Task Orientation explained the highest variation in academic efficacy (about 14%). Besides, the results of the multiple correlation analysis revealed that all ten learning environment variables accounted for the 22% of the variance in math self-efficacy when the unit of analysis was students. Moreover, math self-efficacy was positively associated with Involvement (β = .21), Investigation (β = .17), and Task Orientation (β =.27). However, on the contrary to the results of the simple correlation analysis, while math self-efficacy was negatively associated with Teacher Support (β = -.14) and

Cooperation (β = -.10), no association was found for Student Cohesiveness, Equity, Personal Relevance, Shared Control, and Student negotiation. In both analyses, Task Orientation was found as the best predictor of mathematics self- efficacy. Dorman's (2001) study was replicated by Dorman et al. (2003) with the data collected from Australian, British, and Canadian sample. 3602 math students from secondary schools participated in this study. When individuals were the unit of analysis, they found similar results with Dorman (2001). Zero order correlations indicated significant but low relationships between each dimension of classroom environment and math efficacy, ranging from .13 (for Student Cohesiveness and Efficacy) to .40 (for Task Orientation and Efficacy). On the other hand, results of the multiple correlation analysis revealed that Involvement (β = .18), Investigation (β = .15), Task Orientation (β = .30), Cooperation (β = -.12), and Equity (β =. 06) were significant predictors of the math efficacy, while none of the dimensions of CLES scale was found significant. All these variables accounted for 22% of the variations in students' math efficacy scores. Although these studies yielded similar results, researcher did not investigate the reasons of the opposite signs founded in bivariate and multiple correlation analyses for Teacher Support and Cooperation, which might point out suppression effect among predictors (see Tabachnick & Fidell, 2007).

Dorman et al. (2006) designed a study to explore the role of learning environment on academic self-efficacy in science and attitude towards science. They used 5 of the 7 subscales of WIHIC namely Student Cohesiveness, Teacher Support, Involvement, Task Orientation, and Equity to assess classroom learning environment. They used Midgley and Urdan's (1995) six-item scale to assess academic efficacy in science. Moreover, 5 scales of Students' Perception of Assessment Questionnaire (Fisher, Waldrip, & Dorman, 2005), namely Congruence with Planned Learning, Authenticity, Student Consultation, Transparency, and Diversity were used to assess the mediation effect of assessment characteristics on the relation of learning environment on self-efficacy. They conducted stepwise multiple regression analyses, and results showed that among 5 subscales of WIHIC, Teacher Support (β = .11), Involvement (β = .15), and Task Orientation (β = .53) were significant and positive predictors of self-efficacy in science. Task Orientation was the strongest predictor of science self-efficacy. Moreover, a structural equation model was set to examine the mediation effect. Results revealed that Task Orientation is the most potential predictor of the self-efficacy and it is the only learning environment variable having both direct and indirect effect on self-efficacy. Moreover, while other learning environment variables were found uncorrelated with self-efficacy, Teacher Support had an indirect effect on self-efficacy via Congruence with Planned Learning. On the other hand, Student Cohesiveness, Teacher Support, Task Orientation, and Equity have either direct or indirect effect on attitude to science.

Regarding *achievement goals*, Ames (1992) discussed the relation of classroom learning environment to achievement goal theory, and suggested that classroom structures play an important role in the type of achievement goals and in turn affect how students possess qualitatively different motivation patterns. For example, Task (e.g., focusing on the meaningful aspects of learning activities), Authority (e.g., focusing on helping students participate in the decision making), and Evaluation/Recognition (e.g., providing opportunities for improvement) were regarded as classroom structures supporting mastery goals (see Ames, 1992). In a study with 208 undergraduate chemistry students, Church et al. (2001) examined the association between perceived learning environment (i.e., lecture engagement, evaluation focus, and harsh evaluation) and achievement goals. Results of the HLM analyses revealed that lecture engagement ($\beta = .37$) was positively, and evaluation focus ($\beta = -.12$) and harsh evaluation ($\beta = -.23$) were negatively related to mastery goal adoption. Moreover, while performance avoidance goal adoption was related to only harsh evaluation ($\beta = .21$), performance approach goal adoption was only related to evaluation focus ($\beta = .12$). In another study, Gherasim et al. (2012) examined the relationship between classroom environment, and achievement goals and math performance. 498 7^{th} grade students administered WIHIC and Patterns of Adaptive Learning Survey (Middleton & Midgley, 1997) including mastery goals, performance approach goals, and performance avoidance subscales. The researchers use the 5 scales of WIHIC and combined them into two categories: peer support (student cohesiveness and cooperation) and teacher support (teacher support, task orientation and equity). Results showed that in the boys' sample, performance-avoidance goals interacted with teacher support, while in the girls' sample, performance approach goals interacted with peers support in predicting math grades. They also found no effect of peer support on math achievement. Namely, girls with higher performance approach goals obtained better grades regardless of the peer support while girls with lower performance approach goals got better grades when they perceived higher peer support in the classroom. On the other hand, teacher support did not have positive effect on math grades of boys with higher performance avoidance goals while math grades of boys with lower level of performance avoidance goals was positively affected from teacher support.

Another student self-regulation variable is *metacognition*, and it has been rarely studied in learning environment research. In science education, on the other hand, studies showed significant associations between classroom learning environment characteristics and metacognition (e.g. Schraw et al. 2006). In a study with 1152 Turkish eight grade elementary students Ozkal et al. (2009) proposed a conceptual model of relationships among constructivist learning environment perception variables (Personal Relevance, Uncertainty, Critical Voice, Shared Control, and Student Negotiation), scientific epistemological belief variables (fixed and tentative), and learning approach. Results of the path analysis revealed that all constructivist learning environment variables significantly predict students' learning approach: either directly or via tentative beliefs. In another study, Yilmaz-Tuzun and Topcu (2010) examined the relationship between constructivist learning environment (assessed by CLES) and metacognition (assessed by Jr. MAI) with the sample of 626 6^{th}, 7^{th}, and 8^{th} graders in Turkey. Results revealed that students' perceptions of higher level personal relevance, student negotiation, and uncertainty positively associated with metacognition while critical voice and shared control were not found as related to metacognition.

There are some studies exploring the direct and indirect interplay among classroom learning environment, multiple motivational variables, and academic achievement. For example, Arisoy (2007) conducted a study with 956 8th grade students from 36 science classes. The researcher administered CLES and MSLQ to the students in order to examine the relation between students' perception of science classroom from a constructivist perspective (i.e., Personal Relevance, Student Negotiation, Shared Control, Critical Voice, and Uncertainty) and adaptive motivational beliefs (i.e., Intrinsic Goal Orientation, Task Value, Control of Learning Beliefs, and Self-Efficacy for Learning and Performance). The researcher performed a canonical correlation analysis for these two sets of variables. Results indicated positive and significant association for all learning environment and all motivational variables. Namely, the more positively students perceive science classroom environment in terms of personal relevance, uncertainty, critical voice, shared control and student negotiation; the higher intrinsic goal orientation, task value, control of learning beliefs, and self-efficacy they have. Moreover, learning environment variables set accounted for 25% of the variance in motivational beliefs variables set. Additionally, Arisoy (2007) found that although female students reported higher scores on all scale of CLES than boys, the only significant differences were for perception of personal relevance and critical voice.

In sum, studies revealed significant associations between perceived classroom learning environment dimensions and self-regulatory outcomes (e.g Dorman et al. 2006; Schraw et al. 2006). Although some of the dimensions of classroom learning environment were found negatively associated with self-regulation variables, results mostly revealed positive relationships. Therefore, in the present study, it is expected to find positive association of classroom learning environment to self-efficacy, metacognitive self-regulation, and achievement goal orientation.

Mediator Role of Self-Regulation in Predicting Academic Achievement by Perceived Classroom Learning Environment

Self-regulatory activities, in most of the self-regulation models, are regarded as mediators between personal and contextual characteristics and achievement (Pintrich, 2000). According to Pintrich (2000), "it is not just individuals' cultural, demographic, or personality characteristics that influence achievement and learning directly, or just the contextual characteristics of the classroom environment that shape achievement, but the individuals' self-regulation of their cognition, motivation, and behavior that mediate the relationships between the person, context, and eventual achievement" (p.453). Thus, it is reasonable to investigate the association between students' perception of classroom learning environment and achievement by considering the mediator role of motivation. Patrick et al. (2007) applied a theoretical perspective to classroom environment research by integrating social-cognitive theoretical view of motivation. They proposed a model on the mediation effect of motivational beliefs (mastery goals, academic efficacy, and social efficacy with peers) on the relationship between the classroom social environment (Teacher emotional support, Promoting interaction, Promoting mutual respect, and Student academic support), and students' engagement (self-regulation strategies and task related interaction) and math achievement. 602 fifth grade students participated in the study, and results of the structural equation modelling analysis provided a strong support to their hypothesis. Namely, teacher support, promotion of interaction, and student support were related to self- regulation and to task related interaction, and those relations were fully or partially mediated by motivational beliefs. Although self-regulation was not found as significant predictor of math achievement, task relation was significantly related to math achievement. In another study, Sungur and Gungoren (2009) performed a structural equation modelling analysis with the data obtained from 900 students from grades 6-8. The researchers proposed a model in which students' classroom environment (motivation tasks, autonomy support, and mastery evaluation) perceptions have direct effects on motivational (self-efficacy, intrinsic value, mastery goals, and performance goals) and cognitive components (strategy use) of self-regulation and indirect effects on science achievement (GPA). Results of the study demonstrated that the effect of perceived classroom environment on science achievement was mediated by motivational components of self-regulation. The indirect effect of perceived learning environment on science achievement was found .21. Moreover, 7% of the variance in science achievement was accounted for motivational component of self-regulation (motivational beliefs and goals orientations), and cognitive component of self-regulation (strategy use).

Peters (2013) examined whether the relationship between self-efficacy and math achievement differ based on students' perceptions of learning environment (learner centered or teacher centered). 326 college students were participated in the study. Students' perceptions of learning environment were aggregated and used as level-2 variable. Results of the multilevel analysis showed that, firstly, intraclass correlation (ICC) values were .073 and .122 indicating that 7.3% and 12% of the overall variation in students' math self-efficacy and achievement, respectively, lied between classrooms. Secondly, math self-efficacy was found positively related to math achievement. Thirdly, students' who perceived higher teacher centered classroom environment reported higher self-efficacy; however, classroom environment was not found as a significant predictor of achievement. Lastly, classroom environment did not moderate the effect of self-efficacy and math achievement. The researchers concluded that, classroom climate indirectly influenced mathematics achievement. That is, students' math self-efficacy mediated the influence of classroom environment on achievement.

Yildirim (2012) examined the role of motivational beliefs (math self-efficacy, anxiety, intrinsic value, and instrumental value) in mediating the relationship between perceived teacher support and student's mathematics achievement based PISA mathematics scores. The data gathered from 4855 15-year-old students in Turkey were analyzed via multilevel analysis (HLM). Results revealed that, after controlling for gender and socioeconomic status (SES), students' perceived teacher support was significantly and positively associated with math self-efficacy, intrinsic value, and instrumental value while negatively related to anxiety. Gender, SES, and perceived teacher support together, at the student level, explained 8%, 3%, 9%, and 7% of the between students variance in math self-efficacy, anxiety, intrinsic value, and instrumental value, respectively. On the other hand, perceived teacher support was not found as significant predictor of math achievement. However, PISA math achievement was significantly predicted by math self-efficacy (positively) and anxiety (negatively). Results also indicated that among the 4 motivational variables, only math self-efficacy and anxiety mediate the relations between perceived teacher support and PISA math achievement. Math self-efficacy and anxiety explained 16% of the variance in math achievement. In a similar study, Is-Guzel (2006) found that teacher support was not a significant predictor of PISA math achievement of Turkish sample while it was a negative predictor of PISA math achievement of European Union Countries and European Union Candidate Countries sample. In another study, Fast et al. (2010) examined the mediation effect of math self-efficacy on the relationship between students' perceptions of learning environment (teacher's encouraging mastery goals, teacher's providing challenging work, and teacher's caring) and math achievement. A series of multilevel analysis were performed and it was found that students had significantly higher levels of math efficacy in the classrooms perceived as more caring, challenging, and mastery-oriented, and math efficacy positively predicted math performance. Moreover, the influence of perceived classroom environment based on teacher behaviors on math achievement was mediated by math self-efficacy, although among the classroom learning environment variables, only teachers' encouraging mastery goal were found as directly associated with math achievement.

Church et al. (2001) examined the mediation effect of achievement goal variables on the relationship between perceived classroom environment and achievement. Firstly, the researchers conducted an HLM analysis to find out which classroom variables predicted achievement goals. ICCs indicated that about 7% of the variance in performance avoidance goals was between classes, while the amount of between class variance was less than 1%, which is negligible, for mastery goals and performance approach goals. Results indicated that while mastery goals and performance approach goals were positive predictors of students' final grades of course, performance avoidance goals were negatively predict the final grades. Moreover, achievement goal variables mediated the influence of perceived classroom environment variables on students' final grades of course, while classroom learning environment variables were not directly related to grades.

In sum, the results of a group of study suggested that the influence of learning environment on academic achievement is mediated by students' self-regulation (e.g., Church et al. 2001; Fast et al., 2010; Peters, 2013; Yildirim, 2012). In line with the findings of these previous studies, in this study, it is expected that the association between the classroom learning environment and science achievement to be mediated by self-efficacy, metacognitive self-regulation, and achievement goal orientation.

2.1.3 Students' Gender

Students' gender is an important variable to be considered while investigating science achievement. There are some studies in the literature stating that either female students (e.g., Britner & Pajares, 2006; Hacieminoglu, Yilmaz-Tuzun, & Ertepinar, 2009) or male students (e.g., Beaton, et al., 1996; Penner, 2003) had higher science achievement. On the other hand, majority of the past research reveal no gender difference in science achievement (e.g., Akyol et al. 2010; Cavas, 2011; Marino, 2010; Senler & Sungur, 2009).

Some studies showed that the association between gender and science achievement may differ depending on achievement level, grade level, country, and motivational level. For example, regarding motivation, Tas (2013) investigated gender difference in science achievement of 7^{th} grade students (n = 8318) with the data gathered across the Turkey. She performed a multilevel analysis with gender, prior achievement, perception of homework quality, and feedback on homework as the level-1 variables. Results revealed that female students significantly outperformed males in science achievement (γ = .085). However, when the researcher added homework self-regulation variables (i.e., homework goal orientation, procrastination tendency, and strategy use) to the previous model, gender was no longer a significant predictor of science achievement. Similarly, Areepattamannil et al. (2011) studied with 13985 15-year-old students from 431 schools across Canada. They performed several multilevel models by using HLM. Results revealed that, when only background characters of students incorporated in the model, gender was found as a significant predictor of science achievement (favoring males). However, when researchers added motivation and motivational beliefs variables into the previous model, gender did not significantly predict students' science achievement any more.

The gender difference in science achievement may also depend on the country and achievement level. For example, by using PISA 2006 science scores, Shafiq (2013) examined students' gender gap in science achievement in Azerbaijan, Indonesia, Jordan, the Kyrgyz Republic, Qatar, Tunisia, and Turkey. The researcher performed quartile regression analyses that divided students into 5 groups based on their science achievement, and computed gender gap in achievement within the each group. In each analysis, age, grade, father's education, mother's education, number of books at home, computer at home, school instruction language same as language spoken at home, school having pedagogical autonomy, school facing competition, school reporting performance data publicly, parents having a saying in school budget, public school, percent girls, and school location (rural or urban) were controlled. Results revealed that no significant gender gap was found in all 5 groups of students in Jordan, Qatar, and Turkey. On the other hand, results of the other countries were mixed depending on the achievement level of the groups. In Azerbaijan only significant difference was found in the lowest quantile that favoring females. In Indonesia, the Kyrgyz Republic, and Tunisia, either no significant differences were found or overachievement of males was found in some achievement levels. In another study, Kaya (2008) examined the gender difference in 4^{th} graders' science achievement by using the TIMSS 2003 data. She provided results for the five countries: United States, Singapore, Japan, Australia, and Scotland. HLM analyses were performed for country specific and for combined data. Results revealed that, when analyses were performed for each country separately, the only significant gender differences were found in the science scores of students in Singapore and Scotland. However, when the combined data were analyzed for cross-country differences, gender differences in science scores were found only in US and Scotland. In both cases, boys reported higher science achievement than girls. No significant gender differences were found in other countries.

To sum up, results of the past studies mostly revealed no gender difference in science achievement. Moreover, results of the some studies suggested that the possible relation between gender and science achievement was influenced from other factors such as student motivation, grade level, achievement level, and country. Thus, this study has potential to provide more comprehensive investigation of the association between gender and science achievement in a more specific context (7^{th} grade students in Turkey) by considering gender and various student and teacher characteristics (which are supposed to be related to science achievement) together.

2.2 Teacher Variables

Social learning theory of Bandura (1986) explains human functioning as the interaction between personal, environmental, and behavioral factors. Regarding classroom context, teacher behaviors, beliefs, and characteristics could be considered as environmental factors that might play a role in students' learning process. Teacher effectiveness research aimed to investigate the teacher characteristics, behaviors, and beliefs that are potential to influence students' learning.

Teacher, among the school related variables, is regarded as one of the most important factors effecting educational processes (Harris, Rutledge, Ingle & Thompson, 2010) and student outcomes (Wright, Horn, & Sanders, 1997). Several empirical studies indicated that, among the school-related factors, teacher effectiveness accounted for the most of the variation in student achievement. For example, in a study, Wright et al. (1997) aimed to examine the relative magnitude of teacher effects, intraclassroom heterogeneity, student achievement level, and class size on student achievement. Based on the results, authors reported that:

> The most important factor affecting student learning is the teacher. In addition, the results show wide variation in effectiveness among teachers. The immediate and clear implication of this finding is that seemingly more can be done to improve education by improving the effectiveness of teachers than by any other single factor. Effective teachers appear to be effective with students of all achievement levels, regardless of the level of heterogeneity in their classrooms (p.63).

Since the role of teachers on students learning processes is dramatically important, building stuff in schools with qualified teachers became one of the primary goals of educational institutions (Bolyard & Moyer-Packenham, 2008). There are some important actions that give rise the research on teacher effectiveness and the efforts to increase teacher effectiveness in schools such as the National Commission on Teaching and America's Future (NCTAF) report published in 1996, and No Child Left Behind Act of 2001 (2002). For example, The NCTAF (1996) proposed that "…-by the year 2006-we will provide every student in America with what should be his or her educational birthright: access to competent, caring and qualified teaching…" (p.10). However, it is very difficult to identify the characteristics of qualified teachers. The terms effective teachers, qualified teacher, exemplary teachers, good teachers and successful teachers can also be seen in the literature emphasizing the teacher quality or teacher effectiveness. Over a few decades, researchers show interest on this subject and try to determine the characteristics of qualified teacher and their role in teacher effectiveness. (e.g., Bolyard & Moyer-Packenham, 2008; Patrick & Smart, 1998).

Teacher effectiveness is a multidimensional construct. Since the literature is not clear on the definition of the effective teacher, it is not surprising that research focused on different dimensions of teacher effectiveness (Patrick & Smart, 1998). Patrick and Smart organized the factors of effective teaching drown from past research in a table and these categories are shown in the Figure 2.3.

Despite these broad approaches, it is believed by some researchers that the clear definition of qualified or effective teacher characteristics may contribute to enhance student outcomes (Tytler, Waldrip, & Griffiths, 2004; Waldrip et al. 2009). In their broad literature review on science and mathematics teacher quality, Bolyard and Moyer-Packenham (2008) determined 6 teacher characteristics that were frequently studied as indicators of teacher quality; teachers' general ability; experience, pedagogical knowledge; subject knowledge; certificate status (subject specific); and beliefs, practices, and behaviors.

Dimensions of effective teaching

Samuelowicz and Bain, 1992 Lecturers conceptions of teaching at tertiary level	• conveying knowledge • facilitating student's independent learning • conveying knowledge and facilitating student's independent learning
Ramsden, 1992 Key principles of effective teaching in higher education	• an interest in explaining things clearly • appropriate assessment and feedback • encouraging independence, control and active engagement • a willingness to set clear goals and intellectual challenge • concern and respect for students and student learning • a willingness to learn from students
Entwistle and Tait, 1990 Two factors of teacher effectiveness	• teaching ability • openness to students
Swartz, White and Stuck, 1990 Two factors of effective teaching	• clear instructional presentation • management of student behaviour
Lowman and Mathie, 1993 Two factors of effective teaching	• intellectual excitement • interpersonal support
Brown and Atkins, 1993 Three factors of effective teachers	• caring • systematic • stimulating
Ramsden, 1991 Effective teaching characteristics	• provides understandable explanations • provides good feedback • encourages independent thought • being organised • stimulates students' interest • emphatic to students' needs • sets clear goals
Halpert, 1990 Factors of charismatic leadership	• expert power • referent power • job involvement

Figure 2.3 Dimensions of effective teaching

Source: Patrick & Smart, 1998, p.167

As seen from the Figure 2.3 and Bolyard and Moyer-Packenham's (2008) literature review, most of the researchers concerned effective teachers in terms of teachers' personal characteristics and teacher practices and behaviors in learning environment and associated them with student outcomes. However, teacher beliefs and occupational well-being are other important factors that effecting teachers' effectiveness and rarely studied within the teacher effectiveness research (e.g., Klusmann et al., 2008). Research on teachers' occupational health examines teacher effectiveness in terms of burnout and job dissatisfaction (Klusmann et al., 2008; Kyriacou, 2001). Regarding teacher beliefs, the focus of this study includes teachers' self-efficacy beliefs (Tschannen-Moran and Woolfolk Hoy, 2001) and implicit beliefs about intelligence (Dweck, 1999),. Although several researchers assumed that teachers' occupational well-being, self-efficacy beliefs, and implicit beliefs about intelligence have substantial effect on students' learning processes and classroom learning environment, these variables are rarely studied empirically. Therefore, the present study is aimed to extent the teacher effectiveness literature by considering the role of these variables on student outcomes and classroom learning environment. Accordingly, in the following sections, past studies related to teachers' Self-efficacy, Burnout, Job satisfaction, and Implicit Theories of Intelligence are conceptually explained, and related literature on the link between teachers' Self-efficacy, Burnout, Job satisfaction, and Implicit Theories of Intelligence, gender, and experience, and student outcomes and perceived classroom learning environment are summarized.

2.2.1 Teacher Self-Efficacy

Teachers' sense of efficacy beliefs has been defined as a teacher's "judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (Tschannen-Moran & Woolfolk Hoy, 2001, p.783). Tschannen-Moran and Woolfolk Hoy identified three type of teaching efficacy: Efficacy for Instructional Strategies, Efficacy for Classroom Management, and Efficacy for Student Engagement. Efficacy for Instructional Strategies indicates the level of teachers' confidence for using variety of instructional strategies and providing alternative explanations for better teaching, Efficacy for Classroom Management emphasizes the level of confidence for managing classroom effectively and controlling disruptive behavior. Finally, Efficacy for Student Engagement focuses on the degree of teachers' confidence for engaging all students and encouraging them to do well in school work (Tschannen-Moran & Woolfolk Hoy, 2007).

Teachers' confidence in teaching influences their effort, goal orientation, persistence, and resilience in teaching (Tschannen-Moran & Woolfolk Hoy, 2001; 2007). Teachers who possess higher level of self-efficacy have more tolerance to student's mistakes (Ashton & Webb, 1986), believe their ability to control or influence students' achievement and motivation (Tschannen-Moran et al. 1998), and tend to use different instructional methods (Allinder, 1994; Tschannen-Moran & Woolfolk Hoy, 2001; Woolfolk, Rosoff, & Hoy, 1990) than teachers who have less confidence in teaching. Moreover teachers tend to spend more time on the subjects in which they feel more confident (Riggs & Enochs, 1990), while they avoid teaching the subjects in which they feel less confident (Riggs, 1995).

Tschannen-Moran et al. (1998) reviewed the studies on teachers' efficacy beliefs conducted between 1974 and 1997 by using various measures. They reported that teachers' sense of efficacy beliefs are associated with teachers' willingness to implement innovations and to stay in the profession, and with less stress level and less negative affect in teaching. Moreover, based on the findings of these studies, researchers stated that teachers with strong self-efficacy showed more favorable behaviors in the classroom such as giving better feedbacks to students, providing greater academic focus in the classroom, investing more effort to teaching, being open to new ideas, showing persistence when faced with obstacles. Accordingly, teachers with strong self-efficacy were found to influence students' cognitive and affective outcomes positively. Furthermore, Ross' (1994, 1998) review of 88 studies addressing teacher efficacy revealed 6 teacher behaviors related to their efficacy beliefs: "(1) learn and use new approaches and strategies for teaching, (2) use management techniques that enhance student autonomy and diminish student control, (3) provide special assistance to low achieving students, (4) build students' self-perceptions of their academic skills, (5) set attainable goals, and (6) persist in the face of student failure" (as cited in Woolfolk Hoy & Spero, 2005, p.345). Accordingly, since teaching self-efficacy was found positively related to these desired teacher behaviors, teacher's efficacy beliefs could be expected to have positive influence on student outcomes.

Although, researchers generally have suggested a close relationship between teacher self-efficacy beliefs and student outcomes, empirical studies examining this relationship are so rare, (e.g., Anderson, Greene, & Loewen, 1988; Caprara et al. 2006; Midgley, Feldlaufer, & Eccles, 1989). A few studies found a link between teacher self-efficacy and student achievement (Ashton & Webb, 1986), self-esteem (Borton, 1991), motivation (Midgley et al. 1989), attitude toward school (Miskel, McDonald, & Bloom, 1983), and students' self-efficacy (Anderson et al. 1988).

Teacher Self-Efficacy and Students' Achievement

Regarding student achievement, Vasquez's (2008) critical review of the past research that directly examined the connection between teacher efficacy and student achievement in reading showed that she found only 5 studies conducted until 2008, and these studies were conducted with elementary or junior high school students. Vasquez stated that all of these studies used correlation with multiple stepwise method to analyze the data, and results of these studies revealed that in two of these studies, significant correlation between teacher efficacy and student achievement was found, no significant correlation was found in other two of the studies, and lastly in one of these studies one significant and one nonsignificant relations were reported for different grades. Furthermore, in the most recent review of teacher efficacy studies, Klassen et al. (2011) pointed out the lack of attention on the association between teachers' self-efficacy and student outcomes. Researchers found that among 68 studies examining teacher efficacy beliefs published between 1986 and 1997, only

3 (4.4%) of them focused on these relationships. Similarly, among 218 studies examining teacher efficacy beliefs published between 1998 and 2009, only 2 (0.9%) of the studies focused on these relationships. Moreover, the researchers indicated that these relationships were modest and were not as high as previously suggested by most researchers. Consequently, Klassen et al. (2011) stated the more studies are needed to provide evidence to support the association between teachers' self-efficacy beliefs and student outcomes.

Caprara et al. (2006) examined the link between teachers' self-efficacy beliefs, and job satisfaction and students' academic achievement. 2184 teachers from 75 junior high schools were participated in the study. Researchers collected the data across 2 years in three steps: at time 1 and 3, they collected data on students' academic achievement in terms of average final grade, and at time 2, they collected the data on teachers' self-efficacy beliefs and job satisfaction. Results of the structural model indicated low relationship (β = .024) between teachers sense of self-efficacy and students' academic achievement at the end of the academic year. They also found a link between students' prior achievement and teacher efficacy (β = .321), and concluded that there was a reciprocal relationship between teachers' self-efficacy and students' achievement. Furthermore, no relationship was found between job satisfaction, and both prior achievement and achievement at the end of the year.

Ross (1992) measured 18 history teachers' personal teaching efficacy and general teaching efficacy beliefs by using Gibson and Dembo's (1984) 16-item self-report questionnaire including two subscales. While the first subscale focused on teachers' sense of self-efficacy to influence student learning, the other subscale focused on teachers' sense of teaching efficacy by considering the effects of external factors such as home environment and parental influence. The researcher computed an achievement score by summing the students' scores on three measures: cognitive skills, comparative thinking, and knowledge. Result of the regression analysis revealed that, among the all predictors, only teachers' personal self-efficacy and use of coach significantly and positively predicted student achievement. On the other hand, results of the correlation analysis showed that students' achievement was significantly related to total teacher efficacy (r =.79), personal teaching efficacy (r=.59), and general teaching efficacy (r =.54). Similarly, in another study, Benhow (2006) compared students' achievements in English language arts based on teachers' efficacy beliefs. Participants were 162 teachers and 3402 third grade students. Teachers were administered Gibson and Dembo's (1984) scale to assess teachers' teaching efficacy beliefs and their personal teaching efficacy beliefs, and they classified them as low or high. Results of the t-tests revealed no significant difference between the two groups of students achievement based on teachers' level of self-efficacy in teaching. Anderson et al.'s (1988) study with 24 teachers and 584 students indicated positive correlation between student achievement on a standardized test and teacher efficacy beliefs for 3rd grade students, but not for 6th grade students. In another study, Vasquez (2008) conducted a study with 110 English language arts teachers and their 2061 students from 9th and 10th grades in Florida. The study aimed to explore the effects of teacher efficacy on students' reading achievement scores on a standardized test. In order to assess teacher self-efficacy, Tschannen-Moran and Woolfolk Hoy's (2001) Teacher Sense of Efficacy Scale (TSES) which assess teaching efficacy in terms of efficacy for student engagement, efficacy for instructional strategies, and efficacy for classroom management was used. A total self-efficacy score was also calculated by using these three dimensions. Researchers performed four 2-level HLM analyses for three aspects of teaching efficacy and total self-efficacy, separately, and also included students' race, grade, and socioeconomic status variables in the models to control for. However, results indicated that none of the three dimensions of teaching efficacy was significant predictor of students' reading achievement gains.

Teacher Self-Efficacy and Student Self-Regulation

Although, researchers generally assumed a close relationship between teacher self-efficacy beliefs and student outcomes, empirical studies examining the linkage between teacher self-efficacy and student self-regulation. For example, only a few studies focused on the relation of teacher self-efficacy to student self-efficacy. In a study, Kurien (2011) examined the association between teacher efficacy, and student efficacy for science and efficacy for inquiry-based science. Participants included 26 middle school science teachers and 660 students from those teachers' classes. Researchers performed 2-level HLM analysis, and results revealed that teachers' teaching efficacy for inquiry-based science and teachers' personal teaching efficacy for science were not significant predictors of students' efficacy for inquiry-based science and students' efficacy for science, respectively. The researcher explored these relations in terms of some possible interactions by including additional variables such as grade level and quality of teacher student-relationship. However, results did not yield any interaction of these variables with teacher efficacy beliefs variables. In another study, contrary to Kurien's (2011) study, in a correlational study, Stuart (2006) found a significant and positive association between students' academic self-efficacy and teachers' self-efficacy (r =.17). On the other hand, no study was found for the relation of teacher self-efficacy to students' metacognitive self-regulation and achievement goals.

Teacher Self-Efficacy and Perceived Classroom Learning Environment

Some researchers proposed indirect effect of teacher self-efficacy on student achievement via classroom environment (e.g., Guo et al. 2012; Guo et al. 2010; Woolfolk Hoy & Davis, 2005). That is, teachers' self-efficacy determines their behaviors and teaching practice in the classroom, and in turn, the classroom environment formed by teacher behaviors and instructional practices affect student outcomes (Guo et al. 2012). According to Ashton and Webb (1986), teachers with high efficacy beliefs behave in a certain way which positively influences student achievement. For example, highly efficacious teachers provide classroom environments in which they use more humanistic classroom management strategies (Woolfolk & Hoy, 1990), favor warm interpersonal relationships, and focus more on academic work in the classroom (Ashton & Webb, 1986), and prefer more student-centered teaching (Czerniak & Schriver, 1994). Thus, students taught by high efficacious teachers show higher level of cognitive and affective gains during the academic year. Many studies provided evidences for the positive effect of classroom environment on student outcomes (e.g., Dorman, 2001; Fraser & Walberg, 1991; Haertel et al. 1981; Walberg et al. 1986). Consequently, teacher self-efficacy is likely to have an indirect effect on student outcomes via classroom environment. On the other hand, only a few studies examined this indirect effect (e.g., Guo et al. 2012; Guo et al. 2010), and results of these studies showed that classroom environment mediates the association between teachers' self-efficacy beliefs and students' academic gains. For example, Guo et al. (2010) examined the influence of emotionally supportive and instructionally supportive classroom environments on the relations between preschool teachers' self-efficacy and preschoolers' language and literacy gains. 67 preschool teachers and their 328 students were participated in the study. Results of the HLM analyses revealed that the interaction between teachers' self-efficacy and instructional support was not a significant predictor of students' vocabulary gains (γ = .139) and print awareness (γ = -.005), and the interaction between teachers' self-efficacy and emotional support was a significant predictor of students' vocabulary gains (γ = .266) but not of print awareness (γ = -.004). Namely, within the classrooms characterised by high level of emotional support, students' vocabulary gains were positively associated with teachers' self-efficacy. Moreover, Guo et al. (2012) also investigated the indirect effect of teacher self-efficacy on students' literacy skills via classroom environment. 1043 fifth grade students were participated in this study. The results of the structural equation modelling analysis showed that teachers with higher self-efficacy provided more supportive and more positive classroom environment were provided by teachers than did the teachers with lower self-efficacy. Additionally, their students had higher literacy skills. Moreover, teacher self-efficacy had an indirect effect on students' literacy skills via teacher support for learning.

In sum, although many researchers assumed a positive association between teacher self-efficacy and student outcomes (e.g., Ashton & Webb, 1986; Tschannen-Moran et al. 1998), and classroom learning environment (Guo et al. 2012), surprisingly, empirical researchers who especially work in teacher effectiveness overlook the importance of teacher self-efficacy. The effect of teachers' self-efficacy beliefs on student outcomes has been rarely studied in the literature. Although there were few studies focused on these relations, they mostly addressed academic achievement as student outcome variable. However, being important self-regulation processes in students' learning, students' use of metacognitive strategies in learning and achievement goals have not been studied. In the studies mentioned above, researchers found either positive correlation or no correlation between student outcomes and teacher self-efficacy beliefs. Even when a positive correlation was found, the effect was moderate or low (see Klassen et al. 2011). Moreover, few researchers proposed indirect effect of teachers' self-efficacy on student outcomes via classroom environments (e.g., Guo et al. 2012; Guo et al. 2010). Although results provided evidences for this indirect relationship, they are not sufficient to generalize these findings to other grade levels or subject areas. Based on the findings, it can be concluded that there is a lack of empirical studies on the direct and indirect effect of teachers' self-efficacy beliefs on student outcomes. Additionally, results of the existing studies have not shown consistent relations. Moreover, only one of these studies was found in the subject of science. Therefore, with the purpose of filling this gap in the literature, in the present study, the effect of science teachers' efficacy beliefs on 7th grade students affective outcomes (i.e., self-efficacy, metacognitive self-regulation, and achievement goals), perception of learning environment, and science achievement are planned to be investigated. In present study it is expected to find positive association between teacher self-efficacy, and classroom learning environment and student learning outcomes.

2.2.2 Teacher Burnout

Teaching is considered to be both physically and psychologically challenging and stressful work (e.g., Borg & Riding, 1991; Dorman, 2003; Kieschke & Schaarschmidt, 2008; Kyriacou, 2001). This situation may cause teachers to burnout (Klusmann et al. 2008; Jennett, Harris, & Mesibov, 2003).

The term “burnout” was firstly coined in 1974 by Herbert Freudenberger (Freudenberger, 1974). He considered the first sign of burnout in workers as accomplishing less even though working harder (Freudenberger, 1977). The commonly used definition of burnout was made by Maslach and Jacknon (1881) as “a syndrome of emotional exhaustion and cynicism that occurs frequently among individuals who do 'people-work' of some kind” (p. 99). Burnout consists of three dimensions: 1) *emotional exhaustion* which is the feeling of being depleted of personal emotional resources and being more susceptible to stressors, 2) *depersonalization* which is the interpersonal dimension of burnout indicating the feeling of being distant from others and giving negative or very detached response to other people at work, and 3) *reduced personal accomplishment* indicating reduction of positive self-evaluations and self-efficacy on the job (Maslach & Jackson, 1881). Although these three dimensions constitute burnout together, Maslach and Jackson (1881) regarded feeling of emotional exhaustion as the key aspect of burnout syndrome and related to depersonalization dimension. They also stated that the Personal Accomplishment dimension was independent of the other two dimensions and it cannot be thought as the opposite construct of the Emotional Exhaustion and Depersonalization. These relations among the dimensions of burnout were also supported by a meta-analysis study of Lee and Ashford (1996).

Focusing on prediction and outcomes of burnout and the ways to cope with burnout, Conservation of Resources (COR) theory (Hobfoll & Freedy, 1993) is the most commonly used theory in the field. According to this theory, burnout takes place when valued resources are not sufficient to meet the demands or when individuals lose valued resources (Hobfoll & Freedy, 1993) While major demands related with work include role ambiguity, work pressure, heavy workload, stressful events etc.; the major resources include social support, participating in decision making, job enhancement etc. (Lee & Ashforth, 1996). Researchers have used COR theory to investigate the association of burnout with demands and resources (Lee & Ashforth, 1996). Initial research showed that burnout was related to peoples’ tendency to give up job; reluctance to spent more time working with people; relationships with family, friends, and other people that get worse; suffering from insomnia, and increased use of alcohol and drugs (see Maslach & Jackson, 1881).

Teacher burnout influences the quality and consistency of education (Farber, 1982). Therefore, over the years, teacher stress and burnout have received an increasing attention among educational researchers (e.g., Betoret, 2009; Kyriacou, 1987; Lee & Ashforth, 1996; Maslach & Jackson, 1881; Yan & Jian-Xin, 2007). Studies indicated the main sources of stress for teachers as "teaching pupils who lack motivation, maintaining discipline, time pressures and workload, coping with change, being evaluated by others, dealings with colleagues, self-esteem and status, administration and management, role conflict and ambiguity, and poor working conditions" (Kyriacou, 2001, p.29).

Burnout has negative effects on teachers' instructional performance and on student outcomes (Klusmann et al. 2008), and significantly reduces teachers' motivation to continue teaching profession and to be satisfied with their relationship with students (Farber, 1982). Farber and Miller (1981) asserted that a burned out teacher "may be less sympathetic toward students, may have a lower tolerance for frustration in the classroom, may plan for their classes less often or less carefully, may fantasize or actually plan on leaving the profession, may feel frequently emotionally or physically exhausted, may feel anxious, irritable, depressed, and in general, may feel less committed and dedicated to their work" (as cited in Farber, 1982, p.2). Burned out teachers fail to establish effective relationship with their students; provide less information, praise, and acceptance of students' ideas; and avoid interactions (Tatar & Yahav, 1999). According to Dworkin (1987), since burned-out teachers are less willing to invest much into their teaching, their students' achievement gains are more likely to be lower. In order to reach educational goals which focus on enhancing students' learning, teachers are supposed to experience low level of burnout and to establish effective learning environment by providing effective management strategies, supportive student teacher relationships, lectures with appropriate pace, and cognitive activities (Klusman et al., 2008). Maslach and Leiter (1999) proposed a research agenda to gain insight about the influence of burnout on the teaching process and they developed a model. In this model, while burnout was regarded as a factor affecting teachers' and students' behaviors and experiences, it was also assumed as being affected from various factors including the nature of social environment, school setting, and work, as well as teachers' and students' personal characteristics. In other words, according to this model, burnout has negative influence on teachers' behaviors in classrooms, and in turn, it reduces students' learning and performance, perception of self-efficacy in school, feeling of competent as learners, intrinsic motivation, and creativity. Moreover, this model also indicated the contribution of student behaviors such as disruptive actions in the classroom, disrespect, and inattentiveness on teacher burnout. Thus, this model proposed a reciprocal association of teacher burnout with student outcomes and classroom environment.

In the field of science, experiencing stressful working conditions causes reduction in the science teachers' instructional performance (Halim, Samsudin, Merrah, & Osman, 2006; Soyibo, 1994). Soyibo (1994) conducted a study with 230 high school science teachers in Jamaica to explore the most stressful factors in science teaching. He used a 40-item science teacher stress inventory (STSI), developed by Okeobala and Jegede (1992), to measure science teacher's occupational stress level (as cited in Soyibo, 1994). As the major sources of stress, science teachers ranked difficulty in obtaining science teaching equipment, teaching students who are unmotivated to learn science, and coping with teaching difficult topics. Additionally, they ranked fear of getting injured in laboratory accidents, low salary, and fast pace of the school day as factors that have least impact on stress. The similar results were found with Malaysian science teachers (Halim et al. 2006). Although science teachers reported some important factors affecting their well-being in work, few studies focused on science teachers' work related stress (e.g., Halim et al. 2006; Okebukola, 1988; Soyibo, 1994) and burnout (e.g., Klusmann et al. 2008).

Past research on teacher burnout have mostly focused on the association of burnout with background variables and contextual variables such as gender, age, marital status, number of children in a class, and work load (e.g., Byrne, 1991, Maslach & Jackson, 1981; Weng, 2004). However, little is known about the influence of teacher burnout on classroom environment and student outcomes.

The relation of teacher burnout to student outcomes has been rarely studied. These few studies were conducted by using different research methods, and results generally pointed out a negative association. For example, Zhang and Sapp (2008) investigated the effect of teacher burnout on student state motivation which is "featuring the stimulation that directs students to have a positive attitude toward a course and the instructor and to learn cognitively" (p.156), and affective learning which "concerns the student's attitude and feelings toward the subject matter or the teacher" (p.157). In their experimental research, they randomly assigned 172 college students in the classrooms thought by a teacher having high or low burnout. Results of their study revealed that students with low burnout teacher were more motivated to learn and had higher affective learning than students with a high burnout teacher. In a more broad research, Dworkin (1987) firstly intended to explore the role of (1) teacher burnout, (2) intention to quit teaching, and (3) actual teaching behavior in student performance and behaviors represented by an achievement score, an achievement gain score, and student attendance behavior. However, the author stated that building the regression model with only these three predictors might well-overestimated the effect of these variables in predicting student variables. Therefore, in order to mitigate this concern, the researcher incorporated other variables which were known to be related to either student performance or the main predictors. These variables included 3 blocks of teacher variables (actor traits, side-bets, and satisfaction and solidarity variables), plus the block of student background variables. Data were obtained from 518 teachers and their 2287 4-6th grade students. Results revealed that teacher burnout had minimal effect on students' achievement gain and attendance behavior. An interesting result reported in the study was that low achievers in the classrooms taught by burned-out teachers reported higher achievement gains than high achievers taught by such teachers.

Although a reciprocal association was proposed by Maslcah and Laiter (1999), studies generally examined the effect of classroom environment on teacher burnout (e.g., Byrne, 1994; Dorman, 2003a). For example, Dorman (2003a) examined the effect of perceived classroom learning environment on teacher burnout with 246 teachers. Dorman used a classroom environment scale assessing teachers' perceptions on Student Affiliation, Interactions, Co-Operation, Task Orientation, Order and Organization, Individualization, and Teacher Control in the classroom. To assess teacher burnout, Maslach Burnout Inventory Educator Survey (MBI-ES) form was used. Result of the structural model revealed that Task Orientation and Interaction were negatively and Co-operation was positively and significantly related to Personal Accomplishment. Moreover, Co-operation and Order and Organization were negatively associated with Depersonalization and Emotional Exhaustion, respectively. In another study, Byrne (1994) investigated the influence of organizational and personality factors on teacher burnout with 3,044 elementary, intermediate, and secondary teachers, and found significant effects of classroom environment on Emotional Exhaustion and Depersonalization, but not on Personal Accomplishment. On the contrary, the influential effect of teacher burnout on classroom environment has rarely been investigated empirically (see Klusman et al., 2008). In their recent study, Klusman et al. (2008) proposed a model considering teacher burnout, classroom learning environment, and their effects on student outcomes together. The authors determined four self-regulatory types for teachers, depending on combinations of teachers' levels of resilience and engagement. In the first part of their study, they collected data from 1789 ninth grade mathematics and science teachers in Germany to investigate whether these self-regulatory patterns differed in terms of teachers' burnout and job satisfaction. In the second part, they collected data from 318 of the teachers sampled in the first part. On average, 12 students for each teacher rated their teacher's personal characteristics and classroom environment. Students' scores on PISA 2003 Test and on motivation instrument were also included. Results of the study revealed that teachers who scored high on both resilience and engagement showed less emotional exhaustion and high job satisfaction, and had most favorable student ratings in almost all aspects of classroom environment. Authors concluded that teachers experiencing higher level of occupational well-being had more positive effect on students' emotional experience, while having no effect on mathematics achievement.

In sum, teacher's burnout level is regarded as an important factor for student learning. Although educational researchers mostly assumed a strong reciprocal associations of teacher burnout with classroom environment and student variables, the nature of these relation was not sufficiently investigated empirically. In order to fill this gap in the literature, in this study, the influence of teacher burnout on classroom environment and student outcomes, namely science achievement, self-efficacy, metacognitive self-regulation, and achievement goals were intended to be investigated. In the line with the related literature, in this study, it is expected to find a negative association between teacher burnout, and students' self-efficacy, metacognitive self-regulation, mastery approach goals, performance approach goals, mastery avoidance goals, perceived classroom environment, and achievement, but positive association between teacher burnout and performance avoidance goals.

2.2.3 Job Satisfaction

Beside burnout, job satisfaction is also an important indicator of occupational well-being. Job satisfaction of people has received great attention in recent studies on occupational health across the world. Since it is an ambiguous term, there is no consensus about the definition of job satisfaction (see Evans, 1997; Weiss, 2002). Locke (1976) defined job satisfaction as "a pleasurable or positive emotional state resulting from the appraisal of one's job or job experiences" (p. 1300). This definition seems mostly accepted description of the job satisfaction. Furthermore, more recently, Weiss (2002) reconsidered the existing definitions of job satisfaction, and stated that it is a broad term and includes three key constructs: overall evaluative judgements about jobs, affective experiences at work, and beliefs about jobs. According to Weiss (2002), in general, job satisfaction can be defined as "a positive (or negative) evaluative judgment one makes about one's job or job situation" (p. 175). He also emphasized the agreement that job satisfaction was considered as an affective construct.

According to Michaelowa and Wittmann (2007), job satisfaction literature is independently developed in different disciplines such as educational science and pedagogy, organizational theory, and economics. Among these, teacher job satisfaction received empirical pedagogical researchers' interest because of three reasons: it was (1) assumed to have an influence on the effectiveness of teaching and student' achievement, (2) considered as helpful in predicting teachers' turnover, and (3) expected to contribute teachers' occupational well-being (Michaelowa & Wittmann, 2007). According to Hackman and Oldham (1975) jobs are characterized by five core factors: skill variety, task identity, task significance, autonomy, and task feedback. Working conditions of teachers are different from other people working in various occupations. Teachers spend most of their working times with pupils instead of adults (Michaelowa & Wittmann, 2007), thus, it is not surprising to consider teacher job satisfaction separately from other jobs.

A number of research studies are devoted to teacher job satisfaction as it relates to a wide range of issues in the work environment. Kim and Loadman (1994) investigated the predictors of teacher job satisfaction in a study conducted with 2054 teachers in United States, and found seven statistically significant predictors of teacher job satisfaction. These predictors included extrinsic sources of job satisfaction such as salary, and opportunities for advancement, and intrinsic sources of job satisfaction such as professional challenge, professional autonomy, working conditions, interaction with colleagues, and interactions with students. In a study by Demirtas (2010), primary school teachers reported high level of job satisfaction, and the author found no significant differences in teacher job satisfaction for gender, branch, and professional seniority, but for age groups. Moreover, according to Zembylas and Papanastasiou, (2005), in several developed countries, teacher job satisfaction was found negatively associated with "imposed and centralized system accountability, lack of professional autonomy, relentlessly imposed changes, constant media criticism, reduced resources, and moderate pay" (p.433).

Studies on teacher job satisfaction, as stated in Chapter 1, also revealed that teachers job satisfaction is positively related to their performance at work (e.g., Ololube, 2006), extra-role behaviors toward students and organization (e.g., Somech & Drach-Zahavy, 2000), self-regulation (e.g., Klusmann et al. 2008), self-efficacy (e.g., Caprara et al. 2006; Klassen & Chiu, 2010; Skaalvik & Skaalvik, 2010), collective efficacy (e.g., Klassen et al. 2010), and life-satisfaction (see Ho & Au, 2006). Moreover, many studies showed that teachers who experience higher level of stress at work tend to feel less satisfaction with their job (e.g., DeFrank & Stroup, 1989; Ferguson, Frost, & Hall, 2012; Skaalvik & Skaalvik, 2010;). According to Demirtas (2010), schools having teachers with high level of job satisfaction are expected to provide qualified education and be successful in enhancing students' educational gains. Therefore, it could be assumed that since teacher job satisfaction is positively associated with favorable teacher characteristics, teachers who satisfied with job are likely to provide qualified education and increase student gains (e.g., Demirtas, 2010; Klusmann et al. 2008). However, only a few studies examined the effect of teacher job satisfaction on classroom learning environment and student learning outcomes. For example, Michaelowa and Wittmann (2007) examined the association of teacher job satisfaction with student performance with a rich data set (including 384 teachers and 6664 students) obtained from primary school students and teachers in a group of sub-Saharan African countries: Burkina Faso, Cameroun, Côte d'Ivoire, Madagascar and Senegal. While students' achievement scores were attained as dependent variable, predictors included several student level variables such as prior achievement, age, and having media (radio and/or television) and books at home, etc., and several school level variables such as teacher job satisfaction, teachers' giving private tuition, teachers' non teaching/school related activities, being volunteer teachers, teachers' being union member, experience etc. Results of the HLM analysis revealed that teacher job satisfaction was a significant and positive predictor of student achievement. The authors concluded that the quality of education could be increased by increasing teachers' job satisfaction. However, although most of the variables in their model had same direct influence on teacher job satisfaction and student achievement, the effect of some predictors (e.g., teachers' educational attainment) on these two variables were not necessarily at the same direction.

In another study, Klusman et al. (2008) classified German teachers into four groups based on their level of resilience and engagement as indicators of self-regulation. Result revealed that in the group comprised by the teachers with higher self-regulation (scored high on both resilience and engagement) had highest job satisfaction and also were best in providing favorable classroom environment. Moreover, the same groups of teachers had higher positive influence on students' motivation (i.e., autonomy and competence), while none of the teacher groups were found as effecting students' math achievement. The authors reported that the influence of teachers' self-regulation on student achievement might be in long term, and might be mediated by students' motivation. Although this study did not investigate the association between teacher job satisfaction and student outcomes, the results yielded that the teachers who had higher job satisfaction tended to provide better classroom environment and motivate students to learn while having no influence on achievement. Moreover, Klusman et al.'s (2008) study revealed that teachers who reported higher level of job satisfaction were those who succeed to lower disturbing behavior in the classroom, use time effectively, encourage students to develop new insights, create supportive social environment, and proceed at an appropriate pace to facilitate all students' learning. These behaviors are consistent with the instructional strategies that were suggested by Ames (1992) as potent to engage students to adopt mastery oriented goals, Accordingly, in the present study, it is expected to find an association between teacher job satisfaction and student motivation (i.e., self-efficacy and achievement goals).

To sum up, past research showed that teacher job satisfaction is one of the important predictors of teachers' occupational well-being and it is affected from working conditions. Moreover, it is positively associated with favorable teacher characteristics such as performance, self-efficacy, and self-regulation which are known as increasing desired educational outcomes. Therefore, although there is a limited number of empirical studies on the influence of teacher job satisfaction on student outcomes, in this study, it is assumed to find out positive association of teacher job satisfaction and students' self-efficacy, metacognitive self-regulation, mastery approach goals, performance approach goals, mastery avoidance goals, perceived classroom learning environment, and achievement, but negative association between teacher burnout and performance avoidance goals

2.2.4 Implicit Theories of Intelligence

According to Dweck (1999), individuals develop different beliefs by which they organize and understand their psychological worlds. That is, individuals who have different beliefs about themselves (self-beliefs) think, feel, and behave in different ways (Dweck, 1999). These beliefs are also regarded as implicit theories (see Dweck, 1999). Implicit theories represent the "beliefs about the malleability of people's attributes, such as intelligence, personality, and moral character" (Dweck, 1996, p.69), and include two assumptions: entity (nonmalleable) and incremental (malleable) (Dweck et al. 1995; Dweck & Leggett, 1988). While people who hold entity theory believe that personal attributes are relatively fixed, people who hold incremental theory believe that personal attributes are relatively malleable (Dweck et al. 1995). According to Dweck, Chui, and Hong (1995), individuals develop different goals and different explanations of performance based on their implicit theories. Namely, for an illustration, people with entity theory tend to explain negative performance as lack of ability and they are vulnerable to a helpless reaction. In contrast, people with incremental theory mostly focus on lack of effort or strategy in explaining negative performance and try to develop their ability (see Dweck, 1996; Dweck et al. 1995; Dweck & Leggett, 1988). Moreover, while people who hold entity theory are more likely to choose performance goals, people who hold incremental theory are more likely to choose mastery goals (Dweck, 1996; Dweck et al. 1995).

Over a few decades, the role of implicit theories in individuals' psychological world received increasing attention among cognitive and social psychologists (Dweck et al. 1995). According to Dweck (1996), individuals' implicit theories possess a motivational framework which leads them to set specific goals, increases specific interpretations of actions, and endorses specific reactions. Social cognitive theory assumes that individuals' beliefs determine their attitudes and behaviors (Bandura, 1986). Accordingly, understanding individuals' implicit theories give information about their reality (Dweck, 1996).

Implicit theories include domain specific attitudes such as intelligence[1], moral character, and personality (Dweck, 1999). Besides, individuals hold implicit theories not only about their own, but also about others (Dweck, 1999), and these theories in turn predict the goals that they adopt related to these characters (Dweck & Leggett, 1988). For example, Dweck (1999) indicated that people's judgments about others' capabilities were influenced by how they define intelligence, and this affects these people's interpretation and reactions toward the situations that include other people. To give an example, in Hong (1994)'s study with college students, participants were given information about other students' success and failures, and they were asked to explain why these outcomes occurred. Results revealed that students holding entity theory were more likely to explain other students' success and failures in terms of their intelligence. They attributed other students' well success and poor success to their smartness. On the other hand, students who hold incremental theory were more likely to explain students' success and failure in terms of their performance, study style, and effort etc.

Regarding teachers, some researchers assumed that teachers' implicit theories of intelligence influence their behaviors and attitudes in the classroom (Deemer, 2004; Lee, 1996; Lynott & Woolfolk, 1994). Past research showed that teachers' implicit

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[1] "Implicit theories of intelligance" refers to individuals' implicit theories about intellectual ability in general (see Chen & Pajares, 2010).

theories of intelligence tend to influence the goal structure of the classroom that created by them (see Shim et al. 2013).

Teachers hold beliefs not only about themselves, but also about their students. Bussis, Chittendon, and Amarel (1976) stated that “teachers’ characteristic beliefs about children and learning have pervasive effect on their behavior, influencing the learning environment that they create for children and for themselves” (p.16, as cited in Lynott & Woolfolk, 1994). Therefore, teachers’ implicit theories (both about themselves and their students) are expected to influence their attitudes and behaviors toward students.

The limited number of studies that directly focused on teachers’ implicit theories about students revealed that teachers’ instructional strategies are influenced by their implicit theories about students’ intelligence, ability, personality etc. (e.g., Lee, 1996; Lynott & Woolfolk, 1994; Swam & Snyder, 1980). For example, in a study with 200 teachers, Lee (1996) examined whether teachers implicit theories about students’ intelligence, ability, personality etc. (e.g., Lee, 1996; Lynott & Woolfolk, 1994; Swam & Snyder, 1980). For example, in a study with 200 teachers, Lee (1996) examined whether teachers’ implicit theories about students’ intelligence influenced their behaviors (i.e., scoring behavior, types of feedback, follow-up assignments, and placement recommendations) toward students. Results revealed that teachers holding incremental theory were more likely to give average scores, effort-oriented feedback, and learning-oriented assignments, and preferred forming heterogeneous groups. On the other hand, teachers holding entity theory tended to give non-average scores, ability-oriented feedback, and performance-oriented assignments, and preferred to form homogeneous groups.

In another study, Swam and Snyder (1980) examined how teachers’ beliefs about the students’ ability influence their teaching approaches with an experimental study. They found an interaction between teachers’ theories of ability and their label for students (low ability-high ability) for their implementing particular teaching strategies. Namely, teachers who believed that ability is fixed and uncontrollable trait tended to use most time consuming but effective teaching methods (rather than the intuitive or memorization methods) with the students they believed to possess low ability. They give more autonomy to students with the goal that the students find their own solutions to the given problems. Conversely, teachers who believed that ability is malleable were more likely to use most time consuming and effective teaching methods (rather than the intuitive or memorization methods) with the students they believed to possess high ability. These teachers presented more directive ways in teaching with the goal that they help students to improve problem-solving skills. In a survey study with elementary teachers, Lynott and Woolfolk (1994) found an association between teachers' implicit theories and their educational goals. Besides, their study revealed that, comparing to teachers implicit theories, teachers who hold incremental theory of intelligence tended to value (as indicators of intelligence) practical skills (such as developing technical knowledge and mastering basic skills, and social behaviors such as cooperation) more. Additionally, in a study by Leroy, Bressoux, Sarrazin, and Trouilloud (2007), a relation was found between teachers' implicit views of intelligence and their approach to learning. In that study, the researchers surveyed 336 elementary teachers, and administered measures of self-efficacy, implicit theories of intelligence, perceived work pressures, and support of autonomy in the classroom. Results of the path analysis revealed that teachers with incremental theory about students' intelligence were more likely to have higher self-efficacy. However, no indirect effect of incremental theory on autonomy supportive climate via teacher self-efficacy was found. Moreover, in their study, teachers with entity theory were found less likely to create autonomy supportive climates in the classroom. That is, entity teachers reported creating a climate which had less potential to foster intrinsic motivation of students.

In sum, based on the past research, it can be concluded that teachers who believe that students' ability is malleable (incremental theory) are more likely attribute students' success and failure to the degree of effort students exert for learning, persistence, and motivation. Moreover, they are more likely to adopt mastery goals which are aiming to increase students' learning. Conversely, teachers who believe that ability is fixed and cannot be changed (entity theory) are more likely to attribute students' success and failure to their ability, and these teachers are less likely to improve their instructional strategies, or exert extra effort. Although a number of studies attempted to explore the nature of the teachers' implicit theories and their impact on their instructional strategies and behaviors toward students, and they provided support for these associations; how teachers' implicit theories about students' abilities in science influence students' motivation and achievement has not been studied yet, and remained to be discovered. Accordingly, using the framework by Dweck and Leggett (1988), this study aimed to investigate whether implicit theories of ability that teachers hold about students, as manifesting their educational goals and instructional strategies, influence students' self-regulation and science achievement or not. Since teachers with incremental theory mostly possess favorable instructional strategies and behaviors toward students, in this study, it is expected to find out a positive association between teachers' ratings of incremental theory, and student outcomes and classroom learning environment. For example, since teachers who hold incremental theory attributed students' failure to the lack of effort (Dweck, 1999), probably their students' confidence about their capabilities to succeed a task will not decreased in the case of failure. Moreover, these teachers are tend to give effort-oriented feedback and learning-oriented assignments (Lee, 1996), this behaviors may increase students awareness about using appropriate learning strategies, and in turn increase students' metacognitive self-regulation.

2.2.5 Teachers' Gender and Experience

Is the teacher gender a matter in students' learning? Over the years, few studies examined this relation in science education while the effect of teacher gender on students' learning processes has been studied in various domains and grade levels across the world. Majority of the studies in science education indicated no significant association between teacher gender and student learning (e.g., Ehrenberg et al. 1995; Forslund and Hull, 1988; Harp, 2010; Simith, 1970). For example, in their study with

44 eight grade science teachers, Harp (2010) performed multiple regression analyses to find out the effect of teacher characteristics on students' science achievement based on their scores on The Texas Assessment of Knowledge and Skills (TAKS) test. TAKS included questions for 5 objectives: Objective 1: Nature and Science (14 questions), Objective 2: Living Systems and the Environment (12 questions), Objective 3: Structures and Properties and Matter (6 questions), Objective 4: Motion, Forces, Energy (6 questions), and Objective 5: Earth and Space Systems (12 questions). The dependent variable was treated class mean score for each TAKS objective. Results revealed that teacher gender was not a significant predictor of students' achievement scores for each of the 5 science objectives. In another study examining the data from the National Educational Longitudinal Study of 1988 (NELS), Ehrenberg et al. (1995) found that teacher gender was not related to students' achievement gains in science and mathematics.

Forslund and Hull (1988) also examined the teacher gender effect on student learning studying with 2672 6th grade students. Students' scores on The Science Research Associates Achievement Test (SRA) were used as achievement scores. The researchers formed four groups of students: (1) male-students/male-teacher, (2) male-students/female-teacher, (3) female-students/male-teacher, and (4) female-students/female-teacher. They performed Analysis of Covariance (ANCOVA) for SRA subsets in the areas of science, language arts, arithmetic, and reading by holding students IQ constant. Results revealed that while male students significantly outperformed girls in science, female students got significantly higher scores than males in language arts, regardless of the teacher gender. Moreover, neither in arithmetic nor in reading, significant difference was found between four groups. The researchers concluded that rather than teacher gender, student gender accounted for the significant results. Namely, teacher gender did not have an effect on achievement scores of either males or females. Similarly, Smith (1970) also found no significant difference between the science achievements of male students with male teachers and male students with female teachers.

Regarding classroom learning environment, a few studies investigated the effect of teacher's gender on students' perceptions of classroom learning environment. Past research showed that students thought by female science teachers generally perceived some aspects of the classroom more positively than students thought by male teachers. For example, den Brok et al. (2006) found a significant gender difference in students' perceptions of science learning environment. In their study, 655 students from 26 eight grade science classes were administered WIHIC scale. Data were analyzed by using multilevel modelling in order to consider the clustered structure of the data. Results revealed that teacher gender was related to student cohesiveness and investigation. That is, students who were thought by female teachers reported higher ratings for these scales. However, no significant difference was found for other subscales. Similar results were found by Levy et al. (2003) in a study using QTI scale. Results of multilevel analyses indicated significant gender effect favoring female teachers on helpful/friendly and understanding dimensions of the scale, but not significant gender effect was found on other subscales. In another study in Turkey, Rakici (2004) found no significant gender effect of teachers for 7 subscales of WIHIC. However, she found an association between teacher gender and interpersonal behaviors (based on QTI scores). Accordingly, students rated their male teachers as possessing more strict and admonishing behaviors than female teachers. Moreover, students reported science learning environment of their male teachers' classes more cooperative than female teachers' classes.

Teacher experience is another background characteristic of teachers expected to influence students' learning. According to an extensive systematic literature review by Zhang (2008), four meta-analytic studies investigated the role of teacher characteristics on students' achievement, which yielded contradictory results. That is, while two of these meta-analytic studies concluded that there was a strong positive association between teacher experience and student achievement (Greenwald, Hedge, and Lain, 1996: Hedge et al., 1994, as cited in. Zhang, 2008), other two studies concluded that there was no strong evidence for the expected positive effect of teachers' experience on student achievement (Hanushek, 1989: 1997, as cited in

Zhang, 2008). More specifically, in Hanushek's (1997) study, more than 70% of the studies found no significant association between teacher experience and student achievement.

In the field of science, only a few studies investigated the effect of teacher experience on student achievement, and majority of them yielded no association between teacher experience and students' science achievement (e.g., Goldhaber & Brewer, 2000; Harp, 2010; Monk, 1994; Zhang, 2008; Zuelke, 2008). To give an example, Zhang (2008) conducted a two-level multilevel analysis to investigate the effect of teacher experience on students' science achievement scores. Participants were 655 eight grade students and their 12 science teachers. Results demonstrated that when controlling other variables in the model, years of teaching experience in science did not directly influence students' achievement in science. Similarly, in a study examining the effect of teacher quality on students' science achievement, Zuelke (2008) examined the data obtained from Florida Comprehensive Achievement Test (FCAT). The researcher investigated the effect of teachers' years of teaching experience on 8th grade students' science achievement in two separate groups of schools: low socioeconomic status and high socioeconomic status. When each group was analyzed separately by using one-way ANOVA, results indicated no significant difference among the 8th grade students' science FCAT scores due to teachers' experience (0-5 years, 5-10 years, and over 15 years) in both group of schools. On the other hand, results of Kaya's (2008) study based on TIMSS 2003 data revealed mixed results. Namely, when other variables controlled in two-level multilevel analyses (HLM), teacher experience was found significantly associated with 4th grade students' science achievement in Japan (γ = .40), but not in Singapore, US, Australia, or Scotland.

Regarding classroom learning environment, studies examining the influence of teacher experience on students' perception of learning environment yielded mixed results. For example, Brekelmans et al. (2002) examined the student-teacher interaction in a classroom with a longitudinal data. Participants were 51 secondary school teachers (in the first decade of their professional career) and more than 19000 students from these teachers' 826 classes. Data were collected annually during 8 years. Thus experience of teachers ranged from 1 to 8 years. Results of students' perceptions showed that, in the first year of teaching career, the most dominant profile of teachers was the Tolerant and the Uncertain/Tolerant profile. Namely, in the early years of their career, teachers were perceived to provide more pleasant, supportive, and cooperative climate in classroom, and students enjoyed attending classes. These inexperienced teachers were also perceived providing poorly structured lessons, more tolerant to disruptive behaviors, and less encouraging to make the students task oriented. On the other hand, when they get more experienced, more dominant profiles of teachers were perceived as Authoritative and Directive. Namely, they did not set close relationship with students, behaved less friendly, and had less tolerance to disruptive behaviors. In another study, Levy et al. (2003) found that students rated more experienced teachers as displaying more admonishing and strict behaviors than less experienced teachers, but the effect size was found as small. In another study with 1471 health science students and their teachers in 75 classes in Australia, Flinn (2004) concluded that more experienced teachers were perceived as displaying more dominant, friendly, and understanding behaviors, and less strict behaviors than less experienced teachers.

To sum up, past research on the influence of teacher gender and experience on students' achievement in science education yielded no significant association. Furthermore, results of the past research that examined the influence of teacher gender and experience on students' perception of learning environment were sparse. Since these relations were rarely studied, it is hard to make a reliable conclusion. Moreover, in the science education, since there are only few studies examined relationship between teacher gender and experience on students' self-regulation processes which are strong indicators of achievement, it is needed to conduct a study with self-efficacy, metacognition, and achievement goal variables. In the present study, it is aimed to extent the teacher effectiveness research by investigate the association between teacher characteristics (i.e., gender and experience), and students' learning outcomes (i.e., science achievement, self-efficacy, metacognition, and achievement goals) and perceived learning environment in science.

CHAPTER III

METHODOLOGY

This chapter specifies the methods that were employed to gather and analyze the data in this study. Specifically, this chapter addresses the details regarding the participants of the study, the instruments, the data collection procedures, the analyses, the internal validity threats, and limitations of the study.

3.1 Design of the Study Design of the Study

This study is a quantitative research which relies on students' and teachers' self-report responses to the questionnaires. Since the focus of this study is the interrelationships between some teacher and student variables, the design of the study can be considered as a correlational study. This study was conducted in Turkey at national level by using survey research method. Participants include science teachers across Turkey and their 7th grade students. 400 elementary schools across Turkey were randomly selected. With contribution of EARGED/EREDED (Ministry of Education, Education Research and Development Department), questionnaires for science teachers and students were sent to the selected schools by mail. Additionally, this study is a cross-sectional study in which all participants were surveyed on one occasion by mail.

3.2 Population and Sample

In this section firstly sampling procedures are mentioned and it is followed by teacher and student sample separately.

3.2.1 Sampling Procedures

The population of the research study are all elementary science teachers and their 7th grade students in elementary schools located in city centers and districts across the Turkey. Because it is not feasible and possible to reach entire population, a reasonable number of sample was selected to represent the population. To make it consistent with the school classification in 2009-2010 national formal education statistics of Turkish National Ministry of Education (MEB, 2010), in this study, the schools located in city centers and districts are combined in the same category and called as city schools, while the other schools located in villages are called village schools.

According to Toprakci (2006), the effects of economic, social, cultural and geographic discrepancies between city and village schools on teacher, students, and education are different and while solving city and village schools' problems, they should be considered differently. Therefore, in this study, it was decided to include just the schools in the city category of Turkish Ministry of Education.

Grade level has an important effect on students in several ways. For example, as grade level increases, a decrease takes place in their motivation in learning science (Gungoren, 2009; Lepper, Corpus & Iyengar, 2005; Senler & Sungur, 2009). Namely, while students have highest motivation at 6th grade, which is the transition period from the primary school to middle school, and lowest motivation at 8th grade which is the transition period from middle school to high school, their motivation is at more average level at 7th grade and is less likely to be affected from transition periods (Gungoren, 2009). In this study, self-efficacy, metacognitive self-regulation, and goal orientation are important motivational constructs that are expected to be related to students' science achievement. Hence, in order to decrease the effects of external factors, it was decided to just 7th grade students be included in the study.

Moreover, since there are variations of schools in terms of policies, opportunities, and features between public and private elementary schools, only public elementary schools were included in this study. Among these differences, the average student number in classrooms can be considered among the important ones. In Turkey, the average student number is considerably less in private schools than in public schools (MEB, 2010). On the other hand, private schools have different policies than public schools regarding teacher salaries, resources, and teacher selection criteria (Guclu, Kurt, & Koc, 2010). These differences between private and public schools might affect the interrelationships among the variables examined in this study. Therefore, private schools were not included in the study.

In quantitative studies, before starting the data collection procedures, it is suggested to determine the minimum sample size to assess a desired level of statistical power for statistical analysis which was planned to be performed (McQuitty, 2004). Therefore, a power analysis was conducted to ensure that the sample size was big enough to represent the population. The focus of this analysis was firstly determining the sufficient school number. According to 2009-2010 national formal education statistics of Turkish National Ministry of Education (MEB, 2010), the public elementary school number is 31,572 and 10,137 of those are located in city centers and districts, which are classified as city in this statistics report.

The appropriate sample size for continuous variables and randomly selected samples is calculated by the formula:

$$n_0 = [(t \times S)/d]^2$$

$$n = [n_0/(1+(n_0/N))]$$

(Buyukozturk, Kılıc, Cakmak, Akgun, Karadeniz, & Demirel, 2010). Here, d is power (tolerance value), N is population size, S is predicted standard deviation and t is the table value corresponding to a determined confidence interval. In this study, the parameters were defined as d=0.05, S=0.5 t=1.96 (for 0.95 confidence interval) and the corresponding sample size for N=10,137 schools was calculated as:

n_0= [1.96 x 0.5)/0.05]=384.16

n= [384.16/(1+(384.16/10,137))]=384.16/1.0378=370.16

Additionally, taking the possibility of less returning rate into consideration, the sample size was determined as 400 schools.

Two stages random sampling procedure was followed to select the teachers and students. Firstly, from the public elementary school list of Turkey, 400 of the 10,137 schools were randomly selected by using SPSS 18.0 program. As a result of this selection procedure, while no school was selected from 9 of the 81 cities by the program, schools selected from 72 cities were included in the sample.

In order to control socioeconomic factors and checking whether this selected sample was representing the population, Turkish Statistical Institute (TSI, 2005)'s Nomenclature of Territorial Units for Statistics (NUTS) classification was used. NUTS classification consists of 3 levels: NUTS 3 level consist of 81 cities according to administrative structure, NUTS 2 level consists of 26 territorial units according to the sizes of population by regarding economic, social, cultural, geographical and other factors, and NUTS 1 level consist of 12 territorial units, which is the aggregated version of level 2. These classifications are mostly based on the European Union criteria and the differences in development, population, culture, geography and socioeconomic status of the cities were taken into account. In this study, NUTS 1 level was selected (see Table, 3.1), as it has more general classification. Afterwards it was checked whether the selected sample represent these 12 territorial units.

Table 3.1 NUTS I level

NUTS 1 Level	Included Cities
1.Northeastern Anatolia	Erzurum, Erzincan, Bayburt, Ağrı, Kars, Iğdır, Ardahan
2.Middleeastern Anatolia	Malatya, Elazığ, Bingöl, Tunceli, Van, Muş, Bitlis, Hakkari
3.Southeartern Anatolia	Gaziantep, Adıyaman, Kilis, Şanlıurfa, Diyarbakır, Mardin, Batman, Şırnak, Siirt
4.Istanbul	İstanbul
5.Western Marmara	Tekirdağ, Edirne, Kırklareli, Balıkesir, Çanakkale
6.Aegean	İzmir, Aydın, Denizli, Muğla, Manisa, Afyon, Kütahya, Uşak
7.Eastern Marmara	Bursa, Eskişehir, Bilecik, Kocaeli, Sakarya, Düzce, Bolu, Yalova
8.Western Anatolia	Ankara, Konya, Karaman
9.Mediterranean	Antalya, Isparta, Burdur, Adana, Mersin, Hatay, Kahramanmaraş, Osmaniye
10.Central Anatolia	Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir, Kayseri, Sivas, Yozgat
11. Western Black Sea	Zonguldak, Karabük, Bartın, Kastamonu, Çankırı, Sinop, Samsun, Tokat, Çorum, Amasya
12.Eastern Black Sea	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane

Source: TSI, 2005

The school numbers for each territorial unit were determined according to 2009-2010 national formal education statistics of Turkish Ministry of National Education. This information was obtained via e-mail from the Statistics Department of Turkish Ministry of National Education. Table 3.2 presents the total number of schools, expected representative number of schools according to the sample selection proportion, and selected number of schools for each territorial unit. The proportion for the expected representative number of schools for each territorial unit was determined by the ratio of selected school number (400) to total school number (10,137). In other words, this ratio is approximately was 4% and it was expected that approximately 4% of the total schools in each territorial unit to be selected. The frequencies in Table 3.2 indicates that the expected representative numbers of schools and selected number of schools are very close to each other and there is no congregation in any of the territorial units. Therefore, the number of schools can be considered as the representative for these 12 territorial units.

Table 3.2 The total number of schools, expected representative number of schools, and selected number of schools for each territorial unit

Territorial units	Total school frequency (f)	Expected representative school frequency (f)	Selected school frequency (f)
.Northeastern Anatolia	425	17	16
Middleeastern Anatolia	567	22	25
.Southeastern Anatolia	1055	42	38
Istanbul	1172	46	49
Western Marmara	440	17	19
Aegean	1311	52	49
Eastern Marmara	966	38	42
Western Anatolia	1032	41	39
Mediterranean	1272	50	46
.Central Anatolia	782	31	33
Western Black Sea	722	28	31
Eastern Black Sea	394	16	13
Total	10137	400	400

The second stage of the sampling procedure includes randomly selection of one of the classes that taught by the selected teacher. Thus, the proposed sample sizes were 400 for teachers and if each class assumed to have approximately 25 students, 10,000 for students. This selected sample can be considered as both highly representative to make generalizations to the population and quantitatively reliable (S. Buyukozturk, personal communication, January 05. 2011).

Data were obtained from 376 of the 400 schools and return rate was 94%. However, data gathered from 4 of the schools were excluded because of either teacher or student questionnaires were not returned. Moreover, as it will be discussed in chapter 4, 50 students' data were also excluded because of having some outliers on specific variables. Consequently, 372 of the 400 schools have sufficient data, including 372 teachers and 8198 student, to be able to be used in HLM analyses which was conducted to analyze the current data and regarded as reasonably high in quantity. The sample characteristics are mentioned in the sections 3.2.2 and 3.2.3 with more details.

3.2.2 Teacher Sample

A total of 372 science teachers (46.2 % males, 53.8% females) working in public elementary schools across Turkey were participated in this study. Ages of the participants ranged from 22 to 65 (M= 35.92, SD= 9.23) and their experiences ranged from 1 to 38 (M= 12.07, SD= 8.69). Additionally, average student number in their classrooms was 29.41 (SD= 6.932) and average weekly course hours of teachers was 23.24 (SD= 4.73). Detailed information about the characteristics of the teacher sample was provided in Table 3.3.

Table 3.3 Characteristics of the teacher sample

Variable	f	%
Gender		
Male	172	46.2
Female	200	53.8
Missing	0	0
Graduated Program		
Science Education	214	57.5
Physics Education	26	7.0
Chemistry Education	31	8.3
Biology Education	28	7.5
Physics	23	6.2
Chemistry	23	6.2
Biology	17	4.6
Education-Others	3	.8
Others	3	.8
Missing	4	1.1
Graduate Level		
Bachelor	321	86.6
Master	23	6.2
Doctorate	0	0
Others	27	7.3
Missing	0	0
Marital Status		
Married	274	73.7
Single	98	26.3
Missing	0	0
Children Number		
0	145	39.0
1	88	23.7
2	110	29.6
3	25	6.7
4	4	1.1
Missing	0	0

Most of the science teachers (72%) were graduated from faculty of education, however just 57.5% of the science teachers were graduated from science education department. Moreover, while the most of the teachers (86.6%) had only bachelor degree, the percentage of the teachers who had higher level of graduate was very low (6.2%). On the other hand, the percentage of the married teachers were 73.7 and 39% of the teachers did not have any child.

3.2.3 Student Sample

The student sample of this study included 8198 (55.9% female, 43.8% male and .4% missing) 7th grade students enrolled in public elementary schools across Turkey. Their average age was 13.15 (SD = .48) and the average of their science grade of previous semester was 3.66 (SD = 1.12).

Table 3.4 Characteristics of the student sample

Variable	*f*	%
Gender		
Male	3590	43.8
Female	4579	55.9
Missing	29	.4
Science GPA in previous semester		
1	353	4.3
2	876	10.7
3	2114	25.8
4	2554	31.2
5	2186	26.7
Missing	115	1.4

The majority of the students' mothers graduated from primary education (50.2%). Similarly, the majority of the students' fathers graduated from primary schools (33.5%). While most of the students' fathers are employed (78.6%), most of the students' mothers are unemployed (79.7%). Detailed information about the background characteristics of the student sample was provided in Table 3.5.

Table 3.5 Student sample's background characteristics

Variable		*f*	%	*f*	%
Education Level		Mother		Father	
	Illiterate	921	11.2	192	2.3
	Primary school	4115	50.2	2747	33.5
	Middle school	1239	15.1	1723	21.0
	High school	1311	16.0	2025	24.7
	College	472	5.8	1089	13.3
	Master degree	53	.6	192	2.3
	PhD degree	14	.2	33	.4
	Missing	73	.9	197	2.4
Employment status		Mother		Father	
	Employed	1294	15.6	6441	78.6
	Unemployed	6634	79.7	438	5.3
	Occasionally employed	220	2.7	596	7.3
	Retired	110	1.3	602	7.3
	Missing	40	.5	121	1.5
Reading materials at home					
	0-10	1068	13.0		
	11-25	2804	34.2		
	25-100	2551	31.1		
	101-200	894	10.9		
	More than 200	777	9.5		
	Missing	104	1.3		
Frequency of buying newspaper					
	Never	1261	15.4		
	Sometimes	5150	62.8		
	Always	1696	20.7		
	Missing	91	1.1		
Separate study room					
	Have a study room	5816	70.9		
	Do not have a study room	2314	28.2		
	Missing	68	.8		
Computer					
	Have a computer	5393	65.8		
	Do not have a computer	2762	33.7		
	Missing	43	.5		
Internet					
	Have internet connection	4221	51.5		
	Do not have internet connection	3932	48.0		
	Missing	45	5		
Sibling					
	0	445	5.4		
	1	2808	34.3		
	2	2352	28.7		
	3	1192	14.5		
	4	601	7.3		
	5 or more	763	9.3		
	Missing	37	.5		

3.3 Data Collection Instruments

In this study, two different sets of instruments were used: one set was for teachers and the other was for students.

3.3.1 Data Collection Instruments – *Teacher Level*

The teacher questionnaire consisted of two distinct parts: (A) Demographic Information questionnaire and (B) Self-evaluation form. In part A, teachers were asked about some personal characteristics such as gender, age, experience graduate level etc. On the other hand, in part B, participants were asked to indicate their level of agreement or disagreement to a number of questionnaire items. These questionnaires included Teachers' Sense of Self efficacy Scale (TSES), Implicit Theory of Science Ability Scale (ITSA), Maslach Burnout Inventory-Educators (MBI-ED) and Job Satisfaction Scale (JSS) (See Table 3.6). Details of each questionnaire are explained in the following sections.

Table 3.6 Data collection instruments for teachers and variables assessed

Instruments	Variables
Demographic Questionnaire-Teacher	Gender Age Graduated Faculty Type Graduated Department Graduate level Experience Weekly Course Hours Class size Marital Status Number of Children
TSES (Tschannen-Moran & Hoy, 2001)	Student Engagement Instructional Strategies Classroom Management
ITSAS (Adapted from ITIS, (Dweck & Henderson, 1988)	Entity
MBI (Maslach & Jackson, 1981)	Emotional Exhaustion Personal Accomplishment
Job Satisfaction Scale (Skaalvik & Skaalvik, 2009)	Job Satisfaction

3.3.1.1 The Demographical Questionnaire-Teacher Level

The demographical questionnaire included 11 questions that assessing teachers' some background characteristics: gender, age, graduated, faculty type, graduate level, experience, weekly course hours, class size, marital status and number of children if they have.

3.3.1.2 Teachers' Sense of Self efficacy Scale-Teacher Level

Teaching self-efficacy of science teachers was assessed by Teachers' Sense of Efficacy Scale (TSES) (also called as Ohio State Teacher Efficacy Scale) developed by Tschannen-Moran and Hoy (2001). The TSES was developed mostly based on the Banduras' unpublished self-efficacy scale and found valid for both pre-service and in-service teachers. Subscale of the TSES focuses on teachers' beliefs about their capabilities on providing good student engagement, using variety of instructional strategies and effective management of the classroom.

Furthermore, the TSES was developed in two forms: long form scale including 24 items and short form scale including 12 items (Tschannen-Moran & Hoy, 2001). Both scales were found valid and reliable for in-service and pre-service teachers and each form consists of three subscales: efficacy for student engagement (SE) (e. g. "How much can you do to motivate students who show low interest in schoolwork?"), efficacy for instructional strategies (IS) (e. g. "To what extent can you use a variety of assessment strategies?") and efficacy for classroom management (CM) (e. g. "How much can you do to control disruptive behavior in the classroom?") (Tschannen-Moran & Hoy, 2001). While the each subscale of the long form of the TSES includes 8 items, in short form, each subscale has 4 items. Response scale is 9-point Likert scale ranging from "1= nothing" to "9 = a great deal". The reliability coefficients (Cronbach's alpha) of each subscale of short and long form of the TSES were close to each other and indicated high reliability (see Table 3.7).

The long form of the TSES scale was translated and adapted in Turkish by Capa, Cakiroglu, and Sarikaya (2005). Participants were 628 pre-service teachers from six different universities located in four major cities in Turkey. In order to provide construct validity of the three factor subscale scores, confirmatory factor analysis (CFA) and Rasch measurement were carried out and acceptable model fit (TLI = .99, CFI = .99, RMSEA = .05) was found. Moreover, findings indicated an evidence for construct validity of the TSES scores obtained from these Turkish pre-service teachers. Cronbach's alpha coefficients for Turkish version of the 24 item TSES scores were .82 for SE, .86 for IS, and .84 for CM. For the whole scale, the reliability of efficacy scores was .93. Therefore, Turkish version of TSES can be considered as reasonable valid and reliable. Similar to the original English version, Turkish TSES bases on 9 point Likert type response scale.

Bumen (2010) conducted a CFA to test the three factor structure of the long form of Turkish TSES for in-service Turkish teachers. Participants of this study included 801 in-service teachers. Results of CFA indicated a good model fit (NNFI = .98, AGFI = .90, GFI = .93, RMSEA = .05). Additionally, reliability estimates were found .87, .78 and .89 for SE, IS and CM respectively, and .93 for the whole scale.

In current study, in order to ensure the 3-factor structure of the short form of TSES, a CFA was conducted. Results showed an adequate model fit ($\chi^2_{(51)} = 160.91$, $p < .05$; CFI = .98, GFI = .93, NFI = .96, NNFI = .97; SRMR = .05; RMSEA = .08; 90% CI = .07, .09). Internal consistency of TSES was examined in terms of Cronbach's alpha and ranged from .76 to .83 for subscales. For whole scale, reliability was found as .89. Descriptions of each subscale, sample items, and their internal consistencies are shown in Table 3.7. Moreover, Table 3.8 presents Lambda-X estimates for the latent factors of TSES in this study.

Table 3.7 Descriptions of the subscales of the TSES and sample items

Subscales	Description	Sample item	Cronbach's Alpha – Short Form (Tschannen-Moran & Hoy, 2001)	Cronbach's Alpha –Long Form (Capa, Cakiroglu, & Sarikaya, 2005)	Cronbach's Alpha – Short Form (Current Study)
Instructional Strategies	Confidence for using variety of instructional strategies	To what extent can you use a variety of assessment strategies?	.86	.86	.80
Classroom Management	Confidence for managing classroom effectively	How much can you do to control disruptive behavior in the classroom?	.86	.84	.83
Student Engagement	Confidence for engaging all students	How much can you do to motivate students who show low interest in schoolwork?	.81	.82	.76

Table 3.8 Lambda-X Estimates for TSES

Subscale	Indicator	Present study LX estimates
Instructional Strategies	q5	.64
	q9	.74
	q10	.67
	q12	.77
Classroom Management	q1	.71
	q6	.81
	q7	.83
	q8	.69
Student Engagement	q2	.68
	q3	.74
	q4	.78
	q11	.55

3.3.1.3 Implicit Theory of Science Ability Scale-Teacher Level

Teachers' believes about students' science skills was measured by adapting Implicit Theory of Intelligence-others form for adults (ITIS) Scale (Dweck, 1999, p.178). The ITIS firstly developed by Dweck and Henderson (1989) on the base of the three entity theory items: (1) "You have a certain amount of intelligence and you really can't do much to change it", (2) "Your intelligence is something about you that you can't change very much", and (3) "You can learn new things, but you can't really change your basic intelligence". Dweck and Henderson (1989) didn't include incremental items in this scale because incremental theory questions were too appealing and people tended to give more desirable responses (reviewed in Hong, Chiu, Dweck, Lin, & Wan, 1999). Dweck (1999, p.176) indicated that using entity-only scale was beneficial in most circumstances and in their studies they preferred using scales including only entity theory items. In their six validation studies, Dweck et al. (1995) found ITIS as having high internal reliability with alpha values ranging from .94 to .98.

The Implicit theory measure has two different versions: one for children and one for adults. Moreover, people's judgements about others can be assessed by replacing the word ‘you’ with ‘people’, ‘someone’ or ‘everyone’, which is called as ‘others” form of intelligence scale (Dweck, 1999: p. 178). The ITIS-others form for adult originally include eight items: four entity theory statements and four incremental theory statements (see Dweck, 1999: p. 178). Although there are four items exist in the entity part of ITIS-for adults as provided in Dweck (1999), the three item (including item1, item2, and item4) form of the same scale has been widely used for adults by researchers (e.g.: Deemer, 2004; Dweck & Henderson, 1989).

The 8-item ITIS (Dweck, 1999: p. 178) was translated and adapted into Turkish by Ozkan, Altinsoy, and Bayazit (2004). The internal consistency of this Turkish version of 8-item ITIS was found as $\alpha = .90$. Furthermore, Buyukdere (2006) conducted a study with 117 teachers and used the others form of the Turkish version of the ITIS. The reliability of the scores obtained from this teacher sample was found as $\alpha = .90$.

In this study, ITIS-others form for adults was adapted to assess science teachers' judgements on people's abilities in science. Although the original scale of Dweck (1999) refers to intellectual ability, according to Stipek and Grallinski (1996), individuals may have subject specific implicit theory of ability. The similar adaptation was also done regarding students' self-theories by Chen and Pajares (2010). Thus, the revised scale Called Implicit Theory of Science Ability Scale (ITSAS) was constructed by reworded by substituting the term ‘intelligence’ for ‘science ability’. Incremental theory items were not included in this study as mostly preferred by researchers (see Hong at al., 1999). The items of new scale: (item1) ‘People have a certain amount of science ability and they really can't do much to change it’, (item2) ‘People's science ability is something about themselves that they can't change very much’, (item3) ‘To be honest, people can't really change how much science ability they have’, and (item4) ‘People can learn new things, but they can't really change their basic science ability’. Response scale is 6-point Likert scale ranging from 1 (strongly agree) to 6 (strongly disagree), as in the original English form. While the low scores indicate disagreement with incremental theory, high scores indicates agreement with incremental theory. Namely, the higher scores on this scale indicate the less participants believe that the people's science ability is fixed.

Chen and Pajares (2010) previously developed a similar implicit theory of science ability scale for children by adapting the self-form of Dweck's (1999) implicit theories scales. They administered the 6-item scale (3 for entity and 3 for incremental theory) to 508 grade 6 students and found the reliability coefficient as .69 for entity and .79 for incremental theory scales.

Before the present study, a pilot study was conducted with 41 pre-service science teachers. The adapted 4 entity items were submitted to exploratory factor analysis (EFA) with Principle Axis Factoring method and Promax rotation (Kappa set at 4). Result of EFA showed that four items loaded on a single factor. The reliability coefficients of the scores was found as $\alpha = .89$.

Afterwards, the same scale was administered to elementary science teachers, and in order to validate ITSAS' factor structure, a CFA was conducted. Results suggested the exclusion of item3, since it causes poor model fit. There is no problem with excluding item3 from the scale, because this form of the scale is consistent with the scales which are frequently used for adults by some researchers (e.g.: Deemer, 2004; Dweck & Henderson, 1988). With these 3 items result, CFA showed perfect model fit to the data ($\chi^2_{(0)} = 0$, $p > .05$). Internal consistency of ITSAS was found as .84. Thus, the Turkish version of ITSAS can be considered as a valid and reliable scale to measure adults' beliefs about science ability. Description of ITSAS, sample item, and its internal consistencies are shown in Table 3.9. Moreover, Table 3.10 exhibits the Lambda-X estimates of ITSAS in this study.

Table 3.9 Reliability of the ITSAS

	Description	Sample item	Cronbach's Alpha (Chen & Pajares, 2010)	Cronbach's Alpha (Current Study)
Implicit Theory of Science Ability (Incremental theory)	Teachers' beliefs that people's science ability is not fixed and can change	People have a certain amount of science ability and they really cannot do much to change it.	.69	.84

Table 3.10 Lambda-X Estimates for ITSAS

Subscale	Indicator	Present study LX estimates
Implicit Theory of Science Ability	q1	.81
	q2	.89
	q4	.69

3.3.1.4 Maslach Burnout Inventory-Teacher Level

Maslach Burnout Inventory (MBI) has been the most widely used burnout inventory in the literature (Schaufeli & Enzmann, 1998). MBI was originally developed in English by Maslach and Jackson (1981) to assess the burnout level of workers who works continuously with people. MBI includes 22 self-report items and consists of three subscales: Emotional Exhaustion (EE, 9 items), Depersonalization (DP, 5 items), and Personal Accomplishment (PA, 8 items). MBI had two different rating scales: frequency and intensity. While the frequency scale ranges from 1 (a few times a year or less) to 6 (every day), intensity scale ranges from 1 (very mild, barely noticeable) to 7 (major, very strong). Additionally, Maslach and Jackson (1981) added a zero (never) value on the frequency scale. High scores from emotional exhaustion and depersonalization and low scores from personal accomplishment are indicative of burnout. Cronbach's alpha values were .89, .74, and .77 for the scores on frequency scale and .86, .74, and .72 for the scores on intensity scale of EE, PA, and DP respectively.

More recently, MBI was specifically designed for use by people who were working in educational settings, which is called as the MBI-Educators Survey (MBI-ES) (see Maslach, Jackson, and Leither, 1996). Although, in this form of the scale, the word ‘recipients’ was replaced with ‘students’ to emphasize the people that they interacted extensively in workplace, the MBI-ES has the same 3 factor structure of the MBI (Maslach, Schaufeli & Leiter, 2001).

The MBI was translated and adapted into Turkish by Ergin (1992). In Turkish version of the MBI 5-point Likert scale ranging from 0 (never) to 4 (always) was used. The Cronbach’s alpha coefficients were found as .83, .65, .and 72 for EE, DP and PA respectively and yielded sufficient internal consistency.

In this study, the MBI-ES form was used to assess teachers’ burnout level. The reliability and validation of the Turkish version of the MBI-ES was firstly studied by Girgin (1995) and Sucuoglu and Kuloglu (1996) separately. They both administered the questionnaire to the teachers. In terms of internal consistency Girgin (1995) found Cronbach’s alpha coefficients for EE, DP, PA as 87, .63 and .74 respectively. On the other hand, in their study, Sucuoglu and Kuloglu (1996) found internal consistency of each variable by calculating the Cronbach’s alpha as .82, .60 and .73. In these two studies, MBI-ES was found reliable and valid.

Subscales of burnout is evaluated separately and calculating a single burnout score by averaging subscales’ means is not suggested (Ergin, 1992). Within the scope of this study, emotional exhaustion and personal accomplishment dimensions of burnout were used. While emotional exhaustion items consist of negative statements, personal accomplishment items include positive items. Since these two dimensions were investigated separately, reverse coding for personal accomplishment items were not needed.

In order to check the construct validity of MBI-ES a CFA was conducted. Result showed good fit to the data ($\chi^2_{(118)}$ = 278.57, p < .05; CFI = .97, GFI = .92, NFI = .94, NNFI = .96; SRMR = .07; RMSEA = .06; 90% CI = .05, .07). The description of each subscale, sample items, internal consistencies of MBI-ES are shown in Table 3.11. Moreover, Table 3.12 exhibits the Lambda-X estimates of MBI-ES in this study.

Table 3.11 Description of the factors of MBI and sample items

Factor	Description	Sample item	*Cronbach's Alpha* (Maslach & Jackson, 1981)	*Cronbach's Alpha* (Sucuoglu & Kuloglu, 1996)	*Cronbach's Alpha (Current Study)*
Emotional Exhaustion	"Feelings of being emotionally overextended and exhausted by one's work"	"I feel burned out from my work"	.86	.82	.87
Personal Accomplishment	"Feelings of competence and successful achievement in one's work with people"	"I deal very effectively with the problems of my" students"	.74	.73	.77

Source: Maslach & Jackson, 1981, p.101

Table 3.12 Lambda-X estimates for MBI-ES

Subscale	Indicator	Present study LX estimates
Emotional Exhaustion	q1	.79
	q2	.79
	q3	.78
	q5	.78
	q7	.87
	q10	.56
	q11	.24
	q12	.67
	q16	.51
Personal Accomplishment	q4	.39
	q6	.62
	q8	.57
	q9	.59
	q13	.59
	q14	.64
	q15	.48
	q17	.49

3.3.1.5 Teacher Job Satisfaction-Teacher Level

Teachers' overall satisfaction about their job will be assessed by a three-item scale developed by Skaalvik and Skaalvik (2010). According to (Skaalvik & Skaalvik, 2010), job satisfaction has been studied as an overall construct and as teachers' satisfaction with different circumstances as well, However, they criticized considering teachers' satisfaction with different circumstances as overall job satisfaction. Skaalvik and Skaalvik (2010) indicated that since the effect of the different circumstances on teachers' overall job satisfaction may vary from teacher to teacher depending on how they value these circumstances, overall job satisfaction of teachers' should not be measured by concrete circumstances such as salary, working hours etc. Their questionnaire measures teachers' overall job satisfaction by using these items: 1- "All things considered, how much do you enjoy working as a teacher?", 2- "If you choose occupation today, would you choose to be a teacher?", and 3-"Have you ever thought about leaving the teaching profession?". For each question, 5-point Likert type response scale was utilized, but in different forms: for the first question, it ranges from “not at all” to “very much”; for the second question, it ranges from “no, definitely not” to “yes, without a doubt”; and for last question, it ranges from “all the time” to “never”. Cronbach’s alpha was found as .71 for this scale.

This scale was translated and adapted into Turkish by the researcher. Result of CFA indicated perfect model fit to the data ($\chi^2_{(0)} = 0$, $p > .05$). Moreover, internal consistency of job satisfaction scale was found as .87. Therefore, the Turkish version of this job satisfaction scale provides reliable and valid information about teachers’ satisfaction from their job.

Description of job satisfaction scale, sample item, and its internal consistency coefficients are shown in Table 3.13. The Lambda-X estimates of job satisfaction scale in this study are provided in Table 3.14.

Table 3.13 Reliability of Teacher Job Satisfaction Scale

	Description	Sample Item	Cronbach’s Alpha (Skaalvik & Skaalvik, 2010)	Cronbach’s Alpha (Current Study)
Teacher Job Satisfaction	Teachers’ overall satisfaction about their job.	All things considered, how much do you enjoy working as a teacher	.71	.87

Table 3.14 Lambda-X estimates for Teacher Job Satisfaction Scale

	Indicator	Present study LX estimates
Teacher Job Satisfaction	q1	.87
	q2	.90
	q3	.76

3.3.2 Data Collection Instruments – Student Level

The student questionnaire includes three distinct parts: (A) Demographic Information Questionnaire, (B) Self-Evaluation Form, and (C) Science Achievement Test (see Table 3.15). In the first part, there were 14 questions about students' background characteristics such as gender, age, number of sibling etc. In the second part, students were asked to report their agreement or disagreement to the questions of the Motivated Strategies for Learning Questionnaire (MSLQ), What Is Happening in This Class Questionnaire (WIHIC), and Achievement Goal Orientation Questionnaire (AGQ). In the last part of the student questionnaire include 14 science questions as a Science Achievement Test (SAT). The following sections include information about these questionnaires with more details.

Table 3.15 Data collection instruments for students and variables assessed

Instruments	Variables
Demographic Questionnaire	Gender Age Grade point average of last semester Socioeconomic status
MSLQ (Pintrich, Simith, Garcia, & McKeachie, 1991)	Self-efficacy Metacognitive self-regulation
WIHIC (Fraser, Fisher & McRobbie, 1996)	Student cohesiveness Teacher support Involvement Investigation Task orientation Cooperation Equity
AGQ (Elliot & McGregor, 2001)	Mastery approach Performance approach Mastery avoidance Performance avoidance
SAT	14 science questions

3.3.2.1 The Demographical Questionnaire-Student Level

The demographical questionnaire included 14 questions to assess students' some background characteristics, namely: age, gender, number of siblings, science grade point average, parents' employment status, parents' educational level, number of reading materials at home, frequency of buying a daily newspaper, presence of a separate study room, presence of a computer and an internet connection at home, and reasons for using computer. This information was indicators of students' socioeconomic status.

3.3.2.2 Motivated Strategies for Learning Questionnaire – Student Level

Students' self-efficacy and metacognitive self-regulation strategy use were measured by the two subscales of the Motivated Strategies for Learning Questionnaire (MSLQ). MSLQ was originally developed in English by Pintrich, Simith, Garcia, and McKeachie (1991) to assess college students' motivation in learning, and ability in using various learning strategies for a course. MSLQ consist of two distinct sections: Motivation and Learning Strategies. The Motivation section includes 31 items and consists of six factors: Intrinsic Goal Orientation, Extrinsic Goal Orientation, Task Value, Control of Learning Beliefs, Self-Efficacy for Learning and Performance, and Test Anxiety. On the other hand, the Learning Strategies section includes 50 items and consists of nine factors: Rehearsal, Elaboration, Organization, Critical Thinking, Metacognitive Self-Regulation, Time and Study Environment, Effort Regulation, Peer Learning, and Help Seeking. The instrument was constructed with a 7 point Likert type response scale ranging from 1 (not at all true of me) to 7 (very true of me).

Pintrich, Smith, Garcia and McKeachie (1993) conducted the reliability and validity analysis of MSLQ with 380 college students. The reliability coefficients were found to ranging from .62 to .93 and from 52 to .80 for the Motivation section and for the Learning Strategies section respectively. On the other hand, acceptable model fit for motivation section ($\chi 2/df = 3.49$, GFI = .77, AGFI = .73 RMR = .07) and for learning strategies section ($\chi 2/df = 2.26$, GFI = .78, AGFI = .75 RMR = .08) were found as a result of the confirmatory factor analysis.

The MSLQ was translated and adapted into Turkish by Sungur (2004). Sungur (2004) validated the Turkish form of the MSLQ with the data obtained from 488 high school student enrolled in biology course. Similar to the original English version of MSLQ, confirmatory factor analysis indicated acceptable model fit for motivation section ($\chi 2/df = 5.3$, GFI = .77, RMR = .11) as well as for learning strategies section ($\chi 2/df = 4.5$, GFI = .71, RMR = .08). Moreover, internal consistency coefficients of motivation section subscales were found as ranging from .54 to .89.and of learning strategies section factors were found as ranging from .57 to .81.

In this study, only Self-Efficacy for Learning and Performance subscale (8 items) from the six factor of the motivation section and only Metacognitive Self-Regulation subscale (12 items) from the nine factor of the learning strategies section were utilized. A confirmatory factor analysis was conducted to test the construct validity of each subscale/ Result of the CFA for Self-Efficacy for Learning and Performance subscale shoved good model fit to the data ($\chi^2_{(20)} = 1311.98$, $p < .05$; CFI = .99, GFI = .96, NFI = .99, NNFI = .98; SRMR = .03; RMSEA = .09; 90% CI = .087, .095). On the other hand, result of CFA indicated a problematic factor structure for Metacognitive Self-Regulation subscale. Although examination of fit indices showed good model fit ($\chi^2_{(54)} = 2150.50$, $p < .05$; CFI = .97, GFI = .96, NFI = .97, NNFI = .97; SRMR = .05; RMSEA = .07; 90% CI = .066, .071), detailed examination of the output pointed item1 and item8 as the sources of the problem: (1) the largest standardized residual was 35.34 between item1 and item8, (2) R^2 values for item1 and item8 were less than .03, while this value is greater than .35 for remained items, (3) item loadings for item1 and item8 were less than .18, while this value is greater than .56 for remained items, (4) modification indices suggested to add an error covariance between item1 and item8 with 1249 point decrease in Chi-square value and decrease factor reliability. Moreover, contrary to the other items, item1 and item8 were negatively worded items. Negatively worded items generally cause a problem when used with regular items and reverse coded (see Schriesheim & Eisenbach, 1995) and they adversely affect the validity of scales while used with elementary students (Benson & Hocevar, 1985). Therefore, these items were decided to be excluded from the scale and a new CFA was conducted to test the construct validity of Metacognitive Self-Regulation subscale for remained 10 items. Results indicated good model fit to the data ($\chi^2_{(35)}$ = 593.13, p < .05; CFI = .99, GFI = .98, NFI = .99, NNFI = .99; SRMR = .02; RMSEA = .05; 90% CI = .042, .048) and provided better fit indices than 12 item version of the scale.

Table 3.16 presents the description of these two factors of MSLQ, sample items and reliability coefficients. Additionally, the Lambda-X estimates of the scales are shown in Table 3.17.

Table 3.16 Description of the two factors of the MSLQ and sample items

Subscales	Description	Sample item	Cronbach's Alphas (Pintrich et al., 1991)	Cronbach's Alphas (Sungur, 2004)	Cronbach's Alphas (Current Study)
Self-efficacy for learning and performance	Students' expectancy for task performance and confidence in their ability to perform a task	I'm confident I can understand the basic concepts taught in this course	.93	.89	.93
Metacognitive self-regulation	How students plan, monitor, and regulate their learning process	Before I study new course material thoroughly, I often skim it to see how it is organized	.79	.81	.89 (10 items)

Source: Pintrich, Smith, Garcia & McKeachie, 1991

Table 3.17 Lambda-X estimates for two subscales of MSLQ

Subscale	Indicator	Present study LX estimates
Self-efficacy for learning and performance	q1	.81
	q2	.78
	q3	.81
	q4	.77
	q5	.72
	q6	.84
	q7	.82
	q8	.80
Metacognitive self-regulation	q2	.58
	q3	.68
	q4	.59
	q5	.65
	q6	.70
	q7	.65
	q9	.73
	q10	.74
	q11	.73
	q12	.61

While the previous studies using MSLQ were conducted with adults, Kahraman (2011) studied with seventh grade elementary school students and assessed their self-efficacy for learning and metacognitive self-regulation in science class through related subscales of MSLQ. Result of CFA revealed adequate model fit for self-efficacy for learning and performance subscale (RMSEA = .12, SRMR = .04, GFI = .94, CFI = .95) and for metacognitive self-regulation subscale (RMSEA = .08, SRMR = .02, GFI = .99, CFI = .99). Cronbach's alpha coefficients pointed out high reliability with the values of .89 and .87 for self-efficacy for learning and performance subscale, and for metacognitive self-regulation subscale respectively. Findings of Kahraman's (2011) study is comparably with this study.

3.3.2.3 What is Happening in This Class Questionnaire – Student Level

Learning environment in each classroom will be assessed by students' responses to the What Is Happening in This Class (WIHIC) questionnaire. WIHIC is originally developed by Fraser, Fisher and McRobbie (1996) as nine factor and 90 items. They constructed this initial form of WIHIC by both conducting statistical analysis through the data from 355 junior high school science students and interweaving with students (Fraser, 2002). The current 56-item seven-scale version was validated by Aldridge and Fraser (2000) with 1081 middle school students (grade 8-10) in 50 classes in Australia. Result of principle components factor analysis followed by varimax rotation indicated seven eight-item factor and each item loaded more than .40 to the relevant factor. Furthermore, Cronbach's alpha coefficients ranging from .81 to .93 for individual level and from .87 to .97 for class mean indicated sufficient internal consistency. Consequently, refined WIHIC questionnaire consist of 7 factor namely: student cohesiveness, teacher support, involvement, investigation, task orientation, cooperation, and equity. Each factor includes 8 items and WHICH include totally 56 items. To asses students' perception of learning environment, students are asked to rate each item based on 5-point Likert scale ranging from 1 (never) to 5 (always).

Telli, Cakıroglu and Brok (2006) translated and adapted WIHIC into Turkish. They studied validity and reliability of the questionnaire with 1983 ninth and tenth grade students in 57 biology classes. Reliability analysis of WIHIC was indicated reasonable internal consistency with Cronbach's alpha coefficient ranging from .75 to .88. Moreover, data support the same 8-item seven factor structure of WIHIC with the English version.

In this study, in order to test the construct validity of WIHIC for elementary students, a confirmatory analysis was conducted. Result of the CFA showed good model fit ($\chi^2_{(1463)}$ = 20259.31, $p < .05$; CFI = .98, GFI = .90, NFI = .98, NNFI = .98; SRMR = .04; RMSEA = .05; 90% CI = .045, .045). Internal consistencies of subscales ranged from .78 to .88. Thus, WIHIC can be regarded as providing valid and reliable information for elementary students. Description of each factor, sample items, and internal consistencies are untaken in Table 3.18. Table 3.19 presents the Lambda-X estimates for the latent factors of WIHIC.

Table 3.18 Description of the WIHIC and sample items

Factor	Description (The extent to which)	Sample item	Cronbach's Alphas (Aldridge &Fraser, 2000)*	Cronbach's Alphas (Telli, Cakıroglu & Brok 2006)	Cronbach's Alpha (Current Study)
Student Cohesiveness	"... students are friendly and supportive of each other"	I make friendships among students in this class	.81	.75	.78
Teacher Support	"... the teacher helps, befriends, and is interested in students"	The teacher takes a personal interest in me	.88	.86	.88
Involvement	"... students have attentive interest, participate in class and are involved with other students in assessing the viability of new ideas"	I discuss ideas in class	.84	.80	.86
Investigation	"... there is emphasis on the skills and of inquiry and their use in problem-solving and investigation"	I carry out investigations to test my ideas	.88	.86	.88
Task Orientation	"... it is important to complete planned activities and stay on the subject matter"	Getting a certain amount of work done is important to me	.88	.81	.81
Cooperation	"... students cooperate with each other during activities"	"I cooperate with other students when doing assignments work"	.89	.83	.84
Equity	"... the teacher treats students equally, including distributing praise, question distribution and opportunities to be included in discussions"	I have the same amount of say in this class as other students	.93	.88	.88

Source: den Brok, Telli, Cakiroglu, Taconis, & Tekkaya 2010, p. 191

* Reliability coefficients are reported for only Australian sample.

Table 3.19 Lambda-X estimates for subscales of WIHIC

Subscale	Indicator	Present study LX estimates
Student Cohesiveness	q1	.61
	q2	.46
	q3	.66
	q4	.51
	q5	.61
	q6	.55
	q7	.66
	q8	.46
Teacher Support	q9	.68
	q10	.62
	q11	.75
	q12	.73
	q13	.77
	q14	.79
	q15	.63
	q16	.62
Involvement	q17	.70
	q18	.69
	q19	.60
	q20	.71
	q21	.64
	q22	.69
	q23	.66
	q24	.61
Investigation	q25	.70
	q26	.60
	q27	.71
	q28	.66
	q29	.74
	q30	.74
	q31	.73
	q32	.69
Task Orientation	q33	.61
	q34	.35
	q35	.62
	q36	.61
	q37	.66
	q38	.67
	q39	.68
	q40	.62
Cooperation	q41	.63
	q42	.61
	q43	.53
	q44	.65
	q45	.55
	q46	.69
	q47	.70
	q48	.63

Table 3.19 (Continued)

Subscale	Indicator	Present study LX estimates
Equity	q49	.64
	q50	.68
	q51	.71
	q52	.72
	q53	.74
	q54	.68
	q55	.68
	q56	.68

3.3.2.4 Achievement Goal Questionnaire – Student Level

Students' Achievement Goal Questionnaire (AGQ), based on 2x2 achievement goal theory, was developed by Elliot and McGregor (2001) to assess students' achievement goal orientation in a specific course. The 15-item questionnaire consists of four factors: mastery approach (3 items), mastery avoidance (3 items), performance approach (3 items), and performance avoidance (6 items). Description of each factor and sample items were presented in Table 3.12. The response scale for all items is a 5-point Likert type scale ranging from 1 (not at all true of me) to 5 (very true of me).

In order to validate the AGQ, Elliot and McGregor (2001) conducted CFA and reliability analyses with the data obtained from 180 undergraduate students. Result of the CFA showed a good model fit ($\chi^2(48) = 60.49$, $p > .05$, RMSEA = .04, TLI = .99, CFI = .99). Moreover, Cronbach's alpha coefficients ranged from .83 to .92 indicated high internal consistency.

The GOQ was translated adapted into Turkish by Senler and Sungur (2007) to assess students' achievement goal orientation in science courses. In Turkish version of the questionnaire, the response scale for all items is a 5-point Likert type scale ranging from 1 (not at all true of me) to 5 (very true of me). Validity and reliability of Turkish version of the AGQ were tested with the data gathered from 616 middle school students. As a result of CFA, an acceptable fit was found for four factor structure of the AGQ (GFI = .92, CFI = .90, RMSEA = .06, SRMR = .07). Additionally, Cronbach's alpha ranged from .64 to .81 indicated sufficiently high reliability for four subscales of the Turkish version of AGQ.

In the present study, a CFA was conducted to test the 4-factor model structure of AGQ. Results indicated adequate model fit to the data ($\chi^2_{(84)}$ = 9848.47, $p < .05$; CFI = .95, GFI = .94, NFI = .95, NNFI = .94; SRMR = .07; RMSEA = .08; 90% CI = .075, .079). Internal consistencies of subscales ranged from .73 to .77. Thus, AGQ can be regarded as providing valid and reliable information for elementary students. Description of each factor of AGQ, sample items, and internal consistencies are untaken in Table 3.20. Table 3.21 presents the Lambda-X estimates for the latent factors of AGQ.

Table 3.20 Description of the AGQ and sample items

Factor	Description	Sample item	Cronbach's Alphas (Elliot & McGregor, 2001)	Cronbach's Alphas (Senler & Sungur, 2007)	Cronbach's Alphas (Current Study)
Mastery approach	Approaching success and valuing learning	"I want to learn as much as possible from this class"	.87	.81	.76
Performance approach	Approaching desirable possibilities	"It is important for me to do better than other students"	.92	.69	.73
Mastery avoidance	Avoiding failure and valuing learning	"I am often concerned that I may not learn all that there is to learn in class"	.99	.65	.73
Performance avoidance	Avoiding undesirable possibilities	"I just want to avoid doing poorly in this class"	.83	.65	.77

Table 3.21 Lambda-X estimates for subscales of AGQ

Subscale	Indicator	Present study LX estimates
Mastery Approach	q1	.71
	q4	.70
	q6	.74
Performance approach	q3	.67
	q8	.71
	q11	.69
Mastery avoidance	q7	.58
	q10	.75
	q12	.76
Performance avoidance	q2	.54
	q5	.63
	q9	.58
	q13	.57
	q14	.67
	q15	.58

3.3.2.5 Science Achievement Test – Student Level

In order to assess students' science achievement, a Science Achievement Test (SAT) was developed by the researcher and a graduate student. The questions were selected from the science tests of previous national exams (e. g. Secondary Education Entrance Examination and Government Complimentary Boarder and Scholar Examination to transition to high schools) that were administered by the Turkish Ministry of National Education in previous years (MONE, 2011). In order to validate the test, expert opinion was taken from a professor in elementary science education department in terms of relatedness of the questions to the instructional objectives, content validity, and format, and a pilot study was conducted with 183 seventh grade students.

Firstly, the units covered in the fall semester of the 7th grade were determined by examining the Turkish science curriculum. By considering the total class hours per units and number of instructional objectives, the average number of questions for each unit was calculated and instructional objectives were determined. The detailed information about units is included in Table 3.22.

Table 3.22 The subjects and topics for the first semester of the 7th grade in the science curriculum.

Unit	Body Systems	Force And Motion	Electricity
Subjects	Digestive System Excretory System Nervous and Endocrine System Sense Organs	Springs Work and Energy Types Of Energy And Energy Conversion Simple Machines Energy and Friction	Static Electricity Thunderbolt Electricity Current Measuring Current and Voltage Series and Parallel Bulb Circuits Short Circuit
Number of Objectives	27	31	32
Number of Class Hours	30	16	16

Based on the unit distributions, 14 objectives were specified and approximately 2 multiple choice questions selected from the previous exams corresponding to each objective. Totally, there were 27 questions included in the achievement test.

This 27-item achievement test was pilot tested in an elementary school that was randomly selected from the school list of Ankara. Test was administered in the spring semester of 2010-2011 and 183 seventh grade students participated in the study. Item analysis of the test was conducted by using ITEMAN program. The indices of discrimination and item difficulty levels (p) that obtained for 27-item test are represented in Table 3.23.

Table 3.23 The indices of discrimination and item difficulty levels (p) of items for initial version of the SAT.

Item	Index of discrimination	Item difficulty (p)
1	0.323	0.869
2	0.324	0.590
3	0.077	0.366
4	0.115	0.333
5	0.482	0.497
6	0.376	0.776
7	0.324	0.607
8	0.431	0.536
9	0.133	0.339
10	0.410	0.514
11	0.387	0.421
12	0.592	0.617
13	0.100	0.290
14	0.085	0.219
15	0.557	0.536
16	0.562	0.749
17	0.486	0.798
18	0.488	0.432
19	0.547	0.698
20	0.471	0.721
21	0.307	0.814
22	0.425	0.546
23	0.580	0.574
24	0.452	0.689
25	0.498	0.399
26	0.491	0.459
27	0.475	0.667

The index of discrimination is the indicator of the degree of differentiation between the examinees knowing the subject well and the others not knowing the subject (Crocker & Algina, 1986). Based on Ebel's (1965) criteria for the interpretation of index of discrimination, items were classified as in Table 3.24.

Table 3.24 Item discrimination criteria of Ebel (1965) and item classification of the current study

Index of discrimination	Item evaluation	Related items
0.40 and up	Very good item	5, 8, 10, 12, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27
0.30 to 0.39	Reasonable good but possibly subject to improvement	1, 2, 6, 7, 11, 21
0.20 to 0.29	Marginal item, usually needing and being subject to improvement	
Below 0.19	Poor item, to be rejected or improved by revision	3, 4, 9, 13, 14

Source: Ebel 1965, p.364

Applying Ebel's (1965) criteria, as shown in the table 3.15, items 5, 8, 10, 12, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, and 27 could be considered as good items and items 1,2,6,7,11,21 were acceptable without any revision. On the other hand, because the indices of discrimination were under the cut-off point .19, items 3, 4, 9, 13, 14 were decided to be removed from the test. Among the remaining items, by considering the index of discrimination and item difficulty, 1 item is determined for each instructional objective. Consequently, the last version of SAT was constructed by decreasing the total number of items from 27 to 14. (See Table 3.25)

Table 3.25 The index of discrimination and difficulty levels (p) of items for last version of the SAT.

Item	Answer key	Index of discrimination	Item difficulty (p)
1	D	0.323	0.869
2	A	0.482	0.497
3	C	0.410	0.514
4	A	0.376	0.776
5	C	0.592	0.617
6	D	0.557	0.536
7	D	0.562	0.749
8	C	0.425	0.546
9	B	0.580	0.574
10	D	0.486	0.798
11	D	0.488	0.432
12	C	0.498	0.399
13	C	0.491	0.459
14	B	0.475	0.667

The item difficulty level (p) is considered as the proportion of the correct responses to the total number of responses (Crocker & Algina, 1986). The higher values for the item difficulty are the indicator of the easy questions. It is regarded as better to construct a test with moderate difficulty level (Crocker & Algina, 1986). In this current study, items were classified in terms of item difficulty by considering cut-off points suggested by Sax (1997). Result of this classification revealed that most of the items were at moderate difficulty level (see Table 3.26).

Table 3.26 Item difficulty levels of final version of SAT

Evaluation	Item difficulty (p)	Related items
Easy	0.85-1.00	1
Moderate	0.50-0.84	3,4,5,6,7,8,10,11,14
Difficult	0.00-0.49	2,9,12,13

Source: Sax 1997

The reliability coefficient was computed by Kuder Richardson 20 (KR 20) formula was found to be 0.78, which pointed out the 14-item achievement test as sufficiently reliable. In Table 3.27, table of specification for SAT was presented.

Table 3.27 Table of specification for 14-item SAT

	Instructional Objectives	Cognitive processing in Bloom's taxonomy		
Content	At the end of the class, students will be able to:	Knowledge	Comprehension	Application
Body systems	Interprets chemical changes in digestion of nutrition.		13*	
	Matches digestive system organs with their functions on a given figure.		12	
	Matches urinary system organs with their functions on a given figure.		14	
	Describes functions of inner glands.	9		
	Exemplify hormone secretion in the human body.		10	
	Explain the role of sense organs in perceiving the environmental stimulus.		8	
	Identifies functions of sense organs.	11		
Force and motion	Predicts direction of force applied by the stretched and compressed springs.		5	
	Relate the physical work with the direction of the force applied on an object			7
	Displays transformations of potential energy and kinetic energy on a given figure.			3
	Relates magnitude of force applied on the lever with effort arm for balance position.			6
Electricity	Predict the charges of objects that push each other.		4	
	Compare the brightness of lamps in serial or parallel circuits.		1	
	Show how voltmeter and ammeter can be connected in a circuit on diagram.			2
Number of questions		2	8	4

* Item number

Accordingly, distribution of items across the content areas is as follows: 7 questions for body systems, 4 questions for force and motion, and 3 questions for electricity units. Students responses to the multiple choice SAT questions were utilized to assess their achievement in science. To calculate SAT scores, students' responses were recoded dichotomously (0: wrong answer, 1: correct answer) and total scores were computed for each student.

3.4 Data Collection Procedure

In this study, the initial step was determining the research problems. A broad literature review was performed in order to determine the research problem and theoretical framework, to explain the concepts that would be included in the study, and to examine the interrelationship among these concepts. Related literature was examined through Educational Resources Information Center (ERIC), Social Science Citation Index (SSCI), Ebscohost, Science Direct, and International Dissertations Abstracts databases. Moreover a lot of print and electronic books were obtained from METU, University of Alberta libraries and other libraries in city of Edmonton and Ankara. Afterwards, the research questions were specified.

The target population of this study was determined as all 7th grade students and science teachers in public elementary schools located in city centers of Turkey. After selecting 400 schools by randomly, some other procedures were followed to determine the teachers and students. Firstly, data were planned to be collected from 1 science teacher from each school and one of the 7^{th} grade classes which he or she teach. In case of some schools might have more than 1 science teacher teaching 7^{th} grades, one of them was asked to be determined as a participant by randomly. Afterwards, it was assumed that each class had approximately 25 students. Thus, the proposed sample size was 400 for teachers and 10,000 for students.

In the light of the related literature, the most appropriate instruments to assess the intended constructs were determined and the instruments were prepared for teachers and students separately. Because of the large student sample size that was planned to be accessed, optical forms were designed to make data entry easier and more precise. On the other hand, because of less number of teachers were planned to be participated in the study, teacher instruments were preferred to be in photocopy form.

Moreover, in order to predict the time needed to complete the instruments by students, they were administered in two classrooms that were randomly selected among the elementary schools in Ankara. It was observed that 1 class hour was enough to complete them.

In the data collection process, researcher cooperated with Ministry of Education, Education Research and Development Department (EARGED/EREDED). After permission of the Ethics community of METU was taken, the research procedure and instruments were deeply examined by EARGED and Elementary Education Department of Ministry of Education, and some adjustments were suggested. EARGED provided the delivery of instruments to the previously determined schools and their return. Data collection was carried out at the fall semester in the 2010-2011 academic year. Data return took approximately one month.

Instruments were sent schools through mail and an instruction paper about how the instruments to be administered was included in each envelope (see APPENDIX D). Instruments were asked to be administered to students by a teacher other than science teacher not to influence the response of the students. Additionally this instruction paper included the information about the purpose and confidentiality of the study.

Information about the purpose of the study was also included in student questionnaires. None of the participants were asked their names or other information about their identity. Moreover, since data were collected in students' real classrooms and questionnaires were examined by an ethics community and by elementary education Department of Ministry of Education, the harm for the students was also not an issue in this study. Approximately 50 minutes were suggested to be allocated for both teachers and students to respond to the questionnaires.

3.5 Data Analysis

The data analyses of the present study include preliminary analysis, descriptive statistics, and inferential statistics. In the first step, as preliminary analyses, data were checked in terms of missing values, outliers, and univariate and multivariate normality. Afterwards, descriptive statistics were checked out in terms of mean, standard deviation, skewness, and kurtosis of the variables to investigate teacher and student level factors with more details.

Regarding inferential statistics, two different analyses were conducted: confirmatory factor analysis and Hierarchical Linear Modelling (HLM). The confirmatory factor analyses were performed to ensure the expected factorial structures of each variable. On the other hand, a series of HLM analyses were performed to test the research questions regarding the extent to which the individual and class level independent variables predicted individual outcome variables, the unique variance each predictor explained, and the direct and moderator effects of class level predictors on individual outcome variables.

The preliminary analyses and descriptive statistic were performed by SPSS 19.0, and to conduct confirmatory factor analyses, LISREL 8.80 (Joreskog & Sorbom, 2006) for Windows with SIMPLIS command language was used. Furthermore, hierarchical linear models were tested through HLM 6.0 program.

3.6 Hierarchical Linear Modeling (HLM)

Hierarchical Linear modeling is a kind of regression analysis for multilevel data and used to investigate the relationships among variables derived from a sample from a hierarchical population. Although, HLM can also be used for longitudinal research and meta-analysis, since these are not the scope of this study, for simplicity HLM is described just for individuals nested within groups in this study.

Population studied in the social research commonly in hierarchical structure: individuals are nested within groups and these individuals and groups are regarded as separate levels of a hierarchical system (Hox, 2010). In an educational study students can be nested within class, school, district, etc. In these groups students have some common factors to be affected such as teacher, classroom environment school policies, etc., and students' response pattern in a specific group tends to be similar to one another while comparing the students' from other group and error terms tends to be correlated. Therefore, responses of the students in a group could not be considered as independent. Considering students' responses in a nested structure prevents obtaining biased estimate of standard errors and interpreting misleading results derived by the statistical test that used these biased standard errors. For instance, if ordinary least square (OLS) regression analysis is used to analyze a nested data with correlated error terms, analysis computes smaller standard errors than it should be. In turn, this situation increases the chance of Type 1 errors. Unlike single level OLS models which assume the observations (in turn, the error terms) are independent from each other, HLM takes into account this clustering effect to predict outcome variable better.

Because of the nested structure of the sample of this study, HLM was selected as a statistical modeling technique to analyze the data set nested in two levels: student level (level-1) data nested within the class (level-2) thought by a specific science teacher. The summary and description of level-1 and level-2 variables are exhibited in Table 3.28.

In hierarchical modeling, population can be in any level, for example students nested in schools, schools nested in districts, districts nested in cities and goes on. In this example, students represent level-1, schools represent level-2 and districts represent level 3. Although in HLM analysis, outcome variable is measured at the lowest level, predictor variables can be at all the existing levels (Hox, 2010, p.7). Since two-level HLM analysis was used in this study, explanation of the statistical features of HLM analysis in this section is limited with two-level models.

A two-level model, in general form, can be represented as:

For level-1 model,

$Y_{ij} = \beta_{0j} + \beta_{1j}X_{1ij} + \beta_{2ij}X_{2ij} + \cdots + \beta_{Qj}X_{Qij} + r_{ij}$

$= \beta_{0j} + \sum_{q=1}^{Q} \beta_{qj}X_{qij} + r_{ij},$

where

$j = 1, \ldots, J$: Index for groups;

$i = 1, \ldots, n_j$: Index for level 1 units nested within j level 2 unit. That is, student I nested within group j;

Y: outcome variable;

β_{qj}: Level-1 coefficients. It can be fixed or random. (q = 0, 1, …, Q);

X_{qij}: Level-1 predictor variable. (q = 0, 1, …, Q);

r_{ij}: Level-1 random effect; and

σ^2: Level-1 variance (Raudenbush & Bryk, 2002).

For level-2 model,

$\beta_{qj} = \gamma_{q0} + \gamma_{q1}W_{1j} + \gamma_{q2}W_{2j} + \cdots + \gamma_{qSq}W_{Sqj} + u_{qj}$

$= \gamma_{q0} + \sum_{s=1}^{Sq} \gamma_{qs}W_{sj} + u_{qj},$

where

γ_{qs}: Level-2 coefficients. They are also called as fixed effects. γ_{00}, indicates the grand mean. (q=0, 1, 2, …, S_q);

W_{sj}: Level-2 predictor variables;

u_{qj}: Level-2 random effect; and

τ_{qq}: Level-2 variance-covariance components. In other words, it is the variance of u_{qj} (Raudenbush & Bryk, 2002).

The following key assumptions of HLM ensure the validity of inferences, accuracy of parameter estimations, and adequacy of model specification (Raudenbush & Bryk, 2002; p.255):

1) Conditional on the level-1 variables, the within group errors (r_{ij}) are normally distributed and independent with a mean of 0 in each group and equal variances (σ^2) across groups.
2) Whatever level-l predictors of the outcome variable that are excluded from the model and thereby relegated to the error term (r_{ij}) are independent of the level-1 predictors included in the model [i.e., Cov(X_{qij}, r_{ij}) = 0 for all q].
3) Level-2 random errors are independent among level-2 units and have a multivariate normal distribution, each with a mean of 0.
4) The effects of any level-2 predictors that are excluded from the model for the intercept and slopes are independent of other level-2 variables [i.e., for every W_{sj} and U_{qj}, Cov(W_{sj}, U_{qj}) = 0].
5) The level-1 errors and the level-2 errors are uncorrelated [i.e., Cov(r_{ij}, U_{qj}) = 0 for all q].
6) The predictors at each level are not correlated with the random errors at the other level (Raudenbush & Bryk, 2002; p.255).

3.7 Variables and Descriptions

The explicit descriptions of the level-1 and level-2 variables are presented in Table 3.28. All average scores were computed based on the result of the factor analyses and variables were derived by getting mean scores of respective indicators.

In this study, there are 15 variables at level-1 and 9 variables at level-2. While most of the variables at level 1 were used as both outcome and predictor variables in separate analyses depending on research questions, level-2 variables can only be used as predictor variables.

Table 3.28 Description of the variables that are used in HLM analysis.

Variable name	Variable Description	Variable Type
Student Level Variables (Level-1)		
S_FEMALE	Gender of the students. A dummy coded variable 0 = Male, 1 = Female	Predictor
ZSAS*	Science Achievement Score. Continuous variable. A total score was computed from 14 science questions in the science achievement test. Correct answers coded as 1 and incorrect answers coded as 0 for each question. Possible total scores from the science achievement test could be within the range between 0 and 14. (see Appendix B for science achievement test)	Outcome
ZSSE*	Self-Efficacy for Learning and Performance. Composite variable that was computed by averaging students' responses to 8 items (Q1, Q2, Q3, Q4, Q5, Q6, Q7, and Q8). Possible mean scores for this variable can be within the range between 1 and 7 (see Appendix A, student questionnaire, section B.1.a).	Outcome, Predictor
ZSMC*	Metacognitive Self-Regulation. Composite variable that was computed by averaging students' responses to 10 items (Q2, Q3, Q4, Q5, Q6, Q7, Q9, Q10, Q11, and Q12). Possible mean scores for this variable can be within the range between 1 and 7 (see Appendix A, student questionnaire, section B.1.b).	Outcome, Predictor
ZSWHSC*	Perception of Learning Environment- Student Cohesiveness Composite variable that was computed by averaging students' responses to 8 items (Q1, Q2, Q3, Q4, Q5, Q6, Q7, and Q8). Possible mean scores for this variable can be within the range between 1 and 5 (see Appendix A, student questionnaire, section B.2).	Outcome, Predictor
ZSWHTS*	Perception of Learning Environment -.Teacher Support. Composite variable that was computed by averaging students' responses to 8 items (Q9, Q10, Q11, Q12, Q13, Q14, Q15, and Q16). Possible mean scores for this variable can be within the range between 1 and 5 (see Appendix A, student questionnaire, section B.2).	Outcome, Predictor

Table 3.28 (Continued)

Variable name	Variable Description	Variable Type
ZSWHINVO*	Perception of Learning Environment – Involvement. Composite variable that was computed by averaging students' responses to 8 items (Q17, Q18, Q19, Q20, Q21, Q22, Q23, and Q24). Possible mean scores for this variable can be within the range between 1 and 5 (see Appendix A, student questionnaire, section B.2).	Outcome, Predictor
ZSWHINVE*	Perception of Learning Environment – Investigation. Composite variable that was computed by averaging students' responses to 8 items (Q25, Q26, Q27, Q28, Q29, Q30, Q31, and Q32). Possible mean scores for this variable can be within the range between 1 and 5 (see Appendix A, student questionnaire, section B.2).	Outcome, Predictor
ZSWHTO*	Perception of Learning Environment – Task Orientation. Composite variable that was computed by averaging students' responses to 8 items (Q33, Q34, Q35, Q36, Q37, Q38, Q39, and Q40). Possible mean scores for this variable can be within the range between 1 and 5 (see Appendix A, student questionnaire, section B.2).	Outcome, Predictor
ZSWHCOOP*	Perception of Learning Environment – Cooperation. Composite variable that was computed by averaging students' responses to 8 items (Q41, Q42, Q43, Q44, Q45, Q46, Q47, and Q48). Possible mean scores for this variable can be within the range between 1 and 5 (see Appendix A, student questionnaire, section B.2).	Outcome, Predictor
ZSWHEQU*	Perception of Learning Environment – Equality. Composite variable that was computed by averaging students' responses to 8 items (Q49, Q50, Q51, Q52, Q53, Q54, Q55, and Q56). Possible mean scores for this variable can be within the range between 1 and 5 (see Appendix A, student questionnaire, section B.2).	Outcome, Predictor
ZSGOMAP*	Achievement Goal Orientation – Mastery Approach. Composite variable that was computed by averaging students' responses to 3 items (Q1, Q4, and Q6). Possible mean scores for this variable can be within the range between 1 and 5 (see Appendix A, student questionnaire, section B.3).	Outcome, Predictor
ZSGOPAP*	Achievement Goal Orientation –Performance Approach. Composite variable that was computed by averaging students' responses to 3 items (Q3, Q8, and Q11). Possible mean scores for this variable can be within the range between 1 and 5 (see Appendix A, student questionnaire, section B.3).	Outcome, Predictor
ZSGOMAV*	Achievement Goal Orientation – Mastery Avoidance. Composite variable that was computed by averaging students' responses to 3 items (Q7, Q10, and Q12). Possible mean scores for this variable can be within the range between 1 and 5 (see Appendix A, student questionnaire, section B.3).	Outcome, Predictor
ZSGOPAV*	Achievement Goal Orientation –Performance Avoidance. Composite variable that was computed by averaging students' responses to 6 items (Q2, Q5, Q9, Q13, Q14, and Q15). Possible mean scores for this variable can be within the range between 1 and 5 (see Appendix A, student questionnaire, section B.3).	Outcome, Predictor

Table 3.28 (Continued)

Variable name	Variable Description	Variable Type
Class Level Variables (Level-2)		
T_FEMALE	Gender of the teacher. A dummy coded variable 0 = Male, 1 = Female	Predictor
ZT_EXPER*	Experience. Continuous variable representing teachers' years of experience in teaching.	Predictor
ZTSESE*	Teacher Sense of Efficacy for Student Engagement. Composite variable that was computed by averaging teachers' responses to 4 items (Q2, Q3, Q4, and Q11). Possible mean scores for this variable can be within the range between 1 and 9 (see Appendix C, teacher questionnaire, section B.1).	Predictor
ZTSEIS*	Teacher Sense of Efficacy for Instructional Strategies. Composite variable that was computed by averaging teachers' responses to 4 items (Q5, Q9, Q10, and Q12). Possible mean scores for this variable can be within the range between 1 and 9 (see Appendix C, Appendix C, teacher questionnaire, section B.1).	Predictor
ZTSECM*	Teacher Sense of Efficacy for Classroom Management. Composite variable that was computed by averaging teachers' responses to 4 items. (Q1, Q6, Q17, and Q8). Possible mean scores for this variable can be within the range between 1 and 9 (see Appendix C, teacher questionnaire, section B.1).	Predictor
ZTJS*	Teacher Job Satisfaction. Composite variable that was computed by averaging teachers' responses to items. (Q1, Q2 and reverse coded Q3). Possible mean scores for this variable can be within the range between 1 and 5 (see Appendix C, teacher questionnaire, section B.5).	Predictor
ZTBUEE*	Teacher Burnout – Emotional Exhaustion Composite variable that was computed by averaging teachers' responses to 9 items (Q1, Q2, Q3, Q5, Q7, Q10, Q11, Q12, and Q16). Possible mean scores for this variable can be within the range between 0 and 4 (see Appendix C, teacher questionnaire, section B.4).	Predictor
ZBUPA*	Teacher Burnout – Personal Accomplishment Composite variable that was computed by averaging teachers' responses to 8 items (Q4, Q6, Q8, Q9, Q13, Q14, Q15, and Q17). Possible mean scores for this variable can be within the range between 0 and 4 (see Appendix C, teacher questionnaire, section B.4).	Predictor
ZTITSA*	Teachers' believes about students' ability in science - Implicit Theories of Science Ability. Composite variable that was computed by averaging teachers' responses to 3 items (Q1, Q2, and Q4). Possible mean scores for this variable can be within the range between 0 and 6 (see Appendix C, teacher questionnaire, section B.2).	Predictor

* Variable was standardized to mean = 0 and SD = 1 before conducting HLM analysis.

3.8 Threats to Internal Validity of the Study

In social studies, in order to ensure the internal validity, it is important to eliminate the external variables that may affect the observed relationships among the variables. Frankel and Wallen (2003) determined the situations that could affect the internal validity of a study as location, mortality, subject characteristics, instrumentation, testing, history, maturation, attitude of subjects, implementation, and regression.

In this study, firstly, instruments were administered to students by different teachers. However, teachers were sent an implementation guide to administer instruments. Teachers were informed about the process of instruments' administration to the students, and instruments were asked to be administered by a teacher other than science teacher. This may help decreasing the implementation threat but if the instruments were administered by science teachers, this might cause data collector characteristics threat to affect the internal validity. On the other hand, students and science teachers give their responses to the Likert type scales and multiple choice test questions, and this situation provided the objectivity in scoring. Therefore, instrument decay was not a threat for the internal validity.

Secondly, subject characteristics could be a threat for student and teacher data, because it is not possible to control variety of characteristics. However, some of the sample characteristics asked in the demographic questionnaires were planned to be controlled in the analysis process. Moreover, being participate in a study might affect subjects' responses or cause bias. They also might tend to give favorable responses. Therefore, attitude of subjects could be a threat for internal validity of this study. On the other hand, since this study is not an experimental study and there was no manipulation, maturation was not considered as a threat.

By considering the subject loses, before the study, sample size was determined large enough. Therefore mortality is not a threat for this study. All participants were tested in their regular classroom environment. Thus, location might not an important internal threat of internal validity. Additionally, since samples were randomly selected and no specific extreme groups were the primary interest of this study, regressions was not expected to be a threat.

Testing could be a threat to internal validity for student data, because; questions in the achievement test were selected from national exams practiced in previous years. Although there is a possibility that students solve the same questions before, they are from the first semester's units and students might have forgotten them.

Lastly, since there might be some unexpected situation occurred before the implementation of the instruments, history could be a threat of the internal validity of this study.

3.9 Assumptions

1. The data collectors were not biased during the study.

2. The participants of the study were respond to the items of the instruments and test seriously.

3. The instruments and the test were administered under the standard conditions.

4. The participant students did not interact with each other during the administration of instruments.

3.10 Limitations

There would be several limitations to this study. First of all, measurement of the variables was mostly based on self-report questionnaires. Therefore, it is assumed that the participants gave careful attention to each item in the questionnaires, and their responses were honest and based on their own personal beliefs and opinions rather than on what they believe to be acceptable. Also, it is assumed that the participants' beliefs and opinions truly measured using the selected self-report questionnaires. Additionally, this is a cross-sectional study. In order to examine cause and affect relationships, it is suggested that future studies investigate changes in students' science achievement in relation to teacher level and student level variables across time using a longitudinal design.

3.11 Elementary Science Education in Turkey

Science education is one of the main focuses of the elementary education in Turkey. Therefore increasing students' knowledge, affect, and skills in science would be an important step to reach educational goals. Althought the fundamental changes in Turkish elementary curriculum have taken place in 2005, in March 2012, with the extention of the compulsory education from 8 years to 12 years (4 years of elementary education, 4 years of middle school education, and 4 years of high school education), some editional changes in science curriculum have taken place. The new curriculum has begun to be practiced in September 2013 (MONE, 2013). When the present study was conducted (spring term of 2010-2011 academic year), the previous curriculum was being practiced. According to that curriculum, elementary school had 2 levels: the first level included grades from 1 to 5 and the second level included grades from 6 to 8. Students used to start to take science course at 4th grade and than theys continue to take science course each year up to 8th grade. The weekly course hours were 4 hours. The elementary science curriculum was mainly developed by considering the science curriculums of developed countries and by adapting them to Turkish context. Additionally, the cultural and socioeconomic status in the different reagons of Turkey has also been taken into eaccount. By using spiral approach, 7 learning area of science has been focused in the curriculum: (1) Living Things (2) Matter and Change (3) Physical Events (4) Earth and Universe, (5) Science-Technology-Society-Environment, (6) Science Process Skills, and (7) Attitudes and values. In the present study, science topics of the first semester of 7th grade were adressed to assess 7th graders science achievement and its relations with their self-regulation skills that are used in science class and their perceptions of science class' learning environment were examined to shed light on the issue of elementary students' learning science.

CHAPTER IV

RESULTS

In this chapter of the dissertation results were presented as two main sections: (1) Preliminary analyses and (2) Hierarchical Linear Modeling Analyses. In Preliminary Studies section, treatment of missing values and outliers, descriptive statistics of the student level (level-1) and class level (level-2) variables, and bivariate correlations for student variables and for teacher variables were presented. In hierarchical linear modeling analyses part, results of a series of hierarchical linear models that were built to test the related research questions were presented.

4.1 Preliminary Analyses

This section includes treatment of missing values and outliers, descriptive statistics of the student level (level-1) and class level (level-2) variables, and bivariate correlations for student variables and for teacher variable.

4.1.1 Treatment of Missing Values

Because of the complex and large-scale survey design of the current study, missing values were inevitable and should be addressed before performing any statistical analysis. In HLM analysis parameter estimates are based on complete cases. Thus, in this study, missing values were examined separately for student level (level-1) and class level (level-2, obtained from teachers) variables. The amount of the missing values for each variable did not exceed 3.3% and 2.4% in student and teacher data, respectively. Tabachnick and Fidel (2007) suggested that any method for altering missing data yields the similar result, if the amount of missing at random is less than

5%. Although, there are a few different methods suggested by statisticians, multiple imputation method as a model-based imputation method takes greater advantage of the structure in the data compared with other methods (see Kline, 2005; p.56). Therefore, in this study, missing values in continuous variables were handled by using multiple imputation method through LISREL 8.80 (Joreskog & Sorbom, 2006). On the other hand, missing values in student gender and teacher gender variables were not replaced and kept as they were in the data sets.

4.1.2 Outliers

Data were examined in terms of univariate and bivariate outliers to reduce the effect of the extreme scores on the accuracy of parameter estimations. Although there were some outliers scores in the student and teacher data sets, examination of Cook's distance values less than 1 indicated that these outliers were not influential. Despite the fact that all teacher and students variables could be retained based on these results, 50 students who had highest mahalanobis distance value were decided to be excluded from the data in order to increase the authenticity of the inferences derived from the HLM analysis.

4.1.3 Descriptive statistics

Descriptive information for the student level (level-1) and classroom level (level-2) variables were presented in Table 4.1 and Table 4.2, respectively. These descriptives included minimum and maximum scores, means, standard deviations, variances, skewness, and kurtosis values.

Regarding the student variables, firstly, the mean score from science achievement test (M=8.79, SD=3.36) indicated that in average students were able to answer correctly 8 of 14 science questions.

Mean scores of students responses on 7-point self-efficacy and metacognitive self-regulation strategies subscales of MSLQ showed that 7th grade students had high level of confidence in learning science topics (M = 5.23, SD = 1.27) and tend to use metacognitive strategies in learning science topics at high levels (M = 5.07, SD = 1.22). Considering learning environment, although average student responses on each subscale were around the midpoint 4, their perception of teacher support (M = 3.61, SD = 0.91) and investigation (M = 3.63, SD = .86) had lowest averages among 7 subscales of learning environment scale. On the other hand, students perceived relatively high level of task orientation (M = 4.25, SD = .63) and student cohesiveness (M = 4.04, SD = .64). Descriptive statistics suggested that students perceived their learning environment as highly task oriented, cohesive, and equitable, but less teacher supportive and encouraging investigation. Furthermore, standard deviations showed that student disagreed mostly on teacher support.

Finally, students' response on the subscales of achievement goal orientation scale showed that while the mean score of mastery approach goals (M = 4.52, SD = .65) was the highest, the mean score of mastery avoidance goals (M = 3.74, SD = .99) was the lowest. Thus it can be inferred that 7th grade students tend to set goals in science course as mastering task and deep understanding rather than avoiding from misunderstanding and not be able to mastering the task. Looking at the standard deviations, it seems that the range of the students responses were higher in mastery avoidance goals.

Skewness and kurtosis values for each variables also displayed in table 4. 1. Results indicated that all student variables except mastery approach goals were within the range -2 and +2 which is also suggested as acceptable for normal distribution (George & Mallery, 2003).

Table 4.1 Descriptive statistics for student variables

Student Variables (Level-1)	Min.	Max.	M	SD	Variance	Skewness	Kurtosis
ZSAS (Science Achievement Score)	0	14	8.79	3.36	11.30	-.27	-.88
ZSSE (Self-Efficacy)	1	7	5.23	1.27	1.61	-.61	-.40
ZSMC (Metacognitive Self-Regulation)	1	7	5.07	1.22	1.49	-.57	-.30
ZSWHSC (Student Cohesiveness)	1	5	4.04	.64	.41	-.92	.88
ZSWHTS (Teacher Support)	1	5	3.61	.91	.84	-.59	-.27
ZSWHINVO (Involvement)	1	5	3.74	.82	.67	-.59	-.14
ZSWHINVE (Investigation)	1	5	3.63	.86	.74	-.47	-.29
ZSWHTO (Task Orientation)	1	5	4.25	.63	.39	-1.18	1.49
ZSWHCOOP (Cooperation)	1	5	3.78	.77	.59	-.54	-.06
ZSWHEQU (Equality)	1	5	3.99	.83	.69	-.89	.43
ZSGOMAP (Mastery Approach Goals)	1	5	4.53	.65	.43	-1.70	2.94
ZSGOPAP (Performance Approach Goals)	1	5	4.35	.76	.58	-1.36	1.69
ZSGOMAV (Mastery Avoidance Goals)	1	5	3.74	.99	.99	-.67	-.18
ZSGOPAV (Performance Avoidance Goals)	1	5	3.97	.81	.65	-.87	.42

Considering teacher variables, descriptive statistics firstly showed that science teachers who were enrolled in this study had teaching experience between 1 and 38 years (M = 12.07, SD = 8.69).

Science teachers rated their efficacy beliefs in student engagement, instructional strategies, and classroom management on 9-point scale. Science teachers had highest mean score on efficacy for instructional strategies (M = 7.40, SD = .94). Additionally,, mean scores for student engagement (M = 6.52, SD = 1.09) and classroom management (M = 6.99, SD = 1.08) were also above the midpoint 5. These findings implied that science teachers had high confidence in using instructional strategies effectively, managing classroom appropriately, and engaging students in learning science.

Furthermore, mean scores obtained from job satisfaction (M = 4.11, SD = .94), emotional exhaustion (M = 1.37, SD = .75) and personal accomplishment (M = 3.16, SD = .43) scales implied that science teachers had high level of satisfaction from their work and feel successful in job, while they reported low level of emotional exhaustion. These findings suggested that, Turkish science teachers experienced high level of occupational well-being.

Finally, mean score for implicit theories of science ability scale (M = 4.08, SD = 1.22) was slight above the midpoint of 6-point scale. Findings indicated that Turkish science teachers moderately believe that people's ability in science is not fixed and can be enhanced.

Table 4.2 Descriptive statistics for teacher variables

Teacher Variables (Level-1)	Min.	Max.	M	SD	Variance	Skewness	Kurtosis
ZT_EXPER (Years of Teaching)	1.00	38.00	12.07	8.69	75.58	.79	-.12
ZTSESE (Efficacy for Student Engagement)	2.50	9.00	6.52	1.09	1.18	-.33	.54
ZTSEIS (Efficacy for Instructional Strategies)	3.75	9.00	7.40	.94	.89	-.44	.16
ZTSECM (Efficacy for Classroom Management)	2.50	9.00	6.99	1.08	1.17	-.66	1.08
ZTJS (Job Satisfaction)	1.00	5.00	4.11	.943	.89	-1.29	1.33
ZTBUEE (Emotional Exhaustion)	.00	4.00	1.37	.746	.56	.61	.32
ZBUPA (Personal Accomplishment)	1.50	4.00	3.16	.428	.18	-.36	.37
ZTITSA(Implicit Theory of Scıence Ability)	1.00	6.00	4.08	1.22	1.49	-.48	-.63

4.1.4 Bivariate Correlations for Student and Teacher Variables

Two different correlation analyses were conducted for student and teacher variables. The first bivariate correlation analysis was performed to investigate the relationship among 7th grade students' gender, perception of learning environment and self-regulation. Secondly, another bivariate correlation analysis was conducted to test the relations among teachers' gender, burnout, efficacy beliefs, job satisfaction, and beliefs about science ability. Results of these analyses were reported in Table 4.3 and Table 4.4, respectively.

Among student variables, the highest positive correlations were found between the *Self-Efficacy* and *Metacognitive Self-Regulation* (r = .71)*; Investigation* and *Involvement* (r = .67); and *Involvement* and *Teacher support* (r = .63). On the other hand, the lowest but significant correlations were found between *Gender* and *Student Cohesiveness* (r = .03); *Gender* and Science Achievement (r = .04); Performance avoidance and *Science Achievement* (r = .04); *Metacognitive Self-Regulation* and *Mastery Avoidance Goals* (r = .04). However, since the sample size was too large (8198 students), trivial results might be found as significant in bivariate correlation analysis.

Moreover, among the teacher variables, the highest significant correlations were found between the *Emotional Exhaustion* and *Job Satisfaction* (r = - .68); E*fficacy for Student Engagement* and *Efficacy for Classroom Management* (r = .64); and *Efficacy for Student Engagement* and *Efficacy for Instructional Strategies* (r = .63). On the other hand, the lowest significant correlations were found between the *Experience* and P*ersonal Accomplishment* (r= .12); *Self-Efficacy* and *Implicit Theory of Science Ability* (r = .12); and *Experience* and *Efficacy for Classroom Management* (r = .13).

Table 4.3 Intercorrelations among the student variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. ZSSE	1													
2. ZSMC	.71**	1												
3. ZSWHSC	.34**	.36**	1											
4. ZSWHTS	.41**	.41**	.44**	1										
5. ZSWHINVO	.49**	.48**	.56**	.63**	1									
6. ZSWHINVE	.48**	.56**	.47**	.55**	.67**	1								
7. ZSWHTO	.57**	.58**	.45**	.47**	.55**	.58**	1							
8. ZSWHCOOP	.35**	.40**	.58**	.48**	.60**	.60**	.52*	1						
9. ZSWHEQU	.46**	.45**	.44**	.59**	.59**	.53**	.57**	.56**	1					
10. ZSGOMAP	.54**	.52**	.34**	.36**	.40**	.41**	.63**	.36**	.46**	1				
11. ZSGOPAP	.36**	.36**	.24**	.24**	.29**	.29**	.45**	.28**	.31**	.53**	1			
12. ZSGOMAV	.04**	.13**	.15**	.10**	.13**	.15**	.19**	.21**	.15**	.25**	.29**	1		
13. ZSGOPAV	.18**	.24**	.23**	.19**	.22**	.24**	.32**	.29**	.25**	.35**	.54**	.54**	1	
14. ZSAS	.44**	.31**	.17**	.19**	.25**	.19**	.30**	.18**	.23**	.31**	.18**	.00	.04**	1

**p<.001

Table 4.4 Intercorrelations among the teacher variables

	1	2.	3.	4.	4.	6.	7.	8.
1. ZT_EXPER	1							
2. ZTSESE	.09	1						
3. ZTSEIS	-.04	.63**	1					
4. ZTSECM	.13*	.64**	.59**	1				
5. ZTJS	.18**	.25**	.16**	.25**	1			
6. ZTBUEE	-.08	-.19**	-.15**	-.23**	-.68**	1		
7. ZBUPA	.12*	.51**	.47**	.44**	.38**	-.30**	1	
8. TITSA	.02	.12*	.07	.04	.16**	-.14**	.08	1

* p<.05, **p<.001

4.2 Hierarchical linear Modeling (HLM) Analyses

This chapter of the dissertation is devoted to the presentation of the result of a series of HLM analyses which addressed to related research questions.

Prior to conduct HLM analyses, all continuous variables were standardized by using z scores (M=0, SD=1). Although standardization of scores in regression based analyses is criticized (see Pedhazur, 1997), it provides advantage for readers when comparing predictor variables. Since scores in this study, were standardized to z scores, coefficients should be interpreted as standard deviation units, similar to the interpretation of a beta in a traditional ordinary least squares regression.

4.2.1 Results of the Research Question 1: Students' Perceptions of Learning Environment

The first set of HLM analyses were conducted to test the research questions focusing on students' perceptions of learning environment:

1 The first research question consisted of 2 sub-questions:

1.a. To what extent do students in different classes vary in perception of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity*)?

1.b. To what extent do class (teacher) level variables (i.e., *Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment,* and *Implicit Theory of Ability in Science*) predict students' perceptions of the each dimensions of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity*)?

4.2.1.1 Results of Research Question 1.a: One-Way Random Effects ANOVA Model

Research question 1.a was tested through One-Way Random Effects Analysis of Variance Model, which is the baseline model in building multilevel models and has no level-1 and level-2 variables. It provides information about the amount of variation in the outcome lies within and between classes in terms of Intra-Class Correlation Coefficient (ICC) and about the reliability of the estimation of true class means (Raudenbush & Bryk, 2002).

The regression equation addressing this research question is as follows:

Student level (level-1) model:

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

Class-level (level-2) model:

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

In these models,

Y_{ij} is the outcome variable (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity*)

β_{0j} is regression intercept of class j, that is, class mean on outcome variable.

γ_{00} is the grand mean, that is, overall average score of outcome variable for all classes.

r_{ij} is the random effect of student i in class j.

u_{0j} is the random effect of class j.

Since classroom learning environment includes 7 dimensions such as *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity*, 7 separate One-Way random effects ANOVA models were built by using each dimension of classroom learning environment as an outcome variable. The final estimations of fixed effects and random effects obtained from ANOVA models were presented in Table 4.5 and Table 4.6, respectively.

Maximum likelihood estimations of variance components obtained from one-way random effects ANOVA models showed that all variance components at class level (τ_{00}) were statistically significant, where τ_{00} is the variance of the true class means,

β_{0j}, around the grand-mean, γ_{00}. That is, there were considerable amount of variation among class means for *Student Cohesiveness* (τ_{00} = .068, χ^2= 972.70, df = 371, p<.001), *Teacher Support* (τ_{00} = .119 χ^2 = 1493.43, df = 371, p<.001), *Involvement* (τ_{00} = .064, χ^2= 933.90, df = 371, p<.001), *Investigation* (τ_{00} = .081, χ^2= 1096.53, df = 371, p<.001), *Task Orientation* (τ_{00} = .063, χ^2= 938.16, df=371, p<.001), *Cooperation* (τ_{00} = .085, χ^2= 1149.52, df = 371, p<.001), and *Equity* (τ_{00} = .081, χ^2= 1100.70, df = 371, p<.001). Therefore, conducting HLM analyses for this data set is appropriate.

The Intra-class Correlation (ICC) can be interpreted as an indication of the proportion of the variance at the second level and as the expected (population) correlation between two randomly selected students within the same class (Hox, 2010). ICC is calculated as (Raudenbush & Bryk, 2002; p.71):

$$\rho = \tau_{00}/(\tau_{00} + \sigma^2).$$

For example, for student cohesiveness, ICC was calculated as:

$$ICC_{student\ cohesiveness} = \rho = \frac{0.068}{0.068 + 0.920} = 0.07$$

ICC’s for 7 dimensions of learning environment are presented in Table 4.5. In this study, ICC’s indicated that 7% of the total variance in *Student Cohesiveness*, 12% of the total variance in *Teacher Support*, 7% of the total variance in *Involvement*, 8% of the total variance in *Investigation*, 7% of the total variance in *Task Orientation*, 9% of the total variance in *Cooperation,* and 7% of the total variance in *Equity* were accounted for by the between-group variance.

Additionally, one-way random effects ANOVA models also provide reliability estimate which is obtained by averaging all class reliabilities. In multilevel models, reliability statistics indicate how well the sample means serve as indicators of the true group means and reliability increases when sample size within each groups increases (Raudenbush & Bryk, 2002; p.72). Reliability is calculated as:

$$\lambda_j = \tau_{00}/(\tau_{00} + \sigma^2/n_j).$$

In this study, as presented in Table 4.6, the reliability statistics for the outcome variables in one-way random effects ANOVA model were moderately high, ranging from .59 to .74.

Table 4.5 Final Estimation of Fixed Effects for Classroom Learning Environment Dimensions: One-Way Random Effects ANOVA Model

Fixed Effects	Coefficient	SE
ZSWHSC (Student Cohesiveness) Average class mean, γ_{00}	.010	.017
ZSWHTS (Teacher Support) Average class mean, γ_{00}	.010	.021
ZSWHINVO (Involvement) Average class mean, γ_{00}	.010	.017
ZSWHINVE (Investigation) Average class mean, γ_{00}	.012	.018
ZSWHTO (Task Orientation) Average class mean, γ_{00}	.007	.017
ZSWHCOOP (Cooperation) Average class mean, γ_{00}	.013	.019
ZSWHEQU (Equality) Average class mean, γ_{00}	.011	.018

Table 4.6 Final Estimation of Variance Components for Classroom Learning Environment Dimensions: One-Way Random Effects ANOVA Model

Random Effects	Variance Components	df	χ^2	ICC(ρ)	Reliability(λ)
ZSWHSC (Student Cohesiveness)				.07	.61
Class mean, u_{0j}	.068	371	972.70***		
Level-1 Effect, r_{ij}	.920				
ZSWHTS (Teacher Support)				.12	.74
Class mean, u_{0j}	.119	371	1493.43***		
Level-1 Effect, r_{ij}	.867				
ZSWHINVO (Involvement)				.07	.59
Class mean, u_{0j}	.064	371	933.90***		
Level-1 Effect, r_{ij}	.924				
ZSWHINVE (Investigation)				.08	.65
Class mean, u_{0j}	.081	371	1096.53***		
Level-1 Effect, r_{ij}	.908				
ZSWHTO (Task Orientation)				.07	.60
Class mean, u_{0j}	.063	371	938.16***		
Level-1 Effect, r_{ij}	.914				
ZSWHCOOP (Cooperation)				.09	/67
Class mean, u_{0j}	.085	371	1149.52***		
Level-1 Effect, r_{ij}	.891				
ZSWHEQU (Equality)				.08	.66
Class mean, u_{0j}	.081	371	1100.70***		
Level-1 Effect, r_{ij}	.897				

Note. ICC = Intraclass correlation,

*** *p <.001*

4.2.1.2 Results of Research Question 1.b: Means as Outcomes Model

The student level model, one-way random effects ANOVA model, showed that students' scores on *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity* were varying around their class means. Therefore, based on the overall results of one-way random effects ANOVA models, to examine the class-level predictors accounting between class variations in students' perceptions of the each dimensions of classroom learning environment, means as outcomes models were developed for each outcome variables. Results of the means as outcomes models were presented in Table 4.7 and Table 4.8, respectively.

The regression equation addressing this research question is as follows:

Student level (level-1) model:

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

Teacher level (level-2) model:

$$\begin{aligned}\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{T\_FEMALE})_j + \gamma_{02}(ZT\_EXPER\ )_j + \gamma_{03}(ZTSESE)_j \\ + \gamma_{04}(ZTSEIS)_j + \gamma_{05}(ZTSECM)_j + \gamma_{06}(ZTJS)_j + \gamma_{07}(ZTBUEE)_j \\ + \gamma_{08}(ZBUPA)_j + \gamma_{09}(ZTITSA)_j + u_{0j}\end{aligned}$$

In these models,

Y_{ij} is the outcome variable (*Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity)*

β_{0j} is regression intercept of class j, that is, class mean on outcome variable.

γ_{00} is the grand mean, that is, overall average score of outcome variable for all classes.

γ_{01} is the differentiating effect of teacher's *Gender* on class mean of outcome variable.

γ_{02} is the differentiating effect of teacher's *Experience* on class mean of outcome variable.

γ_{03} is the differentiating effect of teacher's efficacy beliefs for student engagement on class mean of outcome variable.

γ_{04} is the differentiating effect of teacher's efficacy beliefs for instructional strategies on class mean of outcome variable.

γ_{05} is the differentiating effect of teacher's efficacy beliefs for classroom management on class mean of outcome variable.

γ_{06} is the differentiating effect of teacher's job satisfaction on class mean of outcome variable.

γ_{07} is the differentiating effect of teacher's feeling of emotional exhaustion on class mean of outcome variable.

γ_{08} is the differentiating effect of teacher's feeling of personal accomplishment on class mean of outcome variable.

γ_{09} is the differentiating effect of teacher's beliefs about science ability on class mean of outcome variable.

r_{ij} is the level-1 residual.

u_{0j} is the level-2residual.

In this new model, τ_{00} has different meaning that it is described as the residual or conditional variance, namely, class level variance in β_{0j}, after controlling other class level (level-2) variables (Raudenbush & Bryk, 2002; p.73).

This model was firstly performed separately for each outcome variable with the nine level-2 predictors. Then, considering the magnitude of significant t values, best predictor was selected. Model was rebuilt by only this predictor variable. Afterwards, final model was built by subsequently adding predictors regarding the magnitude of t values. During this process, significant predictors were retained in the model while non-significant predictors were removed. Results of the final estimations of means as outcome models were presented in Table 4.7 and Table 4.8.

Results of the means as outcome model for ***Student Cohesiveness*** showed that among 9 teacher level variables, only *Experience* (ZT_EXPER; γ = .042, se = .017, p < .05) and *Efficacy for Student Engagement* (ZTSESE; γ = .047, se = .017, p < .01) were found as positively significantly associated with students' perceptions of *Student Cohesiveness*. That is, students that were thought by more experienced teachers or by teacher having higher confidence in student engagement perceived the learning environment as more friendly and supportive in terms of student relationships.

Perceived ***Teacher Support*** was found as positively significantly associated with gender (T_FEMALE; γ = .088, se = .041, p < .05), *Efficacy for Student Engagement* (ZTSESE; γ = .065, se = .021, p < .01), *Job Satisfaction* (ZTJS; γ = .093, se = .028, p < .01), and *Emotional Exhaustion* (ZTBUEE; γ = .060, se = .028, p < .05), while negatively significantly associated with *Experience* (ZT_EXPER; γ = -.056, se = .020, p < .01). That is, students who were thought by female teachers, by teacher having higher confidence for student engagement, by teachers feeling higher satisfaction from work or by teachers who felt higher level of emotional exhaustion perceived their classroom learning environment as more being supported and helped by teacher. However, classrooms being thought by experienced teachers were perceived as less teacher supportive.

Students' scores on perceived ***Involvement*** were related significantly and positively to *Efficacy for Student Engagement* (ZTSESE; γ = .065, se = .017, p < .001. That is, students thought by the teachers who reported higher scores on efficacy for student engagement have more attentive interest and more participate in class.

Results also indicated positive and significant relationship between perceived ***Investigation*** and *Efficacy for Student Engagement* (ZTSESE; γ = .108 se = .023, p < .001), but negative significant relationship was indicated between **I*nvestigation*** and *Efficacy for Classroom Management* (ZTSECM; γ = -.055, se = .023, p < .05). These results implied that students' perceived learning environment as more inquiry and investigation based while they were thought by the science teachers with higher confidence in student engagement or less confidence in using classroom management strategies in classroom.

Students' perceptions of ***Task Orientation*** were found as positively and significantly associated with *Efficacy for Student Engagement* (ZTSESE; γ = .093, se = .021, p < .001), while negatively but significantly associated with *Efficacy for Classroom Management* (ZTSECM; γ = -.055, se = .022, p < .05). These results indicated that while teachers rated higher efficacy for student engagement, but less efficacy for classroom management, the mean classroom perception of task orientation got higher.

Perceived ***Cooperation*** was positively and significantly related with *Efficacy for Student Engagement* (ZTSESE; γ = .064, se = .018, p < .01). That is, classrooms' mean perception of cooperation get higher in the classrooms which were thought by teachers with higher efficacy for student engagement.

Lastly, students' perceptions on ***Equity*** was found positively and significantly related to *Efficacy for Student Engagement* (ZTSESE; γ = .069, se = .018, p < .001). This result indicated that teachers who had more confidence in student engagement tended to treat students more equally.

In sum, based on the overall results of the fixed effects of Means as Outcomes Model, it can be concluded that teachers' efficacy for student engagement was positively related to all dimensions of classroom learning environment, while none of the learning environment dimensions was related to teachers' efficacy for instructional strategies, personal accomplishment and beliefs about science ability. Secondly, male or experienced teachers were perceived less supportive by students. Moreover, teachers' feeling of satisfaction about work and feeling of emotionally drained from work were positively affected classrooms' average perception of teacher support. Finally, teachers' efficacy for classroom management negatively affected classrooms' average perception of investigation and task orientation,

The final estimations of variance components obtained from means as outcomes models of learning environment dimensions were presented in Table 4.8. In the present models, the degrees of freedom can be calculated by following procedure:

Degree of Freedom = J – Q – 1

Where,

J is the number of classes with the sufficient data,

Q is the number of class level variables included in the final model.

For example, in the model built with student cohesiveness as outcome variable, degree of freedom based on the above formula can be computed as:

df = 372 – 2 – 1 =369.

For each model built for dimensions of classroom learning environment (*Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation*, and *Equity*), the residual variance between classes was substantially smaller than the estimated variance in random effects ANOVA model (see Table 4.6 and Table 4.8). These reductions were caused by the inclusion of teacher level variables. The comparison of the τ_{00} estimates obtained from two models (Random ANOVA Model and Means as Outcomes Model) provides an index, R^2, indicating the proportion reduction in predictor error or variance explained at class level (level-2).

R^2 = Proportion of variance explained in β_{0j}

$$= \frac{\tau_{00}(Random\ ANOVA) - \tau_{00}(Means\ as\ Outcome)}{\tau_{00}(Random\ ANOVA)}$$

For example, in the model built with student cohesiveness as outcome variable, proportion of variance explained accounted for teacher variables is calculated as:

$$R^2 = \frac{0.06745 - 0.06346}{0.06745} = 0.059$$

As shown in Table 4.8, 5.9% of the true between-class variance in ***Student Cohesiveness*** was accounted for by teachers' *Experience* and *Efficacy for Student Engagement*. 13.5% of the true between-class variance in ***Teacher Support*** was accounted for teachers' *Gender, Experience, Efficacy for Student Engagement, Job Satisfaction,* and *Emotional Exhaustion.* 7.8% of the true between-class variance in ***Involvement*** was accounted for by teachers' *Efficacy for Student Engagement.* 8.6% of the true between-class variance in ***Investigation*** was accounted for teachers' *Efficacy for Student Engagement* and *Efficacy for Classroom Management.* 7.9% of the true between-class variance in ***Task Orientation*** was accounted for teachers' *Efficacy for Student Engagement* and *Efficacy for Classroom Management.* 3.8% of the true between-class variance in ***Cooperation*** was accounted for teachers' *Efficacy for Student Engagement.* Finally, 5% of the true between-class variance in ***Equity*** was accounted for teachers' *Efficacy for Student Engagement.* Nevertheless, based on the statistically significant X^2 statistics of each model, it can be concluded that even after the significant teacher level predictors in each model were hold constant, or control for, classes still varied significantly in students' average perceptions of classroom learning environment (*Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation*, and *Equity*). In other words, these class level factors did not account for all the variation in the intercepts. Even after controlling these class level factors, classes still varied significantly in their average scores on related outcome variable.

Table 4.7 Final estimations of fixed effects for teacher level predictors - Means as Outcomes Model

	Student Coh.		Teacher Sup.		Involvement		Investigation		Task orientation		Cooperation		Equity	
Fixed Effects	γ	SE	γ	SE	γ	SE	γ	SE	γ	SE	γ	SE	γ	SE
Model for Class Means														
Intercept	.009	.017	-.038	.029	.009	.017	.012	.018	.008	.017	.013	.018	.011	.018
T_FEMALE (Gender)			.088*	.041										
ZT_EXPER (Experience)	.042*	.017	-.056**	.020										
ZTSESE (Efficacy for Student Engagement)	.047**	.017	.065**	.021	.065***	.017	.108***	.023	.093***	.021	.064**	.018	.069***	.018
ZTSEIS (Efficacy for Instructional Strategies)														
ZTSECM (Efficacy for Classroom Management)							-.055*	.023	-.055*	.022				
ZTJS (Job Satisfaction)			.093**	.028										
ZTBUEE (Emotional Exhaustion)			.060*	.028										
ZBUPA (Personal Accomplishment)														
ZTITSA(Implicit Theory of Science Ability)														

Note. Only predictors in final models were included in the table. The all continuous teacher level variables were grand mean centered

**p< .05, **p<.01, ***p<.001*

Table 4.8 Final estimations of variance components for learning environment dimensions - Means as Outcomes Model

Random Effects	Variance Components	df	χ^2	R^2
ZSWHSC (Student Cohesiveness)				
Class mean, $u0j$	.064	369	936.94***	.059
Level-1 Effect, rij	.920			
ZSWHTS (Teacher Support)				
Class mean, u_{0j}	.103	366	1333.38***	.135
Level-1 Effect, r_{ij}	.867			
ZSWHINVO (Involvement)				
Class mean, u_{0j}	.059	370	894.31***	.078
Level-1 Effect, r_{ij}	.924			
ZSWHINVE (Investigation)				
Class mean, u_{0j}	.074	369	1027.64***	.086
Level-1 Effect, r_{ij}	.908			
ZSWHTO (Task Orientation)				
Class mean, u_{0j}	.058	369	890.21***	.079
Level-1 Effect, r_{ij}	.914			
ZSWHCOOP (Cooperation)				
Class mean, u_{0j}	.082	370	1110.27***	.038
Level-1 Effect, r_{ij}	.891			
ZSWHEQU (Equality)				
Class mean, u_{0j}	.076	370	1056.73***	.050
Level-1 Effect, r_{ij}	.897			

*** $p < .001$

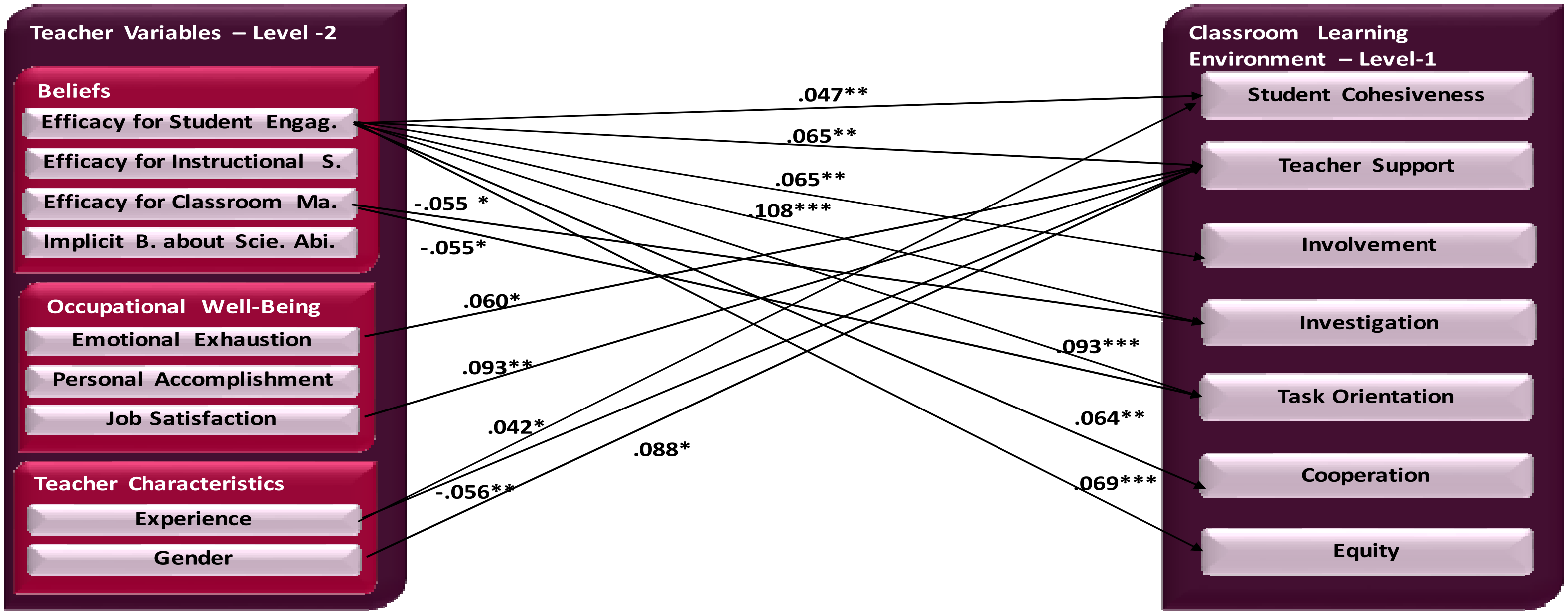

Figure 4.1 Predicting classroom learning environment by teacher variables (level-2)

Note. Arrows do not indicate causal relationships. Their directions are from predictors to outcome variables.

$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

4.2.2. Results of Research Question 2: Students' Self-Regulation

The second set of HLM analyses were conducted to test the research questions focusing on students' self-regulation:

2 The second research question consisted of 4 sub-questions:

2.a. To what extent do students in different classes vary in self-regulation dimensions (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*)?

2.b. To what extent do class (teacher) level variables (i.e., *Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Science Ability*) predict students' self-regulation (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*)?

2.c. To what extent do student variables in terms of *Gender* and perception of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity)* predict students' self-regulation (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*)?

2.d. To what extent do class (teacher) level variables (i.e., *Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Ability in Science*) influence the relationship between students' self-regulation (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*), and students' *Gender* and perception of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity)*?

4.2.2.1 Results of Research Question 2.a: One-Way Random Effects ANOVA Model

Research question 2.a was tested through One-Way Random Effects Analysis of Variance Model. The regression equation addressing this research question is as follows:

Student level (level-1) model:

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

Teacher level (level-2) model:

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

In these models,

Y_{ij} is the outcome variable (Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals, and Performance Avoidance Goals)

β_{0j} is regression intercept of class j, that is, class mean on outcome variable.

γ_{00} is the grand mean, that is, overall average score of outcome variable for all classes.

r_{ij} is the random effect of student i in class j.

u_{0j} is the random effect of class j.

In the present study, students' self-regulation included six constructs namely *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance*

Approach Goals, Mastery Avoidance Goals, and *Performance Avoidance Goals*. Therefore, six separate One-Way random effects ANOVA models were built by using each dimension self-regulation as an outcome variable. Table 4.9 presents the results of the final estimations of fixed effects and random effects obtained from ANOVA models.

The final estimations of variance components obtained from one-way random effects ANOVA models showed that all variance components at class level (τ_{00}) were statistically significant, where τ_{00} is the variance of the true class means, β_{0j}, around the grand-mean, γ_{00}. It means that there are substantial amount of variation among class means for Self-Efficacy (τ_{00} = .111, χ^2 = 1387.01, df = 371, p<.001), Metacognitive Self-Regulation (τ_{00} = .079, χ^2 = 1068.38, df = 371, p<.001), Mastery Approach Goal Orientation (τ_{00} = .060, χ^2 = 916.54, df = 371, p<.001), Performance Approach Goal Orientation (τ_{00} = .036, χ^2 = 694.69, df = 371, p<.001), Mastery Avoidance Goal Orientation (τ_{00} = .032, χ^2 = 647.30, df=371, p<.001), and Performance Goal Orientation (τ_{00} = .046, χ^2 = 768.84, df = 371, p<.001). Therefore, conducting HLM analyses for this data set was considered as appropriate.

ICC's, as calculated by the formula: $\rho = \tau_{00}/(\tau_{00} + \sigma^2)$ for six self-regulation variables, are presented in Table 4.10. In the present study, ICC's indicated that 11% of the total variance in *Self-Efficacy*, 8% of the total variance in *Metacognitive Self-Regulation*, 6% of the total variance in *Mastery Approach Goal Orientation*, 4% of the total variance in *Performance Approach Goal Orientation*, 3% of the total variance in *Mastery Avoidance Goal Orientation*, and 5% of the total variance in *Performance Avoidance Goal Orientation* were accounted by the between-class variance.

Moreover, as presented in Table 4.10, the reliability statistics for the outcome variables obtained from one-way random effects ANOVA model were moderate, ranging from .42 to .73. It indicated that the sample means tend to be moderately reliable as indicators of the true class mean.

Table 4.9 Final estimation of fixed effects for students' Self-Regulation dimensions: One-Way Random Effects ANOVA Model

Fixed Effects	γ_{00}	SE
ZSSE (Self-Efficacy)		
Average class mean	-.003	.020
ZSMC (Metacognitive Self-Regulation)		
Average class mean	-.001	.018
ZSGOMAP (Mastery Approach Goal Orientation)		
Average class mean	.004	.017
ZSGOPAP (Performance Approach Goal Orientation)		
Average class mean	.004	.015
ZSGOMAV (Mastery Avoidance Goal Orientation)		
Average class mean	.004	.014
ZSGOPAV (Performance Avoidance Goal Orientation)		
Average class mean	.010	.016

Table 4.10 Final estimation of variance components for students' Self-Regulation dimensions: One-Way Random Effects ANOVA Model

Random Effects	Variance Components	df	χ^2	ICC(ρ)	Reliability(λ)
ZSSE (Self-Efficacy)				.11	.73
Class mean, u_{0j}	.111	371	1387.01***		
Level-1 Effect, r_{ij}	.889				
ZSMC (Metacognitive Self-Regulation)				.08	.65
Class mean, u_{0j}	.079	371	1068.38***		
Level-1 Effect, r_{ij}	.916				
ZSGOMAP (Mastery Approach Goal Orientation)				.06	.59
Class mean, u_{0j}	.060	371	916.54***		
Level-1 Effect, r_{ij}	.898				
ZSGOPAP (Performance Approach Goal Orientation)				.04	.46
Class mean, u_{0j}	.036	371	694.69***		
Level-1 Effect, r_{ij}	.931				
ZSGOMAV (Mastery Avoidance Goal Orientation)				.03	.42
Class mean, u_{0j}	.032	371	647.30***		
Level-1 Effect, r_{ij}	.960				
ZSGOPAV (Performance Avoidance Goal Orientation)				.05	.51
Class mean, u_{0j}	.046	371	768.84***		
Level-1 Effect, r_{ij}	.938				

Note. ICC = intra-class correlation, *** $p < .001$

4.2.2.2 Results of Research Question 2.b: Means as Outcomes Model

Results of the one-way random effects ANOVA model indicated that students' self-regulation namely Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals, and *Performance Avoidance Goals* were significantly varying around their class means. Therefore, to address research question 2.b, an expanded model beyond the null model was necessary for each outcome variable. This expanded model, means as outcomes model, was developed by the inclusion of nine level-2 (teacher level) predictors without the inclusion of any level-1 (student level) predictors. Results of the means as outcomes models performed for each self-regulation dimensions were presented in Table 4.11.

The regression equation addressing this research question is as follows:

Student level (level-1) model:

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

Teacher level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{T\_FEMALE})_j + \gamma_{02}(ZT\_EXPER\ )_j + \gamma_{03}(ZTSESE)_j + \gamma_{04}(ZTSEIS)_j + \gamma_{05}(ZTSECM)_j + \gamma_{06}(ZTJS)_j + \gamma_{07}(ZTBUEE)_j + \gamma_{08}(ZBUPA)_j + \gamma_{09}(ZTITSA)_j + u_{0j}$$

In these models,

Y_{ij} is the outcome variable (*Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals*, and *Performance Avoidance Goals*)

β_{0j} is regression intercept of class j, that is, class mean on outcome variable.

γ_{00} is the grand mean, that is, overall average score of outcome variable for all classes.

γ_{01} is the differentiating effect of teacher gender on class mean of outcome variable.

γ_{02} is the differentiating effect of teacher experience on class mean of outcome variable.

γ_{03} is the differentiating effect of teacher's efficacy beliefs for student engagement on class mean of outcome variable.

γ_{04} is the differentiating effect of teacher's efficacy beliefs for instructional strategies on class mean of outcome variable.

γ_{05} is the differentiating effect of teacher's efficacy beliefs for classroom management on class mean of outcome variable.

γ_{06} is the differentiating effect of teacher's job satisfaction on class mean of outcome variable.

γ_{07} is the differentiating effect of teacher's feeling of emotional exhaustion on class mean of outcome variable.

γ_{08} is the differentiating effect of teacher's feeling of personal accomplishment on class mean of outcome variable.

γ_{09} is the differentiating effect of teacher's beliefs about science ability on class mean of outcome variable.

r_{ij} is the level-1 residual.

u_{0j} is is the level-2residual.

τ_{00} is the residual or conditional variance, that is, class level variance in β_{0j}, after controlling other class level (level-2) variables (Raudenbush & Bryk, 2002; p.73).

While constructing the final model, the same procedures with the section 4.2.1.2 were followed. This model was firstly performed separately for each outcome variable with the nine level-2 predictors. Then, considering the magnitude of significant t values, best predictor was selected. Model was rebuilt by only this predictor variable. Afterwards, final model was built by subsequently adding predictors regarding the magnitude of t values. During this process, significant predictors were retained in the model while non-significant predictors were removed. Results of the final estimations of means as outcome models were presented in Table 4.11 and Table 4.12, respectively.

Findings of the means as outcomes model are presented below for each outcome variable, separately. Firstly, results indicated that while for students' ***Self-Efficacy*** was positively associated with teachers' *Emotional Exhaustion* (ZTBUEE; γ = .043, se = .021, p < .05) and *Personal Accomplishment* (ZBUPA; γ = .084, se = .021, p < .001).

Students' scores on ***Metacognitive Self-Regulation*** was found as positively related to *Emotional Exhaustion* (ZTBUEE; γ = .038, se = .019, p < .05) and *Personal Accomplishment* (ZBUPA; γ = .075, se = .019, p < .001), while there was a negative association between ***Metacognitive Self-Regulation*** and *Experience* (ZT_EXPER; γ = -.038, se = .018, p < .05).

Students' ***Mastery Approach Goals*** was positively related to *Efficacy for Student Engagement* (ZTSESE; γ = .044, se = .017, p < .01).

Lastly, *Emotional Exhaustion* (ZTBUEE) was found as associated with both ***Mastery Avoidance Goals** (*γ = .029, se = .015, p < .05) ***and Performance Avoidance Goals*** ((*γ = .034, se = .016, p < .05).

In brief, results of the fixed effects of means as outcomes model exhibited that students tended to be highly confident in science learning, to use metacognitive learning strategies, and to set mastery or performance avoidance goals when they were taught by the teachers who feel more emotional exhaustion. Moreover, students who were thought by the teachers who feel more successful in teaching tended to be highly efficacious and aware of their learning process, too. Students were more likely to set mastery approach oriented goals while they thought by the teachers who have high confidence for student engagement in science teaching. On the other hand, students tended to use less metacognitive strategies in the classrooms thought by more experienced teachers. Finally, none of the teacher characteristics was found as related to students' setting performance approach goals.

The final estimations of variance components obtained from Means as Outcomes Models of self-regulation dimensions were presented in Table 4.12. For each model built for students' self-regulation dimensions (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*) the residual variance between classes was substantially decreased compared to the estimated variance in random effects ANOVA model (see Table 4.10 and Table 4.12). This reduction is caused by the inclusion of teacher level variables. The R^2 (the proportion reduction in variance or variance explained at class level) values calculated via comparison of τ_{00} estimates obtained from these two models were also provided in Table 4.112.

R^2 = Proportion of variance explained in

$$\beta_{0j} = \frac{\tau_{00}(Random\ ANOVA) - \tau_{00}(Means\ as\ Outcome)}{\tau_{00}(Random\ ANOVA)}$$

For example, in the model built with *Self-Efficacy* as outcome variable, proportion of variance explained in β_{0j} accounted for teacher variables is calculated as:

$$R^2 = \frac{0.111 - 0.104}{0.111} = 0.063$$

As presented in Table 4.12, 6.3% of the true between-class variance in ***Student Self-Efficacy*** was accounted for by teachers' *Emotional Exhaustion* and *Personal Accomplishment*. 8.9% of the true between-class variance in students' ***Metacognitive Self-Regulation*** was accounted for teachers' *Experience, Emotional Exhaustion* and *Personal Accomplishment*. 3.3% of the true between-class variance in ***Mastery Approach Goals*** was accounted for by teachers' *Efficacy for Student Engagement. Finally,* 3.1% of the true between-class variance in ***Mastery Avoidance Goals*** *and* 4.4% of the true between-class variance in ***Performance Avoidance Goals*** were accounted for teachers' *Emotional Exhaustion.* Nevertheless, based on the statistically significant X^2 statistics of each model, it can be concluded that even after the significant teacher level predictors in each model were hold constant, or control for, classes still varied significantly in students' responses to self-regulation dimensions (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*). In other words, these class level factors did not account for all the variation in the intercepts. Even after controlling these class level factors, classes still varied significantly in their average scores on outcome variable.

Table 4.11 Final estimations of fixed effects for teacher level predictors of Self-Regulation dimensions: Means as Outcomes Model

Fixed Effects	Self-Efficacy		Metacognitive Self-regulation		Mastery Approach Goals		Performance Approach G.		Mastery Avoidance G.		Performance Avoidance G.	
	γ	SE	γ	SE	γ	SE	γ	SE	γ	SE	γ	SE
Model for Class Means[1]												
Intercept	-.003	.020	-.001	.018	.004	.016	.004	.015	.004	.014	.010	.015
T_FEMALE (Gender)												
ZT_EXPER (Years of Teaching)			-.038*	.018								
ZTSESE (Efficacy for Student Engagement)					.044**	.017						
ZTSEIS (Efficacy for Instructional Strategies)												
ZTSECM (Efficacy for Classroom Management)												
ZTJS (Job Satisfaction)												
ZTBUEE (Emotional Exhaustion)	.043*	.021	.038*	.019					.029*	.015	.034*	.016
ZBUPA (Personal Accomplishment)	.084***	.021	.075***	.019								
ZTITSA(Implicit Theory of Scıence Ability)												

Note. Only predictors in final models were included in the table. Predictors that have no coefficient value in the table were excluded variables from the related model because of its non-significant effect on outcome variable.

**p< .05, **p<.01, ***p<.001,* 1: The all continuous teacher level variables were grand mean centered.

Table 4.12 Final estimations of variance components for teacher level predictors of Self-Regulation dimensions: Means as Outcomes Model

Random Effects	Variance Components	df	χ^2	R^2
ZSSE (Self-Efficacy)				
Class mean, u_{0j}	.104	369	1324.46***	.063
Level-1 Effect, r_{ij}	.889			
ZSMC (Metacognitive Self-Regulation)				
Class mean, u_{0j}	.072	368	1009.59***	.089
Level-1 Effect, r_{ij}	.917			
ZSGOMAP (Mastery Approach Goals)				
Class mean, u_{0j}	.058	370	896.34***	.033
Level-1 Effect, r_{ij}	.899			
ZSGOPAP (Performance Approach Goals)				
Class mean, u_{0j}	.036	371	694.68***	
Level-1 Effect, r_{ij}	.931			
ZSGOMAV (Mastery Avoidance Goals)				
Class mean, u_{0j}	.031	370	641.28***	.031
Level-1 Effect, r_{ij}	.960			
ZSGOPAV (Performance Avoidance Goals)				
Class mean, u_{0j}	.044	370	759.90***	.044
Level-1 Effect, r_{ij}	.938			

*** *p <.00*

4.2.2.3 Results of Research Question 2.c: Random Coefficient Model

The research question 2c addressed the student variables in terms of perceptions of classroom learning environment and *Gender* as factors explaining the differences in students' self-regulation (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*). This research question was tested by means of Random Coefficient Model for each dimensions of self-regulation. Dimensions of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity*) and students' *Gender* were included in the models as student level (level-1) variables. In these models, each class has its own regression equation with an intercept and slopes. Therefore, results of the analyses will provide information about average of the all

372 classes' intercepts and slopes, as well as the amount of variation of regression equations in terms of intercept and slopes from class to class. The relationship between a specific predictor variable and the outcome variable which is defined as slope can be fixed or random. If a slope in the regression equation is fixed, it indicates that the degree of the relationship between the predictor variable and outcome variable is same in each class. On the other hand, random variation of the slope means that the degree of the relationship between a specific predictor variable and the outcome variable varies from class to class. That is, while the slope can be steep in one group, it can be flatter in another group.

The regression equation addressing the research question 2c is as follows:

Student level (level-1) model:

$$Y_{ij} = \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2J} * (ZSWHSC) + \beta_{3J} * (ZSWHTS) + \beta_{4J} * (ZSWHINVO) + \beta_{5J} * (ZSWHINVE) + \beta_{6J} * (ZSWHTO) + \beta_{7J} * (ZSWHCOOP) + \beta_{8J} * (ZSWHEQU) + r_{ij}$$

Teacher level (level-2) model:

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

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$$\beta_{0j} = \gamma_{q0} + u_{qj}$$

In these models,

Y_{ij} is the outcome variable (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals*, and *Performance Avoidance Goals*)

β_{0j} is the mean on each self-regulation dimension (i.e., average scores of the all classes on related outcome variable)

β_{1j} is the differentiating effect of students' gender in class j (i.e., the mean difference between male and female students' scores on related outcome variable)

β_{2j} is the differentiating effect of students' perception of student cohesiveness in class j (i.e., the degree to which perceptions of student cohesiveness differences among students related to outcome variable)

β_{3j} is the differentiating effect of students' perception of teacher support in class j (i.e., the degree to which perceptions of teacher support differences among students related to outcome variable)

β_{4j} is the differentiating effect of students' perception of involvement in class j (i.e., the degree to which perceptions of involvement differences among students related to outcome variable)

β_{5j} is the differentiating effect of students' perception of investigation in class j (i.e., the degree to which perceptions of investigation differences among students related to outcome variable)

β_{6j} is the differentiating effect of students' perception of task orientation in class j (i.e., the degree to which perceptions of task orientation differences among students related to outcome variable)

β_{7j} is the differentiating effect of students' perception of cooperation in class j (i.e., the degree to which perceptions of cooperation differences among students related to outcome variable)

β_{8j} is the differentiating effect of students' perception of equity in class j (i.e., the degree to which perceptions of equity differences among students related to outcome variable)

β_{qj} is the coefficient for variable q for class j after accounting for other variables

γ_{00} is the average of class means on the outcome variable across the population of classes

γ_{q0} is the average *q* factor- outcome variable slope across those classes

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

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

In this regression equation, while β_{0j} represents the intercept parameter, all other β's represent the slope parameter of each predictor variable.

While constructing random coefficient models, building strategy which was suggested by Bryk and Raudenbush (2002) was followed. Among the 8 student level predictors, firstly, student's *Gender* was selected to be included in the model. Gender was tested in terms of whether it was significantly related to outcome variable and whether it was randomly varying or not. After deciding whether to retain the gender in the model as fixed or random, all 7 classroom learning environment variables (*Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity*) were subsequently included in the model. If both fixed and random effects of a predictor were found as significant, this variable was retained in the model. If only fixed effect was found as significant, that variable was retained in the model as fixed. On the other hand, even the fixed effect was found nonsignificant, but random effect was found significant, that variable was retained in the model as randomly varying. Variables for which neither fixed nor random effect was found as significant were removed from related model. Based on the results of the Random Coefficient Model for each outcome variable, final estimation of fixed effects and final estimation of random effects were presented in table 4.13 and 4.14, respectively. Results of the final estimation of random coefficient model were explained separately for each outcome below.

4.2.2.3.1 Self-Efficacy

Result of the final estimation of fixed effects of Random Coefficient Model /see Table 4.13) built for *Self-Efficacy* showed that among the eight level-1 variables, *Student Cohesiveness* (ZSWHSC; γ = .028, se = .012, $p < .05$). *Involvement* (ZSWHINVO; γ = .169, se = .014, $p < .001$), Investigation (ZSWHINVE; γ = .142, se = .015, $p < .001$), *Task Orientation* (ZSWHTO; γ = .348, se = .013, $p < .001$), and *Equity* (ZSWHEQU; γ = .119, se = .014, $p < .001$) were positively and significantly associated with *Self-Efficacy.* However, *Cooperation* (ZSWHCOOP; γ = -.114, se = .013, $p < .001$) was found as negatively related to *Self-Efficacy*. That is, slope coefficient of *Self-Efficacy – Student Cohesiveness* indicated that student who perceived students' relationships in the classroom as more positively and friendly had higher efficacy in science class. The *Self-Efficacy – Involvement* slope coefficient indicated that students who tended to involve in classroom activities had higher confidence in science class. The *Self-Efficacy – Investigation* slope coefficient indicated that students who tended to do more inquiry and have problem solving skills in science class had higher self-efficacy. The slope coefficient of *Self-Efficacy – Task Orientation* indicated that students who perceived classroom as more task oriented reported higher confidence in science class. The *Self-Efficacy – Equity* slope coefficient indicated that students who had more equal learning opportunities with the other students in the same classroom had higher efficacy in learning science. On the other hand, the *Self-Efficacy – Cooperation* slope coefficient showed that cooperation among students in classroom activities decrease students' confidence in science class.

Results of the final estimation of random effects obtained from Random Coefficient Model (see Table 4.14) showed that variance among the class means $\tau_{00} = .049$ with the chi-square statistics of 900.60 was found as statistically significant (p<.001). This significant variation among 372 classes suggested that this variability might be explained by inclusion of class level factors in to the model. Moreover, the slopes of *Self-Efficacy – Teacher Support* (χ^2 = 517.25, *p*< .001)*, Self-Efficacy – Investigation* (χ^2 = 514.76, *p*< .001)*, Self-Efficacy – Task Orientation* (χ^2 = 467.51, *p*< .01)*,* and *Self-Efficacy – Equity* (χ^2 =467.39, *p*< .01)*,* were all varied significantly, which indicated that in some classes, the slopes ere much steeper than for other classes. In other words, while the relationships between *Self-Efficacy* and these variables were stronger in some classes, they were weaker in other classes. The variability among classes also suggested that class differences took effect on the slopes for *Teacher Support, Investigation, Task Orientation,* and *Equity, a*nd class level variables might account for some of the differences. On the other hand, the variance components of *Student Cohesiveness, Involvement*, and *Cooperation* were not found as significant, which yielded that class differences did not have an impact on the slops for these variables. Additionally, although the variance component for *Teacher Support* was found as significant, it was not significant predictor of *Self-Efficacy,* Therefore, though *Teacher Support* was retained in the model, it was not the focus.

To find out how much variance of *Self-Efficacy* was explained in student level the variances in the Analysis of Variance Model and the Random Coefficient Model were compared. The proportion of reduction in variance at student level (R^2) was calculated by using σ^2 estimates of these two models as follows:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Means\ as\ Outcome)}{\sigma^2(random\ ANOVA)} = \frac{0.889 - 0.532}{0.889} = 0.402$$

By including these student level factors (*Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation*, and *Equity*) as predictors of Self-Efficacy within class variance was reduced by 40.2 %. Therefore, these factors account for about 40 % of the student level variance in *Self-Efficacy.*

Regarding reliability of the intercept and randomly varying slopes, results of the HLM analysis showed that reliability of intercept (.54) was quite higher than reliability of slopes of *Teacher Support* (.23), *Investigation* (.23), *Task orientation* (.12), and *Equity* (.14) (see Table 4.14). Bryk and Raudenbush (2002) suggested that the reason for the lower reliability of the slopes was that the true slope variance across classes was much smaller than the variance of the true means and many classes might be relatively homogeneous on the randomly varying level-1variables (e.g., *Teacher Support, Investigation, Task Orientation,* and *Equity*).

4.2.2.3.2 Metacognitive Self-Regulation

Result of the final estimation of fixed effects of Random Coefficient Model /see Table 4.13) built for *Metacognitive Self-Regulation* showed that among the eight level-1 variables, *Gender* (S_FEMALE; γ = .165, se = .019, p < .001). *Student Cohesiveness* (ZSWHSC; γ = .042, se = .011, p < .001). *Teacher Support* (ZSWHTS; γ = .033, se = .012, p < .01). *Involvement* (ZSWHINVO; γ = .058, se = .014, p < .001), *Investigation* (ZSWHINVE, γ = .290, se = .014, p < .001), *Task Orientation* (ZSWHTO; γ = .323, se = .013, p < .001), and *Equity* (ZSWHEQU; γ = .072, se = .013, p < .001) were positively related to *Metacognitive-Self-Regulation.* However, *Cooperation* (ZSWHCOOP; γ = -.059, se = .012, p < .001) was found as negatively related to *Metacognitive-Self-Regulation*. Namely, the slope coefficient of *Metacognitive-Self-Regulation – Gender* indicated that female students were more prone to use metacognitive learning strategies in science class than males. The slope coefficient of *Metacognitive-Self-Regulation – Student Cohesiveness* indicated that students who perceived students' relationships in the classroom as more positively and friendly reported higher scores on Metacognitive Self-Regulation. The slope coefficient of *Metacognitive-Self-Regulation – Teacher Support* indicated that students who were more supported by science teacher tended to use more metacognitive-learning strategies. The *Metacognitive-Self-Regulation – Involvement* slope coefficient indicated that students who tended to involve in classroom activities reported using more metacognitive strategies in science class. The *Metacognitive-*

Self-Regulation – Investigation slope coefficient indicated that students who tended to do more inquiry and have problem solving skills in science class used more metacognitive learning strategies. The slope coefficient of *Metacognitive-Self-Regulation – Task Orientation* indicated that students who perceived classroom as more task oriented reported higher scores on using metacognitive learning strategies in science class. The *Metacognitive-Self-Regulation – Equity* slope coefficient indicated that students who had more equal learning opportunities with the other students in the same classroom tended to use more metacognitive strategies in learning science. On the other hand, the *Metacognitive-Self-Regulation – Cooperation* slope coefficient showed that higher level of cooperation among students in classroom activities and conducting group works related to students' using less metacognitive learning strategies in science class.

Results of the final estimation of random effects obtained from random coefficient model (see Table 4.14) showed that variance among the class means $\tau_{00} = .041$ with the chi-square statistics of 607.31 was found as statistically significant (p<.001). This significant variation among 372 classes suggested that this variability might be explained by inclusion of class level factors in to the model. Moreover, the slopes of *Metacognitive-Self-Regulation – Gender* (χ^2 = 490.422, p< .001), *Metacognitive-Self-Regulation – Investigation* (χ^2 = 489.51, p< .001), *Metacognitive-Self-Regulation – Task Orientation* (χ^2 = 421.48, p< .05), and *Metacognitive-Self-Regulation – Equity* (χ^2 = 448.15, p< .001), were all varied significantly, which indicated that in some classes, the slopes are much steeper than for other classes. In other words, while the relationships between *Metacognitive Self-Regulation* and these variables were stronger in some classes, they are weaker in other classes. The variability among classes also suggested that class differences took effect on the slopes for *Gender, Investigation, Task Orientation,* and *Equity, a*nd class level variables might account for some of the differences. On the other hand, the variance components of *Student Cohesiveness, Teacher Support, Involvement*, and *Cooperation* were not significant, which implies that class differences did not have an impact on the slops for these variables.

To find out how much variance of *Metacognitive Self-Regulation* was explained in student level the variances in the Analysis of Variance Model and the Random Coefficient Model were compared. The proportion of reduction in variance at student level (R^2) was calculated by comparing σ^2 estimates of Analysis of Variance Model and the Random Coefficient Model of as follows:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Means\ as\ Outcome)}{\sigma^2(random\ ANOVA)} = \frac{0.916-0.512}{0.916} = 0.441$$

By including these student level factors (Gender, Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity) as predictors of Metacognitive Self-Regulation, within class variance was reduced by 44.1 %. Therefore, these factors account for about 44 % of the student level variance in Metacognitive Self-Regulation.

Regarding reliability of the intercept and randomly varying slopes, results of the HLM analysis showed that reliability of intercept (.35) was quite reliable than reliability of slopes of Gender (.20), Investigation (.23), Task orientation (.12), and Equity (.16) (see Table 4.14).

4.2.2.3.3 Mastery Approach Goals

Regarding Mastery Approach Goals, result of the fixed effects of Random Coefficient Model (see table 4.13) showed that among the eight level-1 variables, *Gender* (S_FEMALE, γ = .124, se = .018, p < .001). *Student Cohesiveness* (ZSWHSC, γ = .047, se = .011, p < .001), *Task Orientation* (ZSWHTO, γ = .498, se = .014, p < .001), and *Equity* (ZSWHEQU, γ = .153, se = .014, p < .001) were positively and significantly related to *Mastery Approach Goals*. However, *Cooperation* (ZSWHCOOP, γ = -.028, se = .012, p < .05) was found as negatively related to *Mastery Approach Goals.* Namely, the slope coefficient of *Mastery Approach Goals – Gender* indicated that female student tended to set more mastery approach oriented goals in science class than males. The slope coefficient of *Mastery Approach Goals – Student Cohesiveness* indicated that students who perceived students' relationships in the classroom as more positively and friendly reported higher scores on Mastery Approach Goals. The slope coefficient of *Mastery Approach Goals – Task Orientation* indicated that students who perceived classroom as more task oriented were more likely to focus on mastering course subject and value learning. The *Mastery Approach Goals – Equity* slope coefficient indicated that students who had more equal learning opportunities with the other students in the same classroom were more likely to approach success in learning science. On the other hand, *Mastery Approach Goals – Cooperation* slope coefficient showed that higher level of cooperation among students in classroom activities and conducting group works related to students' setting less mastery approach oriented goals in science class.

Results of the final estimation of random effects obtained from random coefficient model (see Table 4.14) showed that that variance among the class means $\tau_{00} = .026$ with the chi-square statistics of 538.43 was found as statistically significant (p<.001). This significant variation among 372 classes suggested that this variability might be explained by inclusion of class level factors in to the model. Moreover, the slopes of *Mastery Approach Goals – Gender* ($\chi^2 = 443.15$, $p< .01$), *Mastery Approach Goals – Teacher Support* ($\chi^2 = 454.79$, $p< .01$), *Mastery Approach Goals – Involvement* ($\chi^2 = 448.64$, $p< .01$), *Mastery Approach Goals – Task Orientation* ($\chi^2 = 584.85$, $p< .001$), and *Mastery Approach Goals - Equity* ($\chi^2 = 509.09$, $p< .001$), were all varied significantly, which indicated that in some classes, the slopes are much steeper than for other classes. In other words, while the relationships between *Mastery Approach Goals* and these variables were stronger in some classes, they are weaker in other classes. The variability among classes also suggested that class differences took effect on the slopes for *Gender, Teacher Support, Involvement, Task Orientation,* and *Equity, an*d class level variables might account for some of the differences. On the other hand, the variance components of *Student Cohesiveness,* and *Cooperation* were not significant, which suggested that class differences did not have an impact on the slops for these variables. Additionally, although the variance components for *Teacher Support, and Involvement* were found as significant, they were not significant predictors of *Mastery Approach Goals,* Therefore, though *Teacher Support* and *Involvement* were retained in the model, they were not the focus.

To find out how much variance of *Mastery Approach Goals* was explained in student level the variances in the Analysis of Variance Model and the Random Coefficient Model were compared. The proportion of reduction in variance at student level (R^2) was calculated by comparing σ^2 estimates of Analysis of Variance Model and the Random Coefficient Model of as follows:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Means\ as\ Outcome)}{\sigma^2(random\ ANOVA)} = \frac{0.898 - 0.484}{0.898} = 0.461$$

By including these student level factors (Gender, Student Cohesiveness, Teacher Support, Involvement, Task Orientation, Cooperation, and Equity) as predictors of Mastery Approach Goal Orientation, within class variance was reduced by 46.1 %. Therefore, these factors account for about 46 % of the student level variance in Mastery Approach Goal Orientation

Regarding reliability of the intercept and randomly varying slopes, results of the HLM analysis showed that reliability of intercept was .26, of Gender was .14, of Teacher Support was .20, of Involvement was .16, of Task orientation was .30, and of Equity was .23 (see Table 4.14).

4.2.2.3.4 Performance Approach Goals

Result of the fixed effects of Random Coefficient Model (see Table 4.13) built for *Performance Approach Goals* revealed *Gender* (S_FEMALE, γ = .085 se = .020, p < .001). *Student Cohesiveness* (ZSWHSC, γ = .032, se = .012, p < .01), *Task Orientation* (ZSWHTO, γ = .370, se = .015, p < .001), and *Equity* (ZSWHEQU, γ = .066, se = .015, p < .001) were positively related to *Performance Approach Goals*. Namely, the slope coefficient of *Performance Approach Goals – Gender* indicated that female student tended to set more performance approach oriented goals in science class than males. The slope coefficient of *Performance Approach Goals –*

Student Cohesiveness indicated that students who perceived students' relationships in the classroom as more positively and friendly reported higher scores on Performance Approach Goals. The slope coefficient of *Performance Approach Goals – Task Orientation* indicated that students who perceived classroom as more task oriented were more likely to set performance approach goals such as performing better than classmates. The *Performance Approach Goals – Equity* slope coefficient indicated that students who had more equal learning opportunities with the other students in the same classroom were more likely to have performance approach oriented goals in learning science.

Results of the final estimation of random effects obtained from Random Coefficient Model (see Table 4.14) showed that that variance among the class means $\tau_{00} = .021$ with the chi-square statistics of 628.09 was found as statistically significant (p<.001). This significant variation among 372 classes suggested that this variability might be explained by inclusion of class level factors in to the model. Moreover, the slopes of *Performance Approach Goals –Involvement* (χ^2 = 451.12, p< .01), *Performance Approach Goals – Task Orientation* (χ^2 = 460.51, p< .01), and *Performance Approach Goals - Equity* (χ^2 = 484.56, p< .001), were all varied significantly, which indicated that in some classes, the slopes are much steeper than for other classes. In other words, while the relationships between *Performance Approach Goals* these variables were stronger in some classes, they are weaker in other classes. The variability among classes also suggested that class differences took effect on the slopes for *Involvement, Task Orientation,* and *Equity* and class level variables might account for some of the differences. On the other hand, the variance components of *Gender, Student Cohesiveness, Involvement*, and *Cooperation* were not significant, which implies that class differences did not have an impact on the slops for these variables. Additionally, although the variance component for *Involvement* was found as significant, it was not significant predictor of *Performance Approach Goals.* Therefore, though *Involvement* was retained in the model, it was not the focus.

To find out how much variance of Performance Approach Goals was explained in student level the variances in the Analysis of Variance Model and the Random Coefficient Model were compared. The proportion of reduction in variance at student level (R^2) was calculated by comparing σ^2 estimates of Analysis of Variance Model and the Random Coefficient Model of as follows:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Means\ as\ Outcome)}{\sigma^2(random\ ANOVA)} = \frac{0.931 - 0.714}{0.931} = 0.233$$

By including these student level factors (Gender, Student Cohesiveness, Involvement, Task Orientation, and Equity) as predictors of *Performance Approach Goals* within class variance was reduced by 23.3 %. Therefore, these factors account for about 23 % of the student level variance in performance approach goal orientation.

Regarding reliability of the intercept and randomly varying slopes, results of the HLM analysis showed that reliability of intercept (.31) was quite reliable than reliability of slopes of Involvement (.15), Task orientation (.17), and Equity (.14) (see Table 4.14).

4.2.2.3.5 Mastery Avoidance Goals

Result of the fixed effects of random coefficient model (see Table 4.13) built for *Mastery Avoidance Goals* showed that among the eight level-1 variables, *Gender* (S_FEMALE, γ = .118 se = .023, p < .001), *Task Orientation* (ZSWHTO, γ = .113 se = .014, p < .001), and *Cooperation* (ZSWHCOOP, γ = .178, se = .015, p < .001) were positively an significantly related to *Mastery Avoidance Goals*. However, *Involvement* (ZSWHINVO, γ = -.047 se = .017, p < .01) was found as negatively related to *Mastery Avoidance Goals.* Namely, the slope coefficient of *Mastery Avoidance Goals – Gender* indicated that female student tended to set more mastery avoidance oriented goals in science class than males. The slope coefficient of *Mastery Avoidance Goals – Task Orientation* indicated that students who perceived classroom as more task oriented reported higher scores on *Mastery Avoidance Goals*.

The *Mastery Avoidance Goals – Cooperation* slope coefficient indicated that students who perceived classroom learning environment as more cooperative were more likely to have mastery avoidance oriented goals in learning science. On the other hand, The *Mastery Avoidance Goals – Involvement* slope coefficient indicated that students who tended to involve in classroom activities reported setting less Mastery avoidance goals in science class.

Results of the final estimation of random effects obtained from random coefficient model (see Table 4.14) showed that that variance among the class means $\tau_{00} = .035$ with the chi-square statistics of 480.83 was found as statistically significant (p<.001). This significant variation among 372 classes suggested that this variability might be explained by inclusion of class level factors in to the model. Moreover, the slopes of *Mastery Avoidance Goals – Gender* (χ^2 = 427.51, *p*< .05), *Mastery Avoidance Goals –Involvement* (χ^2 = 423.51, *p*< .05), and *Mastery Avoidance Goals – Investigation* (χ^2 = 429.11, *p*< .05) were all varied significantly, which indicated that in some classes, the slopes are much steeper than for other classes. In other words, while the relationships between *Mastery Avoidance Goals* and these variables were stronger in some classes, they are weaker in other classes. The variability among classes also suggested that class differences took effect on the slopes for *Gender, Involvement,* and *Investigation, an*d class level variables might account for some of the differences. On the other hand, the variance components of *Task Orientation* and *Equity* were not significant, which implies that class differences did not have an impact on the slops for these variables. Additionally, although the variance component for *Investigation* was found as significant, it was not significant predictor of *Mastery Avoidance Goals,* Therefore, though *Investigation* was retained in the model, it was not the focus.

To find out how much variance of *Mastery Avoidance Goals* was explained in student level the variances in the Analysis of Variance Model and the Random Coefficient Model were compared. The proportion of reduction in variance at student level (R^2) was calculated by comparing σ^2 estimates of Analysis of Variance Model and the Random Coefficient Model of as follows:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Means\ as\ Outcome)}{\sigma^2(random\ ANOVA)} = \frac{0.960 - 0.884}{0.960} = 0.079$$

By including these student level factors (Gender, Involvement, Investigation, Task Orientation, and Equity) as predictors of *Mastery Avoidance Goals,* within class variance was reduced by 7.9%. Therefore, these factors account for about 8% of the student level variance in Mastery Avoidance Goal Orientation.

Regarding reliability of the intercept and randomly varying slopes, results of the HLM analysis showed that reliability of intercept (.24) was quite reliable than reliability of slopes of Gender (.11), Involvement (.12), and Investigation (.14) (see Table 4.14).

4.2.2.3.6 Performance Avoidance Goals

Result of the fixed effects of Random Coefficient Model (see Table 4.13) showed that among the eight level-1 variables, *Student Cohesiveness* (ZSWHSC, γ = .043, se = .014, p < .01), *Task Orientation* (ZSWHTO, γ = .213, se = .016, p < .001), *Cooperation* (ZSWHCOOP, γ = .143, se = .015, p < .001), and *Equity* (ZSWHEQU, γ = .063, se = .016, p < .001) were positively and significantly associated with *Performance Avoidance Goals*. However, *Involvement* (ZSWHINVO, γ = -.044, se = .015, p < .01) was found as negatively related to *Performance Avoidance Goals.* Namely, the slope coefficient of *Performance Avoidance Goals – Student Cohesiveness* indicated that students who perceived students' relationships in the classroom as more positively and friendly reported higher scores on *Performance Avoidance Goals.* The slope coefficient of *Performance Avoidance Goals – Task Orientation* indicated that students who perceived classroom as more task oriented reported higher scores on *Performance Avoidance Goals*. *Performance Approach Goals – Cooperation* slope coefficient showed that higher level of cooperation among students in classroom activities and conducting group works related to students' setting more performance avoidance oriented goals in science class. The *Mastery Avoidance Goals – Equity* slope coefficient indicated that students who had more equal learning opportunities with the other students in the same classroom were more likely to have performance avoidance oriented goals in learning science. On the other hand, The *Performance Avoidance Goals – Involvement* slope coefficient indicated that students who tended to involve in classroom activities reported setting less Performance avoidance goals in science class.

Results of the final estimation of random effects obtained from random coefficient model (see Table 4.14) showed that that variance among the class means $\tau_{00} = .039$ with the chi-square statistics of 502.21 was found as statistically significant (p<.001). This significant variation among 372 classes suggested that this variability might be explained by inclusion of class level factors in to the model. Moreover, the slopes of *Performance Avoidance Goals –Gender* (χ^2 = 434.68, *p*< .05), *Performance Avoidance Goals – Student Cohesiveness* (χ^2 = 423.59, *p*< .05), *Performance Avoidance Goals – Task Orientation* (χ^2 = 455.88, *p*< .01), and *Mastery Avoidance Goals – Equity* (χ^2 = 439.70, *p*< .01) were all varied significantly, which indicated that in some classes, the slopes are much steeper than for other classes. In other words, while the relationships *Performance Avoidance Goals* and between these variables were stronger in some classes, they are weaker in other classes. The variability among classes also suggested that class differences took effect on the slopes for *Gender, Student Cohesiveness, Task Orientation,* and *Equity, an*d class level variables might account for some of the differences. On the other hand, the variance components of *Involvement* and *Cooperation* were not significant, which implies that class differences did not have an impact on the slops for these variables. Additionally, although the variance component for *Gender* was found as significant, it was not significant predictors of *Performance Avoidance Goals,* Therefore, though *Gender* was retained in the model, it was not the focus.

To find out how much variance in *Performance Avoidance Goals* was explained in student level the variances in the Analysis of Variance Model and the Random

Coefficient Model were compared. The proportion of reduction in variance at student level (R^2) was calculated by comparing σ^2 estimates of Analysis of Variance Model and the Random Coefficient Model of as follows:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Means\ as\ Outcome)}{\sigma^2(random\ ANOVA)} = \frac{0.938 - 0.783}{0.938} = 0.165$$

By including these student level factors (*Gender, Student Cohesiveness, Involvement, Task Orientation, Cooperation,* and *Equity*) as predictors of *Performance Avoidance Goals*, within class variance was reduced by 16.5%. Therefore, these factors account for about 17 % of the student level variance in performance avoidance goal orientation.

Regarding reliability of the intercept and randomly varying slopes, results of the HLM analysis showed that reliability of intercept (.26) was quite reliable than reliability of slopes of Gender (.17), Student Cohesiveness (.12), Task Orientation (.19) and Equity (.20) (see Table 4.14).

Table 4.13 Final estimation of fixed effects for student level predictors of Self-Regulation dimensions: Random Coefficient Model

	Self-Efficacy		Metacognitive Self-regulation		Mastery Approach Goals		Performance Approach Goals		Mastery Avoidance Goals		Performance Avoidance Goals	
Fixed Effects	γ	SE	γ	SE	γ	SE	γ	SE	γ	SE	γ	SE
Model for Class Means[1]												
Intercept	-.006	.014	-.092***	.016	-.061***	.015	-.043*	.017	-.064**	.019	-.000	.019
S_FEMALE (Gender)			.165***	.019	.124***	.018	.085***	.020	.118***	.023	.013	.023
ZSWHSC (Student Cohesiveness)	.028*	.012	.042***	.011	.047***	.011	.032**	.012			.043**	014
ZSWHTS (Teacher Support)	.022	.015	.033**	.012	.009	.013						
ZSWHINVO (Involvement)	.169***	.014	.058***	.014	.009	.014	.020	.015	-.047**	.017	-.044**	.015
ZSWHINVE (Investigation)	.142***	015	.290***	.014					.011	.017		
ZSWHTO (Task Orientation)	.348***	.013	.325***	.013	.498***	.014	.370***	.015	.113***	.014	.213***	.016
ZSWHCOOP (Cooperation)	-.114***	.013	-.059***	.012	-.028*	.012			.178***	.015	.143***	.015
ZSWHEQU (Equity)	.119***	.014	.072***	.013	.153***	.014	.066***	.015			.063***	.016

Note. Only predictors in final models were included in the table. Predictors that have no coefficient value in the table were excluded variables from the related model because of its non-significant fixed and random effect on outcome variable.

**p< .05, **p<.01, ***p<.001*

1: The all continuous student level variables were grand mean centered

Table 4.14 Final estimation of random effects for student level predictors of Self-Regulation dimensions: Random Coefficient Model

Random Effects	Variance Components	df	χ^2	R^2	Reliability (λ)
ZSSE (Self-Efficacy)					
Class mean, u_{0j}	..049	371	900.66***		.532
ZSWHTS (Teacher Support), u_{2j}	.019	371	517.25***		.231
ZSWHINVE (Investigation), u_{4j}	.019	371	514.76***		.230
ZSWHTO (Task Orientation), u_{5j}	.008	371	467.51**		.117
ZSWHEQU (Equity), u_{7j}	.011	371	467.39**		.141
Level-1 Effect, r_{ij}	.532			.402	
ZSMC (Metacognitive Self-Regulation)					
Class mean, u_{0j}	.041	371	607.31***		.352
S_FEMALE(Gender), u_{1j}	.033	371	490.422***		.204
ZSWHINVE (Investigation), u_{5j}	.016	371	489.51***		.230
ZSWHTO (Task Orientation), u_{6j}	.008	371	421.48*		.118
ZSWHEQU (Equity), u_{8j}	.010	371	448.15**		.160
Level-1 Effect, r_{ij}	.512			.441	
ZSGOMAP (Mastery Approach Goals)					
Class mean, u_{0j}	.026	371	538.43***		.260
S_FEMALE(Gender), u_{1j}	.021	371	443.15**		.144
ZSWHTS (Teacher Support), u_{3j}	.017	371	454.79**		.197
ZSWHINVO (Involvement, u_{4j}	.012	371	448.64**		.159
ZSWHTO (Task Orientation), u_{5j}	.027	371	584.85***		.304
ZSWHEQU (Equity), u_{7j}	.020	371	509.09***		.227
Level-1 Effect, r_{ij}	.484			.461	
ZSGOPAP (Performance Approach Goals)					
Class mean, u_{0j}	.021	371	628.09***		.313
ZSWHINVO (Involvement, u_{3j}	.013	371	451.12**		.149
ZSWHTO (Task Orientation), u_{4j}	.015	371	460.51**		.167
ZSWHEQU (Equity), u_{5j}	.013	371	484.56***		.143
Level-1 Effect, r_{ij}	.714			.233	
ZSGOMAV (Mastery Avoidance Goals)					
Class mean, u_{0j}	.035	371	480.83***		.236
S_FEMALE(Gender), u_{1j}	.024	371	427.51*		.109
ZSWHINVO (Involvement, u_{2j}	.013	371	423.51*		.124
ZSWHINVE (Investigation), u_{3j}	.015	371	429.11*		.135
Level-1 Effect, r_{ij}	.884			.079	
ZSGOPAV (Performance Avoidance Goals)					
Class mean, u_{0j}	.039	371	502.21***		.259
S_FEMALE(Gender), u_{1j}	.039	371	434.68*		.166
ZSWHSC (Student Cohesiveness), u_{2j}	.009	371	423.59*		.117
ZSWHTO (Task Orientation), u_{4j}	.020	371	455.88**		.187
ZSWHEQU (Equity), u_{6j}	.021	371	439.70**		.199
Level-1 Effect, r_{ij}	.783			.165	

*p< .05, **p<.01, ***p<.00

4.2.2.4 Results of Research Question 2.d: Intercepts and Slopes as Outcomes Model

In order to test the research question about teacher characteristics which influence the effect of student variables on the students' self-regulation, Intercepts and Slopes as Outcomes Model was conducted for each outcome variable (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*).

In this model, randomly varying slopes of significant predictors which were found by Random Coefficient Models in previous section were regarded as outcome variable. Namely, the variability in level-1 (student level) coefficients from class to class was examined to ascertain whether level-2 (class level) factors explain the variability. The coefficient was an indicator of the amount of influence a variable has on the endogenous variable. There was only one level-2 equation for each randomly varying level-1 Beta (slope) coefficient. The level-2 variables which were found as significantly related with level-1 variables are called as moderation effect which referred to the cross-level interaction between student level predictors and class level predictors.

Conducting an Intercepts and Slopes as Outcomes Model for research Question 2d requires the results of three previous research questions: (2a) Analysis of Variance Model, in order to find out whether classes differ in dimensions of students' Self-Regulation (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals*, and *Performance Avoidance Goals*), (2b) Means as Outcomes Model, in order to find out the class level factors that explain the variability in intercepts of each dimension of students' Self-Regulation, and (2c) Random Coefficient Model, in order to find out the student level factors that have fixed or random effect on each dimensions of students' Self-Regulation. In the light of these findings the research question 2d was tested for each dimension of students' Self-Regulation. Since the final estimation of previous models for each dimension were found as different from each other, results of the

Intercepts and Slopes as Outcomes Models were considered separately in following sections.

4.2.2.4.1 Self-Efficacy: Results of Intercepts and Slopes as Outcomes Model

By considering the results of the previous analyses, Intercepts and Slopes as Outcomes Model was built for *Self-Efficacy,* subsequently. The first model was built with the class level variables that were previously found as significantly related to intercept of *Self-Efficacy* in the Means as Outcomes Model (*Emotional Exhaustion* and *Personal Accomplishment*) and student level variables that were previously found as significant predictors of Self-Efficacy in Random Coefficient Model *(/Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity*).

The equations for the first model in these analyses are:

Student Level (level-1) Model:

$$Self-Efficacy\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (ZSWHSC) + \beta_{2J} * (ZSWHTS) + \beta_{3J} * (ZSWHINVO) + \beta_{4J} * (ZSWHINVE) + \beta_{5J} * (ZSWHTO) + \beta_{6J} * (ZSWHCOOP) + \beta_{7J} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (ZTBUEE)_j + \gamma_{02} * (ZBUPA)_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20} + u_{2j}$$

$$\beta_{3j} = \gamma_{30}$$

$\beta_{4j} = \gamma_{40} + u_{4j}$

$\beta_{5j} = \gamma_{50} + u_{5j}$

$\beta_{6j} = \gamma_{60}$

$\beta_{7j} = \gamma_{70} + u_{7j}$

Result of the model presented above showed that *Emotional Exhaustion* and *Personal accomplishment* were found as significant, and these variables were retained in the model.

As a next step, 9 level-2 variables (i.e., *Teacher's Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Science Ability*) were incorporated in the randomly varying slopes of significant predictors (*Investigation, Task Orientation,* and *Equity*) of the model. However, since *Teacher Support* was not significant predictor of *Self-Efficacy*, this variable was not tested for moderation effect.

Afterwards, these 9 level-2 variables were subsequently included in the slope of *Investigation.* The equations for second model in this analysis are:

$$Self - Efficacy\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (ZSWHSC) + \beta_{2J} * (ZSWHTS) + \beta_{3J} * (ZSWHINVO) + \beta_{4J} * (ZSWHINVE) + \beta_{5J} * (ZSWHTO) + \beta_{6J} * (ZSWHCOOP) + \beta_{7J} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

$\beta_{0j} = \gamma_{00} + \gamma_{01} * (ZTBUEE)_j + \gamma_{02} * (ZBUPA)_j + u_{0j}$

$\beta_{1j} = \gamma_{10}$

$$\beta_{2j} = \gamma_{20} + u_{2j}$$

$$\beta_{3j} = \gamma_{30}$$

$$\beta_{4j} = \gamma_{40} + \gamma_{41} * (\text{T\_FEMALE})_j + \gamma_{42} * (ZT\_EXPER)_j + \gamma_{43} * (ZTSESE)_j + \gamma_{44} * (ZTSEIS)_j + \gamma_{45} * (ZTSECM)_j + \gamma_{46} * (ZTJS)_j + \gamma_{47} * (ZTBUEE)_j + \gamma_{48} * (ZBUPA)_j + \gamma_{49} * (ZTITSA)_j + u_{4j}$$

$$\beta_{5j} = \gamma_{50} + u_{5j}$$

$$\beta_{6j} = \gamma_{60}$$

$$\beta_{7j} = \gamma_{70} + u_{7j}$$

Result of the model presented above showed that none of the 9 level-2 variables were found as significant. Therefore all level-2 variables were removed from the model of *Investigation* slope.

Then, the same procedure was followed in the tests for *Task Orientation*. The equations for the third model in this analysis are:

Student level (leve-1) model:

$$Self - Efficacy\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (ZSWHSC) + \beta_{2J} * (ZSWHTS) + \beta_{3J} * (ZSWHINVO) + \beta_{4J} * (ZSWHINVE) + \beta_{5J} * (ZSWHTO) + \beta_{6J} * (ZSWHCOOP) + \beta_{7J} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (ZTBUEE)_j + \gamma_{02} * (ZBUPA)_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$\beta_{2j} = \gamma_{20} + u_{2j}$

$\beta_{3j} = \gamma_{30}$

$\beta_{4j} = \gamma_{40} + u_{4j}$

$$\beta_{5j} = \gamma_{50} + \gamma_{51} * (\text{T\_FEMALE})_j + \gamma_{52} * (ZT\_EXPER)_j + \gamma_{53} * (ZTSESE)_j + \gamma_{54} * (ZTSEIS)_j + \gamma_{55} * (ZTSECM)_j + \gamma_{56} * (ZTJS)_j + \gamma_{57} * (ZTBUEE)_j + \gamma_{58} * (ZBUPA)_j + \gamma_{59} * (ZTITSA)_j + u_{5j}$$

$\beta_{6j} = \gamma_{60}$

$\beta_{7j} = \gamma_{70} + u_{7j}$

Among these 9 level-2 variables, only *Experience* and *Personal Accomplishment* were found as significant. Therefore, only these two variables were retained in the model of *Task Orientation* slope.

Finally, the 9 level-2 variables were also included in the model of the *Equity* slope. The equations for the third model in this analysis are:

Student level (leve-1) model:

$$Self - Efficacy\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (ZSWHSC) + \beta_{2J} * (ZSWHTS) + \beta_{3J} * (ZSWHINVO) + \beta_{4J} * (ZSWHINVE) + \beta_{5J} * (ZSWHTO) + \beta_{6J} * (ZSWHCOOP) + \beta_{7J} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

$\beta_{0j} = \gamma_{00} + \gamma_{01} * (ZTBUEE)_j + \gamma_{02} * (ZBUPA)_j + u_{0j}$

$\beta_{1j} = \gamma_{10}$

$$\beta_{2j} = \gamma_{20} + u_{2j}$$

$$\beta_{3j} = \gamma_{30}$$

$$\beta_{4j} = \gamma_{40} + u_{4j}$$

$$\beta_{5j} = \gamma_{50} + \gamma_{51} * (ZT\_EXPER)_j + \gamma_{52} * (ZBUPA)_j + u_{5j}$$

$$\beta_{6j} = \gamma_{60}$$

$$\beta_{7j} = \gamma_{70} + \gamma_{71} * (\text{T\_FEMALE})_j + \gamma_{72} * (ZT\_EXPER)_j + \gamma_{73} * (ZTSESE)_j + \gamma_{74} * (ZTSEIS)_j + \gamma_{75} * (ZTSECM)_j + \gamma_{76} * (ZTJS)_j + \gamma_{77} * (ZTBUEE)_j + \gamma_{78} * (ZBUPA)_j + \gamma_{79} * (ZTITSA)_j + u_{7j}$$

Results showed that among the 9 level-2 variables, only *Efficacy for Instructional Strategies* was found as significant. Therefore, only *Efficacy for Instructional Strategies* was retained in the model of *Equity* slope. As a full final result of these four models, the final estimation of Intercepts and Slopes as Outcomes Model was represented as the following equation:

Student level (leve-1) model:

$$Self - Efficacy\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (ZSWHSC) + \beta_{2J} * (ZSWHTS) + \beta_{3J} * (ZSWHINVO) + \beta_{4J} * (ZSWHINVE) + \beta_{5J} * (ZSWHTO) + \beta_{6J} * (ZSWHCOOP) + \beta_{7J} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (ZTBUEE)_j + \gamma_{02} * (ZBUPA)_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20} + u_{2j}$$

$$\beta_{3j} = \gamma_{30}$$

$$\beta_{4j} = \gamma_{40} + u_{4j}$$

$$\beta_{5j} = \gamma_{50} + \gamma_{51} * (ZT\_EXPER\ )_j + \gamma_{52} * (ZBUPA)_j + u_{5j}$$

$$\beta_{6j} = \gamma_{60}$$

$$\beta_{7j} = \gamma_{70} + \gamma_{71} * (ZTSEIS)_j + u_{7j}$$

Results of the final estimation of fixed effects obtained from the final full Intercepts and Slopes as Outcomes Model for *Self-Efficacy* were presented in table 4.15. The results of the final full Intercepts and Slopes as Outcomes Model also included the results of Means as Outcome Model (research Question 2b). Students' average *Self-Efficacy* was significantly associated with teachers' *Emotional Exhaustion* and *Personal Accomplishment. Self-Efficacy* was positively related to teachers' *Emotional Exhaustion* (ZTBUEE; $\boldsymbol{\gamma}$ = .032, se = .014, $p < .05$) and *Personal Accomplishment* (ZBUPA; $\boldsymbol{\gamma}$ = .047, se = .015, $p < .01$). That is, the higher science teachers experience *Emotional Exhaustion* and *Personal Accomplishment,* the higher students have confidence in learning science.

Moreover, the results from the Random Coefficient Model (Research Question 2c) were also reported in the final full Intercepts and Slopes as Outcomes Model. *Student Cohesiveness, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity* were found as significantly related to students' *Self-Efficacy. Student Cohesiveness* (ZSWHSC; $\boldsymbol{\gamma}$ = .028, se = .011, $p < .05$). *Involvement* (ZSWHINVO; $\boldsymbol{\gamma}$ = .169, se = .014, $p < .001$), Investigation (ZSWHINVE; $\boldsymbol{\gamma}$ = .142, se = .015, $p < .001$), *Task Orientation* (ZSWHTO; $\boldsymbol{\gamma}$ = .348, se = .013, $p < .001$), and *Equity* (ZSWHEQU; $\boldsymbol{\gamma}$ = .119, se = .014, $p < .001$) were positively associated with *Self-Efficacy.* However, *Cooperation* (ZSWHCOOP; $\boldsymbol{\gamma}$ = -.116, se = .013, $p < .001$) was found as negatively related to *Self-Efficacy*. That is, the average slope coefficient of *Self-Efficacy – Student Cohesiveness* indicated that student who perceived students' relationships in the classroom as more positively and friendly had higher efficacy in science class. The average *Self-Efficacy – Involvement* slope coefficient indicated that students who tended to involve in classroom activities had higher confidence in science class. The average *Self-Efficacy – Investigation* slope coefficient indicated that students who tended to do more inquiry and have problem solving skills in science class had higher self-efficacy. The average slope coefficient of *Self-Efficacy – Task Orientation* indicated that students who perceived classroom as more task oriented reported higher confidence in science class. The average *Self-Efficacy – Equity* slope coefficient indicated that students who had more equal learning opportunities with the other students in the same classroom had higher efficacy in learning science. On the other hand, the average *Self-Efficacy – Cooperation* slope coefficient showed that cooperation among students in classroom activities decrease students' confidence in science class. Comparison of the coefficients obtained from Random Coefficient Model and Intercepts and Slopes as Outcomes Model showed a slight difference in magnitude, although they were identical in terms of directions and interpretations. This difference might be emerged because of the inclusion of level-2 variables into the Intercept and Slopes Model.

Regarding moderation effect, results of final full Intercepts and Slopes as Outcomes Model yielded some cross-level interactions among the predictors of *Self-Efficacy*. Firstly, the *Task Orientati*on slope coefficient model had two significant class level variables: *Experience* (ZT_EXPER; γ_{51}= -.029, se = .010, $p < .01$) and *Personal Accomplishment* (ZTBUPA; γ_{52}= .026, se = .011, $p < .05$). Namely, *Experience* and *Personal Accomplishment* moderated the effect of *Task orientation* on *Self-Efficacy.* The relationship between students' efficacy in science class and perception of task orientation was weaker in the classrooms thought by the more experienced teachers, but stronger for the students in the classrooms thought by the teachers who had higher level personal accomplishment.

The *Self-Efficacy – Task Orientation* slope model is:

$\beta_5 = \gamma_{50} + \gamma_{51} * (ZT\_EXPER) + \gamma_{52} * (ZBUPA) + u_5$

β_5 is the overall *Task Orientation* slope

γ_{50} is the average *Task Orientation* – Self-Efficacy slope across the classes

γ_{51} is the effect of *Experience* on the overall slope

γ_{52} is the effect of *Personal Accomplishment* on the overall slope

u_5 is the random effect or error

These coefficients were found as γ_{50}= .348, γ_{51}= -.029, and γ_{52}= .026. Incorporating these coefficients into the equation resulted with:

$\beta_5 = 0.348 - 0.029(ZT\_EXPER) + 0.026(ZBUPA) + u_5$

Secondly, the *Equity* coefficient model had only one significant class level variable: *Efficacy for Instructional Strategies* (ZTSEIS; γ_{71}= -.021, se = .010, p < .05). That is, science teachers' *Efficacy for Instructional Strategies* mediated the effect of students' perceptions of *Equity* in science class with *Self-Efficacy.* The students' perception of equity in science class had less of influence on Self-Efficacy in the classrooms thought by the teachers having higher confidence in using instructional strategies in science class.

The *Self-Efficacy – Equity* slope model is:

$\beta_7 = \gamma_{70} + \gamma_{71} * (ZTSEIS) + u_7$

β_7 is the overall *Equity* slope

γ_{70} is the average *Equity – Self-Efficacy* slope across the classes

γ_{71} is the effect of *Efficacy for Instructional Strategies* on the overall slope

u_7 is the random effect or error

These coefficients were found as γ_{70}= .119, and γ_{71}= -.021. Incorporating these coefficients into the equation results with:

$$\beta_7 = 0.119 - 0.021(ZTSEIS) + u_7$$

The results of the final estimation of variance components obtained from the full final Intercepts and Slopes as Outcomes Model for *Self-Efficacy* were presented in table 4.16. The proportion of variance explained in each *Self-Efficacy* slope model with significant class level predictors were calculated by comparing variance components obtained from Random Coefficient Model and final full Intercepts and Slopes as Outcomes Model as follows:

Proportion of variance explained in β_{qj}:

$$R^2 = \frac{\tau_{qq}(Random\ Coefficient) - \tau_{qq}(Intercepts\ and\ Slopes\ as\ Outcomes)}{\tau_{qq}(Random\ Coefficient)}$$

β_{qj} is *Self-Efficacy* or the slope coefficient for a given variable

Proportion of variance explained in *Self-Efficacy*, β_{0j}: $R^2 = \frac{0.049-0.047}{0.049} = 0.041$

Proportion of variance explained in *Task Orientation*, β_{5j}: $R^2 = \frac{0.008-0.007}{0.008} = 0.125$

Proportion of variance explained in *Equity*, β_{7j}: $R^2 = \frac{0.011-0.010}{0.011} = 0.091$

Based on these findings, it was concluded that 4.1% of the variance in the between class difference in mean *Self-Efficacy* was accounted for by *Emotional Exhaustion* and *Personal Accomplishment.* For *Task Orientation*, although 12.5% reduction in the variance was accounted for by *Experience* and *Personal Accomplishment*, significant differences still remained among classes (χ^2 = 439.77, p<0.01). Moreover, for *Equity*, 9.1% of the variance was accounted for by *Efficacy for Instructional Strategies*. However, still there was a significant variability among the classes (χ^2 =468.42, p<0.01). All of these proportions indicated that small amount of variations had been accounted for.

Table 4.15 Final estimation of fixed effects for Self-Efficacy: Intercepts and Slopes as Outcomes Model

Fixed Effects	Coefficient	SE
ZSSE (Self-Efficacy), Model for Class Means[1]		
Intercept, γ_{00}	-.007	.014
ZTBUEE (Emotional Exhaustion), γ_{01}	.032*	.014
ZTBUPA (Personal Accomplishment), γ_{02}	.047**	.015
ZSWHSC (Student Cohesiveness), γ_{10}	.028*	.011
ZSWHTS (Teacher Support), γ_{20}	.021	.014
ZSWHINVO (Involvement), γ_{30}	.169***	.014
ZSWHINVE (Investigation), γ_{40}	.142***	015
ZSWHTO (Task Orientation), γ_{50}	.348***	.013
ZT_EXPER (Experience), γ_{51}	-.029**	.010
ZTBUPA (Personal Accomplishment), γ_{52}	.026*	.011
ZSWHCOOP (Cooperation), γ_{60}	-.116***	.013
ZSWHEQU (Equity), γ_{70}	.119***	.014
ZTSEIS (Efficacy for instructional strategies), γ_{71}	-.021*	.010

Note. Only predictors in final model were included in the table.

**p< .05, **p<.01, ***p<.001*

1: The all continuous student level and class level variables were grand mean centered

Table 4.16 Final estimation of variance components for Self-Efficacy: Intercepts and Slopes as Outcomes model

Random Effects	Variance Components	df	χ^2	R^2	Reliability
ZSSE (Self-Efficacy)					
Class mean, u_{0j}	.047	369	885.19***	.041	.532
ZSWHTS (Teacher Support), u_{2j}	.019	371	516.97***		.231
ZSWHINVE (Investigation), u_{4j}	.019	371	514.53***		.230
ZSWHTO (Task Orientation), u_{5j}	.007	369	439.77**	.125	.117
ZSWHEQU (Equity), u_{7j}	.010	370	468.42**	.091	.141
Level-1 Effect, r_{ij}	.533			.401	

Note. Only predictors in final model were included in the table.

**p< .05, **p<.01, ***p<.001*

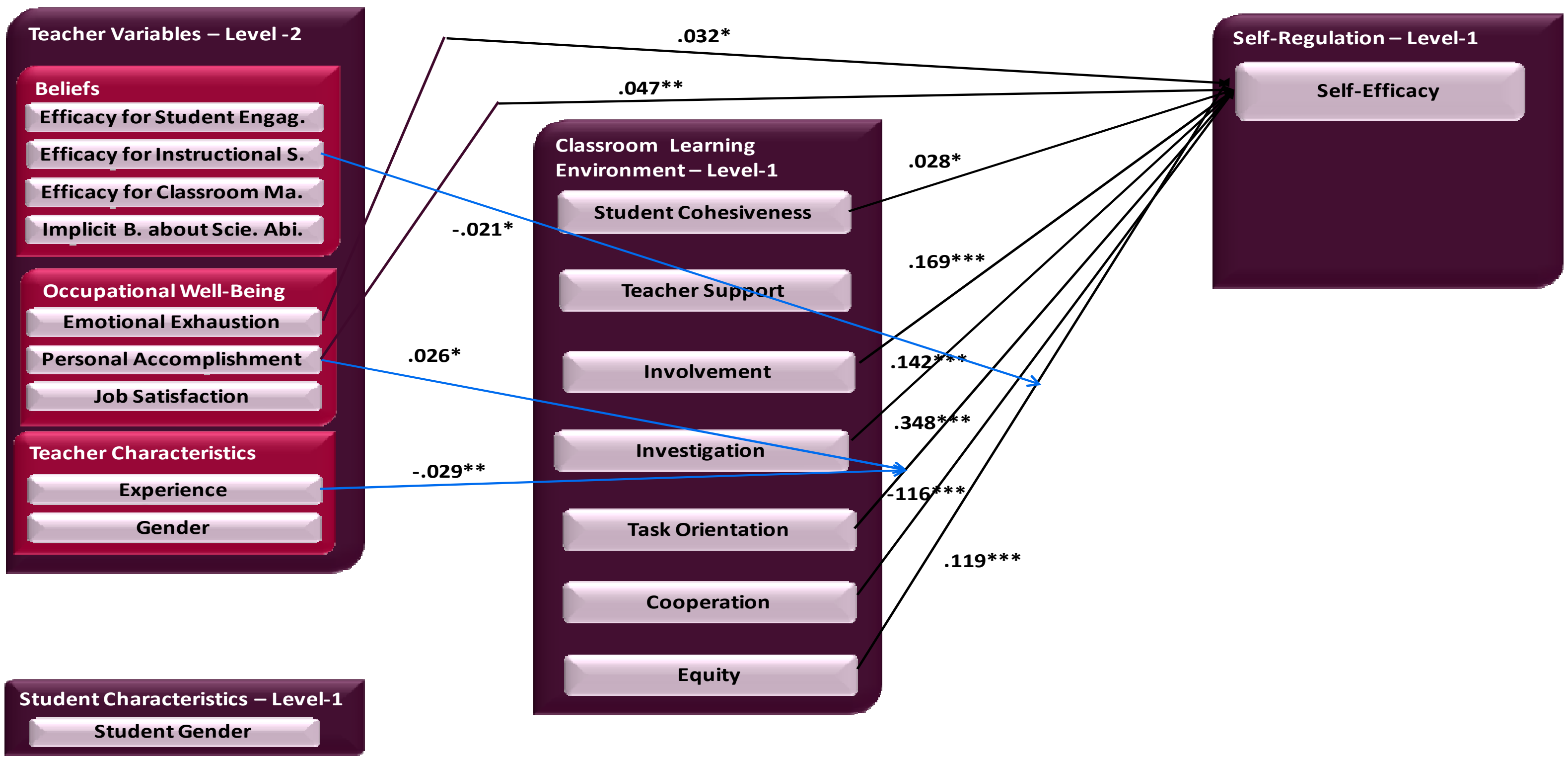

Figure 4.2 Predicting Self-Efficacy by classroom learning environment variables (level-1), student gender (level-1) and teacher variables (level-2).

Note: Arrows do not indicate causal relationships. Their directions are from predictors to outcome variables. Blue arrows indicate interaction of level-1 and level-2 variables. *p< .05, **p<.01, ***p< .001

4.2.2.4.2 Metacognitive Self-Regulation: Results of Intercepts and Slopes as Outcomes Model

Intercepts and Slopes as Outcomes model was built for *Metacognitive Self-Regulation* by taking results of the previous models for the same variable into account. Level-1 and level-2 variables were included in the current model subsequently. Firstly, the class level variables which were previously found as significantly associated with intercept of the *Metacognitive Self-Regulation* in Means As Outcomes Model (*Experience, Emotional Exhaustion and Personal Accomplishment*) and student level variables which were previously found as significant predictors of *Metacognitive Self-Regulation* in Random Coefficients Model (*Gender, Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity*).

The equations for the first model in these analyses are:

Student Level (level-1) Model:

$$Metacognitive\ Self - Regulation\ (Y_{ij})$$
$$= \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2j} * (ZSWHSC) + \beta_{3J} * (ZSWHTS)$$
$$+ \beta_{4J} * (ZSWHINVO) + \beta_{5J} * (ZSWHINVE) + \beta_{6J} * (ZSWHTO)$$
$$+ \beta_{7J} * (ZSWHCOOP) + \beta_{8J} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (ZT\_EXPER)_j + \gamma_{02} * (ZTBUEE)_j + \gamma_{03} * (ZBUPA)_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30}$$

$$\beta_{4j} = \gamma_{40}$$

$\beta_{5j} = \gamma_{50} + u_{5j}$

$\beta_{6j} = \gamma_{60} + u_{6j}$

$\beta_{7j} = \gamma_{70}$

$\beta_{8j} = \gamma_{80} + u_{8j}$

Result of the model presented above showed that among these 3 class level variables *Experience* and *Personal Accomplishment* were found as significant, but not *Emotional Exhaustion.* Therefore, while *Experience* and *Personal Accomplishment* were retained in the model, *Emotional Exhaustion* was removed.

As a next step, 9 level-2 variables (i.e., *Teacher's Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Science Ability*) were subsequently incorporated in the randomly varying slopes of significant predictors of *Metacognitive Self-Regulation* (*Gender, Investigation, Task Orientation,* and *Equity*) of the model. The same procedures were followed with the section 4.2.2.4.1.

Firstly, these 9 level-2 variables were subsequently included in the slope of *Gender.* Among the 9 class level variables, only *Efficacy for Instructional Strategies* was found as significantly related to *Gender* slope. Secondly, same 9 class level variables were incorporated in the *Investigation* slope model. Similarly, only *Efficacy for Instructional Strategies* was the significant predictor of *Investigation* slope. Then, 9 class level variables were included in *Task Orientation* slope models. However, none of these variables was significantly associated with *Task Orientation* slope. In the last step, none of these class level variables were found as significant for *the Equity* slope model. As a final result of these five models, the final estimation of Intercepts and Slopes as Outcomes Model was represented as the following equation:

Student Level (level-1) Model:

$$Metacognitive\ Self-Regulation\ (Y_{ij})$$
$$= \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2j} * (ZSWHSC) + \beta_{3J} * (ZSWHTS)$$
$$+ \beta_{4J} * (ZSWHINVO) + \beta_{5J} * (ZSWHINVE) + \beta_{6J} * (ZSWHTO)$$
$$+ \beta_{7J} * (ZSWHCOOP) + \beta_{8J} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (ZT\_EXPER)_j + \gamma_{02} * (ZBUPA)_j + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11} * (ZTSEIS)_j + u_{1j}$$
$$\beta_{2j} = \gamma_{20}$$
$$\beta_{3j} = \gamma_{30}$$
$$\beta_{4j} = \gamma_{40}$$
$$\beta_{5j} = \gamma_{50} + \gamma_{51} * (ZTSEIS)_j + u_{5j}$$
$$\beta_{6j} = \gamma_{60} + u_{6j}$$
$$\beta_{7j} = \gamma_{70}$$
$$\beta_{8j} = \gamma_{80} + u_{8j}$$

Results of the final estimation of fixed effects obtained from the final full Intercepts and Slopes as Outcomes Model for *Metacognitive Self-Regulation* were shown table 4.17. Students' average score on *Metacognitive Self-Regulation* was significantly associated with teachers' *Experience* and *Personal Accomplishment. Metacognitive Self-Regulation* was positively related to teachers' *Personal Accomplishment* (ZBUPA; $\boldsymbol{\gamma}$ = .039, se = .013, p < .01) but negatively associated with *Experience* (ZT_EXPER; $\boldsymbol{\gamma}$ = -.034, se = .012, p < .01). Namely, students tended to use more Metacognitive Self-Regulation Strategies in the classrooms thought by the science teachers who felt higher *Personal Accomplishment,* but had less experience.

Additionally, the results from the Random Coefficient Model (Research Question 2c) were also reported in the final full Intercepts and Slopes as Outcomes Model. Among the eight level-1 variables, *Gender* (S_FEMALE; γ = .166, se = .019, p < .001). *Student Cohesiveness* (ZSWHSC; γ = .043, se = .011, p < .001). *Teacher Support* (ZSWHTS; γ = .031, se = .012, p < .01). *Involvement* (ZSWHINVO; γ = .059, se = .014, p < .001), *Investigation* (ZSWHINVE; γ = .290, se = .014, p < .001), *Task Orientation* (ZSWHTO; γ = .324, se = .013, p < .001), and *Equity* (ZSWHEQU; γ = .073, se = .013, p < .001) were positively related to *Metacognitive-Self-Regulation.* However, *Cooperation* (ZSWHCOOP; γ = -.059, se = .012, p < .001) was found as negatively related to *Metacognitive-Self-Regulation*. Namely, the slope coefficient of *Metacognitive-Self-Regulation – Gender* indicated that female students were more prone to use metacognitive learning strategies in science class than males. The slope coefficient of *Metacognitive-Self-Regulation – Student Cohesiveness* indicated that students who perceived students' relationships in the classroom as more positively and friendly reported higher scores on *Metacognitive Self-Regulation*. The slope coefficient of *Metacognitive-Self-Regulation – Teacher Support* indicated that students who were more supported by science teacher tended to use more metacognitive learning strategies. The *Metacognitive-Self-Regulation – Involvement* slope coefficient indicated that students who tended to involve in classroom activities reported using more metacognitive strategies in science class. The *Metacognitive-Self-Regulation – Investigation* slope coefficient indicated that students who tended to do more inquiry and have problem solving skills in science class used more metacognitive learning strategies. The slope coefficient of *Metacognitive-Self-Regulation – Task Orientation* indicated that students who perceived classroom as more task oriented reported higher scores on using metacognitive learning strategies in science class. The *Metacognitive-Self-Regulation – Equity* slope coefficient indicated that students who had more equal learning opportunities with the other students in the same classroom tended to use more metacognitive strategies in learning science. On the other hand, the *Metacognitive-Self-Regulation – Cooperation* slope coefficient showed that higher level of cooperation among students in classroom activities and conducting group works related to students' using less metacognitive learning strategies in science class. Comparison of the coefficients obtained from Random Coefficient Model and Intercepts and Slopes as Outcomes Model showed a slight difference in magnitude, although they were identical in terms of directions and interpretations. This difference might be emerged because of the inclusion of level-2 variables into the intercept and slopes models.

Results of final full Intercepts and Slopes as Outcomes Model indicated some cross-level interactions among the predictors of *Metacognitive-Self-Regulation*. Firstly, *Efficacy for Instructional Strategies* (ZTSEIS; $\boldsymbol{\gamma_{11}}$= -.030, se = .015, p < .05) was found as significant predictor of *Gender* coefficient model. Namely, *Efficacy for Instructional Strategies* moderated the effect of *Gender* on *Metacognitive-Self-Regulation.* Female students tended to use more metacognitive learning strategies than males. However, the relationship between students' degree of using metacognitive learning strategies in science class and gender was weaker in the classrooms thought by the teachers who felt more confidence in using variety of instructional strategies in science class.

The *Metacognitive-Self-Regulation – Gender* slope model is:

$\beta_1 = \gamma_{10} + \gamma_{11} * (ZTSEIS) + u_1$

β_1 is the overall Gender slope

γ_{10} is the average Metacognitive-Self-Regulation – Gender slope across the classes

γ_{11} is the effect of Efficacy for Instructional Strategies on the overall slope

u_1 is the random effect or error

These coefficients were found as γ_{10}= .166 and γ_{11}= -.030. Incorporating these coefficients into the equation results with:

$\beta_1 = 0.166 - 0.030(ZTSEIS) + u_1$

Secondly, *Efficacy for Instructional Strategies* (ZTSEIS; γ_{51}= -.025, se = .010, p < .05) was also found as only significant predictor of the *Investigation* coefficient model. That is, science teachers' *Efficacy for Instructional Strategies* mediated the effect of students' perceptions of *Investigation* in science class on *Metacognitive-Self-Regulation*. The students' perception of investigation in science class had less of influence on *Metacognitive-Self-Regulation* in the classrooms thought by the teachers that have higher confidence in using variety of instructional strategies in science class.

The *Metacognitive-Self-Regulation – Investigation* slope model is:

$$\beta_5 = \gamma_{50} + \gamma_{51} * (ZTSEIS) + u_5$$

β_5 is the overall *Investigation* slope

γ_{50} is the average *Metacognitive-Self-Regulation – Investigation* slope across the classes

γ_{51} is the effect of *Efficacy for Instructional Strategies* on the overall slope

u_5 is the random effect or error

These coefficients were found as γ_{50}= .290, and γ_{51}= -.025. Incorporating these coefficients into the equation results with:

$$\beta_5 = 0.290 - 0.025(ZTSEIS) + u_5$$

The results of the final estimation of variance components obtained from the full final Intercepts and Slopes as Outcomes Model for *Metacognitive Self-Regulation* were presented in table 4.18. The proportion of variance explained in each *Metacognitive Self-Regulation* slope model with significant class level predictors were calculated by comparing variance components obtained from Random

Coefficient Model and final full Intercepts and Slopes as Outcomes Model as follows:

Proportion of variance explained in β_{qj}:

$$R^2 = \frac{\tau_{qq}(Random\ Coefficient) - \tau_{qq}(Intercepts\ and\ Slopes\ as\ Outcomes)}{\tau_{qq}(Random\ Coefficient)}$$

β_{qj} is *Metacognitive-Self-Regulation* or the slope coefficient for a given variable

Proportion of variance explained in *Metacognitive-Self-Regulation*, β_{0j}:

$$R^2 = \frac{0.041 - 0.038}{0.041} = 0.073$$

Proportion of variance explained in *Gender*, β_{1j}: $R^2 = \frac{0.033 - 0.031}{0.033} = 0.061$

Proportion of variance explained in *Investigation*, β_{5j}: $R^2 = \frac{0.016 - 0.015}{0.016} = 0.063$

It could be concluded that 7.3% of the variance in the between class difference in mean *Metacognitive-Self-Regulation* was accounted for by *Experience* and *Personal Accomplishment.* For *Gender*, although 6.1% reduction in the variance was accounted for by *Efficacy for Instructional Strategies*, significant differences still remained among classes ($\chi^2 = 485.36$, p<0.001). Moreover, for *Investigation*, 6.3% of the variance was accounted for by *Efficacy for Instructional Strategies*. However, still there was a significant variability among the classes ($\chi^2 = 482.60$, p<0.001). All of these proportions indicated that small amount of variations had been accounted for.

Table 4.17 Final estimation of fixed effects for Metacognitive Self-Regulation: Intercepts and Slopes as Outcomes Model

Fixed Effects	Coefficient	SE
ZSMC (Metacognitive Self-Regulation), Model for Class Means[1]		
Intercept, γ_{00}	-.092***	.016
ZT_EXPER (Experience), γ_{01}	-.034**	.013
ZTBUPA (Personal Accomplishment), γ_{02}	.039**	.013
S_FEMALE (Gender), γ_{10}	.166***	.019
ZTSEIS (Efficacy for Instructional Strategies), γ_{11}	-.030*	.015
ZSWHSC (Student Cohesiveness), γ_{20}	.043***	.011
ZSWHTS (Teacher Support), γ_{30}	.031**	.012
ZSWHINVO (Involvement), γ_{40}	.059***	.014
ZSWHINVE (Investigation), γ_{50}	.290***	.014
ZTSEIS (Efficacy for Instructional Strategies), γ_{51}	-.025*	.010
ZSWHTO (Task Orientation), γ_{60}	.324***	.013
ZSWHCOOP (Cooperation), γ_{70}	-.059***	.012
ZSWHEQU (Equity), γ_{80}	.073***	.013

Note. Only predictors in final model were included in the table.

**p< .05, **p<.01, ***p<.001*

1: The all continuous student level and class level variables were grand mean centered

Table 4.18 Final estimation of variance components for Metacognitive Self-Regulation: Intercepts and Slopes as Outcomes model

Random Effects	Variance Components	df	χ^2	R^2	Reliability
ZSMC (Metacognitive Self-Regulation)					
Class mean, u_{0j}	.038	369	593.96***	.073	.339
S_FEMALE (Gender), u_{1j}	.031	370	485.36***	.061	.197
ZSWHINVE (Investigation), u_{5j}	.015	370	482.60***	.063	.220
ZSWHTO (Task Orientation), u_{6j}	.008	371	421.40*		.119
ZSWHEQU (Equity), u_{8j}	.010	371	448.27**		.159
Level-1 Effect, r_{ij}	.512			.441	

Note. Only predictors in final model were included in the table.

**p< .05, **p<.01, ***p<.001*

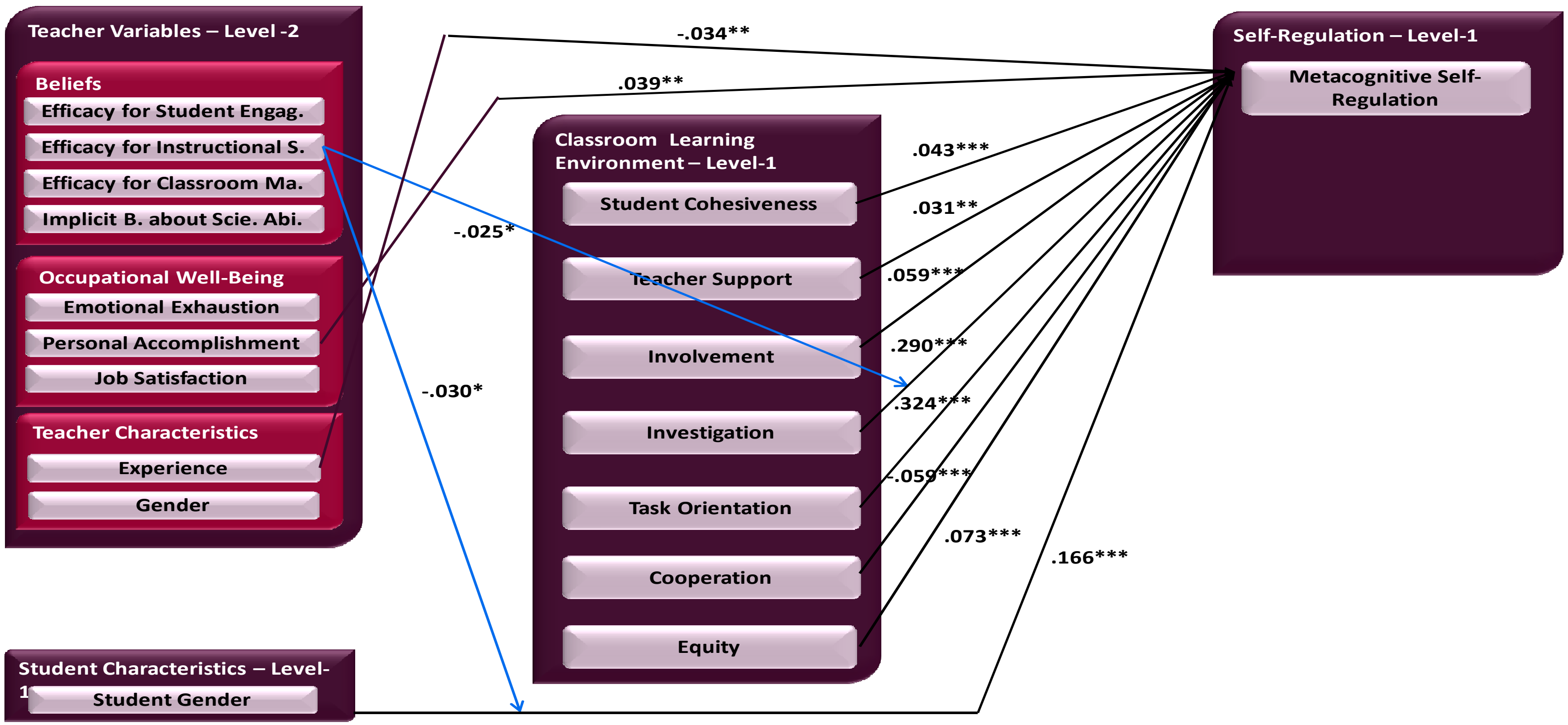

Figure 4.3 Predicting Metacognitive Self-Regulation by classroom learning environment variables (level-1), student gender (level-1) and teacher variables (level-2)

Note: Arrows do not indicate causal relationships. Their directions are from predictors to outcome variables. Blue arrows indicate interaction of level-1 and level-2 variables. *p< .05, **p<.01, ***p< .001.

4.2.2.4.3 Mastery Approach .Goals: Results of Intercepts and Slopes as Outcomes Model

In order to find out the moderation effect of class level variables on student level variables, intercepts and Slopes as Outcomes model was built for *Mastery Approach Goals*. Results of the previous models (i.e., Means as Outcomes Model and Random Coefficient model) were taken into account while building Intercepts and Slopes as Outcomes Model. Student level and class level variables were included in the current model subsequently. Firstly, as a class level variable, *Efficacy for Student Engagement* which was previously found as significantly associated with intercept of the *Mastery Approach Goals* in Means as Outcomes and as student level variables *Gender, Student Cohesiveness, Teacher Support, Involvement, Task Orientation, Cooperation,* and *Equity* which were previously found as predictors of *Mastery Approach Goals* in Random Coefficients Model were included in the model together.

The equations for the first model in these analyses are:

Student Level (level-1) Model:

$$Mastery\ Approach\ Goals\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2j} * (ZSWHSC) + \beta_{3J} * (ZSWHTS) + \beta_{4J} * (ZSWHINVO) + \beta_{5J} * (ZSWHTO) + \beta_{6J} * (ZSWHCOOP) + \beta_{7J} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (ZTSESE)_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30} + u_{3j}$$

$$\beta_{4j} = \gamma_{40} + u_{4j}$$

$$\beta_{5j} = \gamma_{50} + u_{5j}$$

$$\beta_{6j} = \gamma_{60}$$

$\beta_{7j} = \gamma_{70} + u_{7j}$

Result of the model presented above showed that *Efficacy for Student Engagement* was not significantly related to intercept model. Therefore it was excluded from the model.

Then, level-2 variables (i.e., *Teacher's Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Science Ability*) were subsequently included in the randomly varying slopes of the significant predictors of the model (*Gender, Task Orientation,* and *Equity*). Although *Teacher Support* and *Involvement* slopes were randomly varying, since they were not significant predictors of the *Mastery Approach Goals,* these variables were not tested for cross level interaction. While building final full model, the same procedures were followed with the section 4.2.2.4.1.

Firstly, these 9 level-2 variables were subsequently included in the slope of *Gender.* Among the 9 class level variables, only *Experience* was found as significantly related to *Gender* slope. Secondly, 9 class level variables were included in *Task Orientation* slope models. However, none of these variables was significantly associated with *Task Orientation* slope. Similarly, none of these variables was found as significantly associated with *Equity* slope model. As a final result of these four models, the full final estimation of Intercepts and Slopes as Outcomes Model was represented as the following equation:

Student Level (level-1) Model:

$$Mastery\ Approach\ Goals\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2j} * (ZSWHSC) + \beta_{3J} * (ZSWHTS) + \beta_{4J} * (ZSWHINVO) + \beta_{5J} * (ZSWHTO) + \beta_{6J} * (ZSWHCOOP) + \beta_{7J} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

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

$\beta_{1j} = \gamma_{10} + \gamma_{11} * (ZT\_EXPER)_j + u_{1j}$

$\beta_{2j} = \gamma_{20}$

$\beta_{3j} = \gamma_{30} + u_{3j}$

$\beta_{4j} = \gamma_{40} + u_{4j}$

$\beta_{5j} = \gamma_{50} + u_{5j}$

$\beta_{6j} = \gamma_{60}$

$\beta_{7j} = \gamma_{70} + u_{7j}$

Results of the final estimation of fixed effects obtained from the final full Intercepts and Slopes as Outcomes Model for *Mastery Approach goals* were shown in table 4.19. Students' average score on *Mastery Approach Goals* was not significantly associated with any of the class level variables.

Results from the Random Coefficient Model (Research Question 2c) were also included in the final full Intercepts and Slopes as Outcomes Model. Result of the fixed effects of the final full Intercepts and Slopes as Outcomes Model showed that *Gender* (S_FEMALE, γ = .124, se = .018, p < .001). *Student Cohesiveness* (ZSWHSC, γ = .047, se = .012, p < .001), *Task Orientation* (ZSWHTO, γ = .497, se = .014, p < .001), and *Equity* (ZSWHEQU, γ = .153, se = .014, p < .001) were positively related to *Mastery Approach Goals*. However, *Cooperation* (ZSWHCOOP, γ = -.028, se = .012, p < .05) was found as negatively related to *Mastery Approach Goals.* Namely, the slope coefficient of *Mastery Approach Goals – Gender* indicated that female student tended to set more mastery approach oriented goals in science class than males. The slope coefficient of *Mastery Approach Goals – Student Cohesiveness* indicated that students who perceived students' relationships in the classroom as more positively and friendly reported higher scores on *Mastery Approach Goals*. The slope coefficient of *Mastery Approach Goals – Task*

Orientation indicated that students who perceived classroom as more task oriented were more likely to focus on mastering course subject and value learning. The *Mastery Approach Goals – Equity* slope coefficient indicated that students who had more equal learning opportunities with the other students in the same classroom were more likely to approach success in learning science. On the other hand, *Mastery Approach Goals – Cooperation* slope coefficient showed that higher level of cooperation among students in classroom activities and conducting group works related to students' setting less mastery approach oriented goals in science class.

Moreover, results of final full Intercepts and Slopes as Outcomes Model indicated a cross-level interaction among the predictors of *Mastery Approach Goals.* The *Gender* coefficient model significantly associated with *Experience* (ZT_EXPER; $\boldsymbol{\gamma_{11}}$=-.024, se = .012, p < .05). Namely, *Experience* moderated the effect of *Gender* on *Mastery Approach Goals.* Female students tended to set less mastery approach oriented goals in learning science when they thought by more experienced science teacher.

The *Mastery Approach Goals – Gender* slope model is:

$$\beta_1 = \gamma_{10} + \gamma_{11} * (ZT\_EXPER) + u_1$$

β_1 is the overall *Gender* slope

γ_{10} is the average *Mastery Approach Goals– Gender* slope across the classes

γ_{11} is the effect of *Experience* on the overall slope

u_1 is the random effect or error

These coefficients were found as γ_{10}= .124, γ_{11}= -.024. Incorporating these coefficients into the equation results with:

$$\beta_1 = 0.124 - 0.024(ZT\_EXPER) + u_1$$

The results of the final estimation of variance components obtained from the full final Intercepts and Slopes as Outcomes Model for *Mastery Approach Goals* were presented in table 4.120. The proportion of variance explained in each Mastery Approach Goals slope model with significant class level predictors were calculated by comparing variance components obtained from Random Coefficient Model and final full Intercepts and Slopes as Outcomes Model as follows:

Proportion of variance explained in *Gender*, β_{1j}:

$$R^2 = \frac{\tau_{10}(Random\ Coefficient) - \tau_{10}(Intercepts\ and\ Slopes\ as\ Outcom)}{\tau_{10}(Random\ Coefficient)}$$

$$= \frac{0.0213 - 0.0206}{0.0213} = 0.033$$

Based on these findings, it was concluded that there was 3.3% reduction in the variance of the *Gender* slope was accounted for by *Experience* However, significant differences still remained among classes (χ^2 = 439.79, p<0.01). This reduction in the proportion indicated that small amount of variations had been accounted for.

Table 4.19 Final estimation of fixed effects for Mastery Approach Goals: Intercepts and Slopes as Outcomes Model for

Fixed Effects	Coefficient	SE
ZSGOMAP (Mastery Approach Goals), Model for Class Means[1]		
Intercept, γ_{00}	-.062***	.015
S_FEMALE (Gender), γ_{10}	.124***	.018
ZT_EXPER (Experience), γ_{11}	-.024*	.012
ZSWHSC (Student Cohesiveness), γ_{20}	.047***	.011
ZSWHTS (Teacher Support), γ_{30}	.008	.013
ZSWHINVO (Involvement), γ_{40}	.010	.014
ZSWHTO (Task Orientation), γ_{50}	.497***	.014
ZSWHCOOP (Cooperation), γ_{60}	-.028*	.012
ZSWHEQU (Equity), γ_{70}	.153***	.014

Note. Only predictors in final model were included in the table

**p< .05, **p<.01, ***p<.001*

1: The all continuous student level and class level variables were grand mean centere

Table 4.20 Final Estimation of variance components for Mastery Approach Goals: Intercepts and Slopes as Outcomes Model

Random Effects	Variance Components	df	χ^2	R^2	Reliability
ZSGOMAP (Mastery Approach Goals)					
Class mean, u_{0j}	.026	371	538.68***		.260
S_FEMALE (Gender), u_{1j}	.021	370	439.79**	.033	.140
ZSWHTS, (Teacher Support), u_{3j}	.016	371	455.03**		.198
ZSWHINVO (Involvement), u_{4j}	.013	371	448.79**		.157
ZSWHTO (Task Orientation), u_{5j}	.027	371	584.96***		.305
ZSWHEQU (Equity), u_{7j}	.020	371	509.30***		.229
Level-1 Effect, r_{ij}	.484			.461	

Note. Only predictors in final model were included in the table.

**p< .05, **p<.01, ***p<.001*

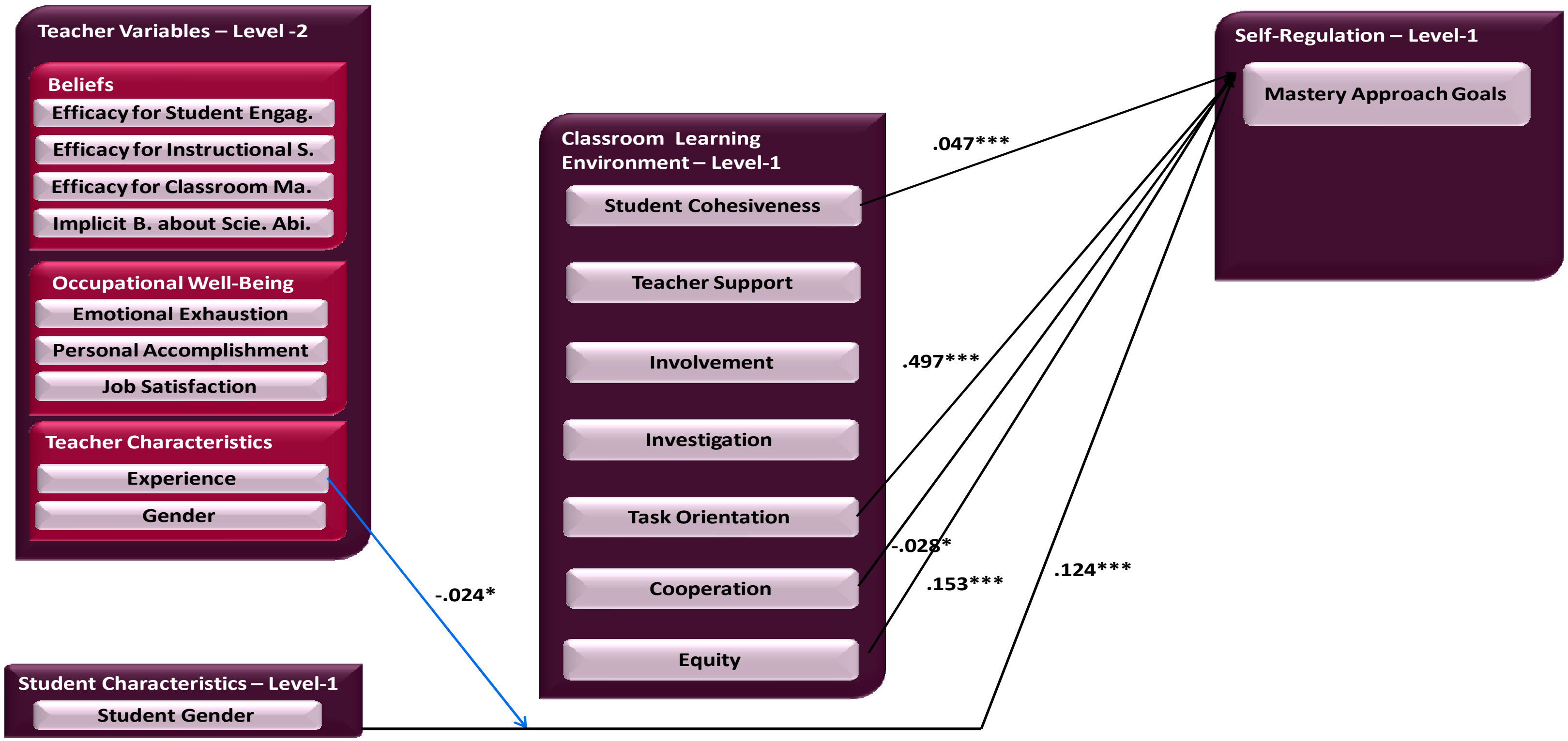

Figure 4.4 Predicting Mastery Approach Goals by classroom learning environment variables (level-1), student gender (level-1) and teacher variables (level-2)

Note: *p< .05, **p<.01, ***p< .001. Arrows do not indicate causal relationships. Their directions are from predictors to outcome variables. Blue arrows indicate interaction of level-1 and level-2 variables.

4.2.2.4.4 Performance Approach Goals: Results of Intercepts and Slopes as Outcomes Model

The moderation effect of class level variables on student level variables for *Performance Approach Goals* were tested by means of Intercepts and Slopes as Outcomes Model. The previously conducted models (i.e., Means as Outcomes Model and Random Coefficient Model) were also considered while building Intercepts and Slopes as Outcomes Model. Only student level and class level variables were included in the current model subsequently. Firstly, since none of the class level variables had been found as significantly associated with intercept of the *Performance Approach Goals* in Means as Outcomes Model only student level variables: *Gender, Student Cohesiveness, Involvement, Task Orientation,* and *Equity* which were previously found as predictors of *Performance Approach Goals* in Random Coefficients Model were included in the model. Then, 9 class level variables (i.e., *Teacher's Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Science Ability*) subsequently included in the randomly varying slopes of the of the significant predictors of the model (i.e., *Task Orientation* and *Equity*). Although *Involvement* slope was randomly varying, since it was not significant predictors of the *Performance Approach Goals,* it was not tested for cross level interaction. While building final full model, the same procedures were followed with the section 4.2.2.4.1.

Firstly, these 9 level-2 variables were subsequently included in the slope of *Task Orientation.* Among the 9 class level variables, *Efficacy for Student Engagement* and *Job satisfaction* were found as significantly related to *Task Orientation* slope. Secondly, all class level variables included in the *Equity* slope model. *Efficacy for Instructional Strategies* and *Personal Accomplishment* were found as significantly associated with *Equity* slope. As a final result of these two models, the full final estimation of Intercepts and Slopes as Outcomes Model was represented as the following equation:

Student Level (level-1) Model:

$$Performance\ Approach\ Goals\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2j} * (ZSWHSC) + \beta_{3J} * (ZSWHINVO) + \beta_{4J} * (ZSWHTO) + \beta_{5J} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + u_{0j}$$
$$\beta_{1j} = \gamma_{10}$$
$$\beta_{2j} = \gamma_{20}$$
$$\beta_{3j} = \gamma_{30} + u_{3j}$$
$$\beta_{4j} = \gamma_{40} + \gamma_{41} * (ZTSESE) + \gamma_{42} * (ZTJS) + u_{4j}$$
$$\beta_{5j} = \gamma_{50} + \gamma_{51} * (ZTSEIS) + \gamma_{52} * (ZBUPA) + u_{5j}$$

Results of the final estimation of fixed effects obtained from the final full Intercepts and Slopes as Outcomes Model for *Performance Approach goals* were shown table 4.21. Students' average score on *Performance Approach Goals* was not significantly associated with any of the class level variables.

Moreover, results from the Random Coefficient Model (Research Question 2c) were also included in the final full Intercepts and Slopes as Outcomes Model. Result of the fixed effects of the final full Intercepts and Slopes as Outcomes Model showed that among the eight level-1 variables, *Gender* (S_FEMALE; γ = .086 se = .020, p < .001). *Student Cohesiveness* (ZSWHSC; γ = .033, se = .012, p < .01), *Task Orientation* (ZSWHTO; γ = .370, se = .014, p < .001), and *Equity* (ZSWHEQU; γ = .066, se = .015, p < .001) were positively and significantly related to *Performance Approach Goals*. Namely, the slope coefficient of *Performance Approach Goals* –

Gender indicated that female student tended to set more performance approach oriented goals in science class than males. The slope coefficient of *Performance Approach Goals – Student Cohesiveness* indicated that students who perceived students' relationships in the classroom as more positively and friendly reported higher scores on *Performance Approach Goals*. The slope coefficient of *Performance Approach Goals – Task Orientation* indicated that students who perceived classroom as more task oriented were more likely to set performance approach goals such as performing better than classmates. The *Performance Approach Goals – Equity* slope coefficient indicated that students who had more equal learning opportunities with the other students in the same classroom were more likely to have performance approach oriented goals in learning science.

Regarding moderation effects, results of final full Intercepts and Slopes as Outcomes Model indicated some cross-level interactions among the predictors of *Performance Approach Goals.* Firstly, the *Task Orientation* coefficient model significantly associated with *Efficacy for Student Engagement* (ZTSESE; $\boldsymbol{\gamma_{41}}$= -.044, se = .013, p < .01) and *Job Satisfaction* (ZTJS; $\boldsymbol{\gamma_{42}}$=.033, se = .013, p < .01). Namely, *Efficacy for Student Engagement* and *Job Satisfaction* moderated the effect of *Task Orientation* on *Performance Approach Goals.* The relationship between students' setting *Performance Approach Goals* and *Task Orientation* was weaker in the classrooms which thought by the teachers who had more confidence in student engagement but stronger in the classrooms thought by the science teachers who felt more satisfaction from work.

The *Performance Approach Goals – Task Orientation* slope model is:

$$\beta_4 = \gamma_{40} + \gamma_{41} * (ZTSESE) + \gamma_{42} * (ZTJS) + u_4$$

β_4 is the overall *Task Orientation* slope

γ_{40} is the average *Performance Approach Goals –Task Orientation* slope across the classes

γ_{41} is the effect of *Efficacy for Student Engagement* on the overall slope

γ_{42} is the effect of *Job Satisfaction* on the overall slope

u_4 is the random effect or error

These coefficients were found as γ_{40}= .370, γ_{41}= -.044, and γ_{42} = .033. Incorporating these coefficients into the equation results with:

$$\beta_4 = 0.370 - 0.044(ZTSESE) + 0.033(ZTJS) + u_4$$

Moreover, *Efficacy for Instructional Strategies* (ZTSEIS; γ_{51}= .037, se = .014, p < .01) and *Personal Accomplishment* (ZBUPA; γ_{52}= -.028, se = .014, p < .05) were also found as significant predictors of the *Equity* coefficient model. That is, science teachers' *Efficacy for Instructional Strategies* and *Personal Accomplishment* mediated the effect of students' perceptions of *Equity* in science class with *Performance Approach Goals*. The students' perception of Equity in science class had more of influence on their setting more performance approach oriented goals in the classrooms thought by the science teachers that had high confidence in using variety of instructional strategies in science class or felt less personal accomplishment.

The *Performance Approach Goals – Equity* slope model is:

$$\beta_5 = \gamma_{50} + \gamma_{51} * (ZTSEIS) + \gamma_{52} * (ZTPA) + u_5$$

β_5 is the overall slope

γ_{50} is the average *Performance Approach Goals – Equity* slope across the classes

γ_{51} is the effect of *Efficacy for Instructional Strategies* on the overall slope

γ_{52} is the effect of *Personal Accomplishment* on the overall slope

u_5 is the random effect or error

These coefficients were found as γ_{50}= .066, γ_{51}= .037, and $\gamma_{52} = -.028$. Incorporating these coefficients into the equation results with:

$$\beta_5 = 0.066 + 0.037(ZTSEIS) - 0.028(ZBUPA) + u_5$$

Results of the final estimation of variance components obtained from the full final Intercepts and Slopes as Outcomes Model for *Performance Approach Goals* were presented in Table 4.22. The proportion of variance explained in each *Performance Approach Goals* slope model with significant class level predictors were calculated by comparing variance components obtained from Random Coefficient Model and final full Intercepts and Slopes as Outcomes Model as follows:

Proportion of variance explained in *Task Orientation* β_{4j}:

$$R^2 = \frac{\tau_{40}(Random\ Coefficient) - \tau_{40}(Intercepts\ and\ Slopes\ as\ Outcomes)}{\tau_{40}(Random\ Coefficient)}$$

$$= \frac{0.015 - 0.013}{0.015} = 0.133$$

Proportion of variance explained in *Equity* β_{5j}:

$$R^2 = \frac{0.013 - 0.012}{0.013} = 0.077$$

It could be concluded that there was 13.3% reduction in the variance of the *Task Orientation* slope was accounted for by *Efficacy for Student Engagement* and *Job Satisfaction.* Moreover, 7.7% of the variance of the *Equity* slope was accounted for by *Efficacy for Instructional Strategies* and *Personal Accomplishment.* However, significant differences still remained among classes in terms of both *Task Orientation* (χ^2 = 452.78, p<0.01) and Equity (χ^2 = 478.29, p<0.001). This reduction in the proportion indicated that considerable amount of variations had been accounted for.

Table 4.21 Final Estimation of Fixed Effects for Performance Approach Goals Intercepts and Slopes as Outcomes Model

Fixed Effects	Coefficient	SE
ZSGOPAP (Performance Approach Goals), Model for Class Means		
Intercept, γ_{00}	-.042*	.017
S_FEMALE (Gender), γ_{10}	.086***	.020
ZSWHSC (Student Cohesiveness), γ_{20}	.033**	.012
ZSWHINVO (Involvement), γ_{30}	.020	.015
ZSWHTO (Task Orientation), γ_{40}	.370***	.014
ZTSESE (Efficacy for Student Engagement), γ_{41}	-.044**	.013
ZTJS (Job Satisfaction), γ_{42}	.033**	.013
ZSWHEQU (Equity), γ_{50}	.066***	.015
ZTSEIS (Efficacy for Instructional Strategies), γ_{51}	.037**	.014
ZBUPA (Personal Accomplishment), γ_{52}	-.028*	.014

Note. Only predictors in final model were included in the table. The all continuous student level and class level variables were grand mean centered

**p< .05, **p<.01, ***p<.001*

Table 4.22 Final estimation of variance components for Performance Approach Goals: Intercepts and Slopes as Outcomes Model

Random Effects	Variance Components	df	χ^2	R^2	Reliability
ZSGOPAP (Performance Approach Goals)					
Class mean, u_{0j}	.021	371	628.13***		.316
ZSWHINVO (Involvement), u_{3j}	.013	371	451.14**		.153
ZSWHTO (Task Orientation), u_{4j}	.013	369	452.78**	.133	.149
ZSWHEQU (Equity), u_{5j}	.012	369	478.29***	.077	.131
Level-1 Effect, r_{ij}	.714			.233	

Note. Only predictors in final model were included in the table.

**p< .05, **p<.01, ***p<.001*

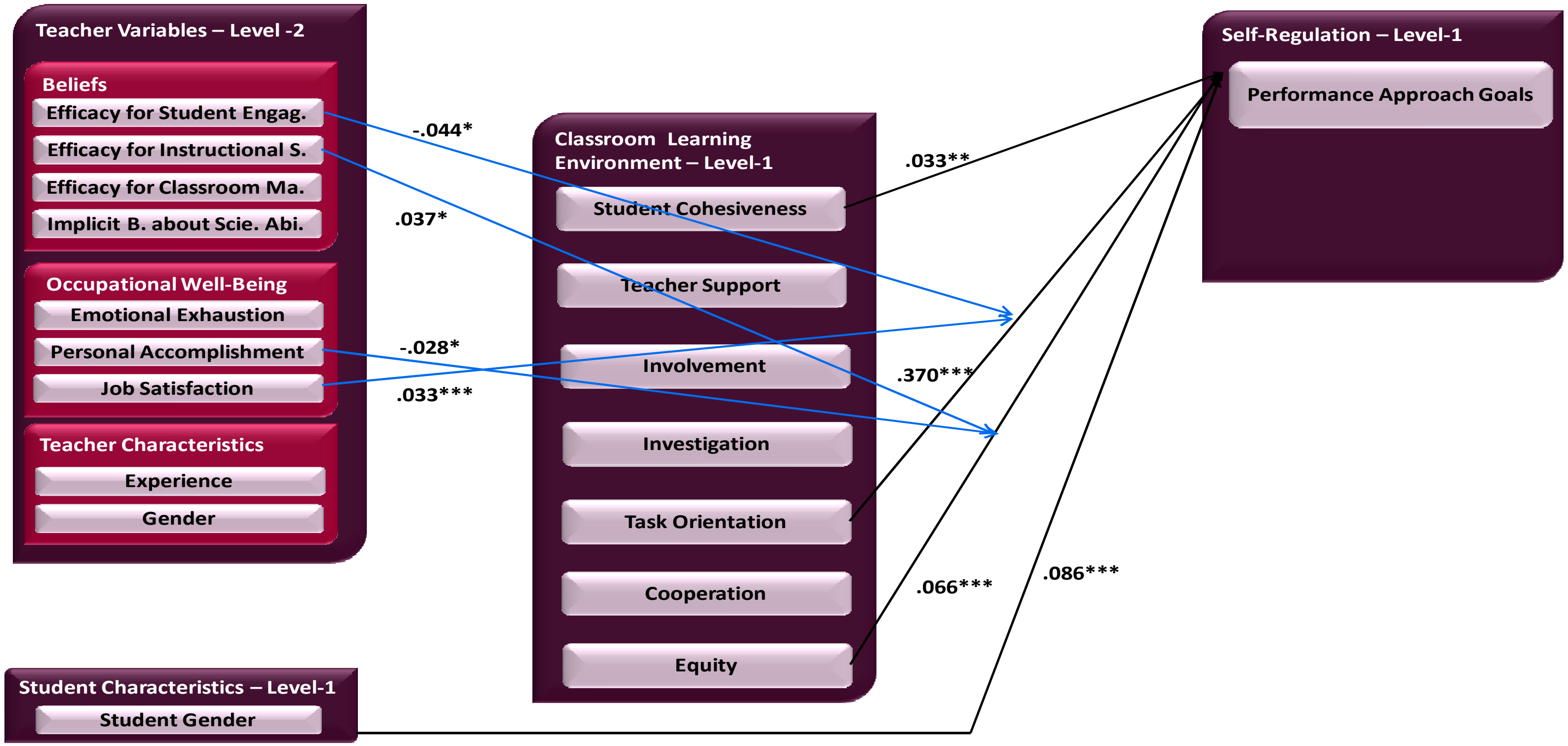

Figure 4.5 Predicting Performance Approach Goals by classroom learning environment variables (level-1), student gender (level-1) and teacher variables (level-2)

Note: *p< .05, **p<.01, ***p< .001. Arrows do not indicate causal relationships. Their directions are from predictors to outcome variables. Blue arrows indicate interaction of level-1 and level-2 variables.

4.2.2.4.5 Mastery Avoidance Goals: Results of Intercepts and Slopes as Outcomes Model

The influence of class level variables on the relationship between student level variables and *Mastery Avoidance Goals* were tested by intercepts and Slopes as Outcomes model. Results of the previous models (i.e., Means as Outcomes Model and Random Coefficient model) were considered while building Intercepts and Slopes as Outcomes Model. Student level and class level variables were included in the current model subsequently. Firstly, as a class level variable, *Emotional Exhaustion* which was previously found as significantly associated with intercept of the *Mastery Avoidance Goals* in Means As Outcomes and as student level variables *Gender, Involvement, Investigation, Task Orientation,* and *Cooperation* which were previously found as predictors of *Mastery Avoidance Goals* in Random Coefficients Model were included in the model together.

The equations for the first model in these analyses are:

Student Level (level-1) Model:

$$\begin{aligned} Mastery\ Avoidance\ Goals\ (Y_{ij}) \\ &= \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2j} * (ZSWHINVO) + \beta_{3J} \\ &* (ZSWHINVE) + \beta_{4J} * (ZSWHTO) + \beta_{5J} * (ZSWHCOOP) + r_{ij} \end{aligned}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (ZTBUEE)_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + u_{3j}$$

$$\beta_{4j} = \gamma_{40}$$

$$\beta_{5j} = \gamma_{50}$$

Result of the model presented above showed that *Emotional Exhaustion* was not a significant predictor of the intercept model. Therefore it was excluded from the model.

Afterwards, all class level variables (i.e., *Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Science Ability*) were subsequently included in the randomly varying slopes (*Gender* and *Involvement*) of the model. Although *Investigation* slope was randomly varying, since it was not significant predictor of the *Mastery Avoidance Goals,* it was not tested for cross level interaction. While building final full model, the same procedures were followed with the section 4.2.2.4.1.

Firstly, all class level variables were subsequently included in the slope of *Gender.* However, none of the class level variables was found as significantly related to *Gender* slope. Secondly, 9 class level variables were included in *Involvement* slope model. Among all class level variables only *Efficacy for Student Engagement* was significantly associated with *Involvement* slope. As a final result of these three models, the full final estimation of Intercepts and Slopes as Outcomes Model was represented as the following equation:

Student Level (level-1) Model:

$$Mastery\ Avoidance\ Goals\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2j} * (ZSWHINVO) + \beta_{3J} * (ZSWHINVE) + \beta_{4J} * (ZSWHTO) + \beta_{5J} * (ZSWHCOOP) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11} * (ZTSESE)_j + u_{1j}$$
$$\beta_{2j} = \gamma_{20} + u_{2j}$$

$\beta_{3j} = \gamma_{30} + u_{3j}$

$\beta_{4j} = \gamma_{40}$

$\beta_{5j} = \gamma_{50}$

Results of the final estimation of fixed effects obtained from the final full Intercepts and Slopes as Outcomes Model for *Mastery Avoidance goals* were shown table 4.23. Students' average score on *Mastery Avoidance Goals* was not significantly associated with any of the class level variables.

Results from the Random Coefficient Model (Research Question 2c) were also included in the final full Intercepts and Slopes as Outcomes Model. Result of the fixed effects of the final full Intercepts and Slopes as Outcomes Model showed that among the eight level-1 variables, *Gender* (S_FEMALE; γ = .117, se = .023, p < .001), *Task Orientation* (ZSWHTO; γ = .114 se = .014, p < .001), and *Cooperation* (ZSWHCOOP; γ = .178, se = .015, p < .001) were significantly and positively related to *Mastery Avoidance Goals*. However, *Involvement* (ZSWHINVO; γ = -.047 se = .017, p < .01) was found as negatively related to *Mastery Avoidance Goals.* Namely, the slope coefficient of *Mastery Avoidance Goals – Gender* indicated that female student tended to set more mastery avoidance oriented goals in science class than males. The slope coefficient of *Mastery Avoidance Goals – Task Orientation* indicated that students who perceived classroom as more task oriented reported higher scores on Mastery Avoidance Goals. The *Mastery Avoidance Goals – Cooperation* slope coefficient indicated that students who perceived classroom learning environment as more cooperative were more likely to have mastery avoidance oriented goals in learning science. On the other hand, The *Mastery Avoidance Goals – Involvement* slope coefficient indicated that students who tended to involve in classroom activities reported setting less Mastery avoidance goals in science class

Additionally, results of final full Intercepts and Slopes as Outcomes Model indicated a cross-level interaction for *Mastery Avoidance Goals.* The *Gender* coefficient model significantly associated with *Efficacy for Student Engagement* (ZTSESE; $\boldsymbol{\gamma_{11}}$=-.039, se = .017, p < .05). That is, *Efficacy for Student Engagement* moderated the effect of *Gender* on *Mastery Avoidance Goals.* The relationship between students' setting Mastery Avoidance Goals and Gender was weaker in the classrooms thought by the teachers who had more confidence in student engagement.

The *Mastery Avoidance Goals – Gender* slope model is:

$$\beta_1 = \gamma_{10} + \gamma_{11} * (ZTSESE) + u_1$$

β_1 is the overall Gender slope

γ_{10} is the average Mastery Avoidance Goals – Gender slope across the classes

γ_{11} is the effect of Efficacy for Student Engagement on the overall slope

u_1 is the random effect or error

These coefficients were found as γ_{10}= .117, γ_{11}= -.039. Incorporating these coefficients into the equation results with:

$$\beta_1 = 0.117 - 0.039(ZTSESE) + u_1$$

The results of the final estimation of variance components obtained from the full final Intercepts and Slopes as Outcomes Model for *Mastery Avoidance Goals* were presented in table 4.24. The proportion of variance explained in each *Mastery Avoidance Goals* slope model with significant class level predictors were calculated by comparing variance components obtained from Random Coefficient Model and final full Intercepts and Slopes as Outcomes Model as follows:

Proportion of variance explained in *Gender*, β_{1j}:

$$R^2 = \frac{\tau_{10}(Random\ Coefficient) - \tau_{10}(Intercepts\ and\ Slopes\ as\ Outcomes)}{\tau_{10}(Random\ Coefficient)}$$

$$= \frac{0.024 - 0.023}{0.024} = 0.042$$

It could be concluded that there was 4.2% reduction in the variance of the Gender slope was accounted for by *Efficacy for Student Engagement*. However, significant differences still remained among classes (χ^2 = 426.70, p<0.05). This reduction in the proportion indicated that small amount of variations had been accounted for.

Table 4.23 Final estimation of fixed effects for Mastery Avoidance Goals: Intercepts and Slopes as Outcomes Model

Fixed Effects	Coefficient	SE
ZSGOMAV (Mastery Avoidance Goals), Model for Class Mean		
Intercept, γ_{00}	-.065***	.019
S_FEMALE (Gender), γ_{10}	.117***	.023
ZTSESE (Efficacy for Student Engagement), γ_{11}	-.039*	.017
ZSWHINVO (Involvement), γ_{20}	-.047**	.017
ZSWHINVE (Investigation), γ_{30}	.012	.017
ZSWHTO (Task Orientation), γ_{40}	.114***	.014
ZSWHCOOP (Cooperation), γ_{50}	.178***	.015

Note. Only predictors in final model were included in the table. The all continuous student level and class level variables were grand mean centered

**p< .05, **p<.01, ***p<.001*

Table 4.24 Final Estimation of Variance Components for Mastery Avoidance Goals: Intercepts and Slopes as Outcomes model

Random Effects	Variance Components	df	χ^2	R^2	Reliability (λ)
ZSGOMAV (Mastery Avoidance Goals)					
Class mean, u_{0j}	.035	371	480.76***		.236
S_FEMALE (Gender), u_{1j}	.023	370	426.70*	.042	.105
ZSWHINVO (Involvement), u_{2j}	.013	371	423.38*		.122
ZSWHINVE (Investigation), u_{3j}	.015	371	429.06*		.133
Level-1 Effect, r_{ij}	.884			.079	

Note. Only predictors in final model were included in the table.

*$p< .05$, **$p<.01$, ***$p<.001$*

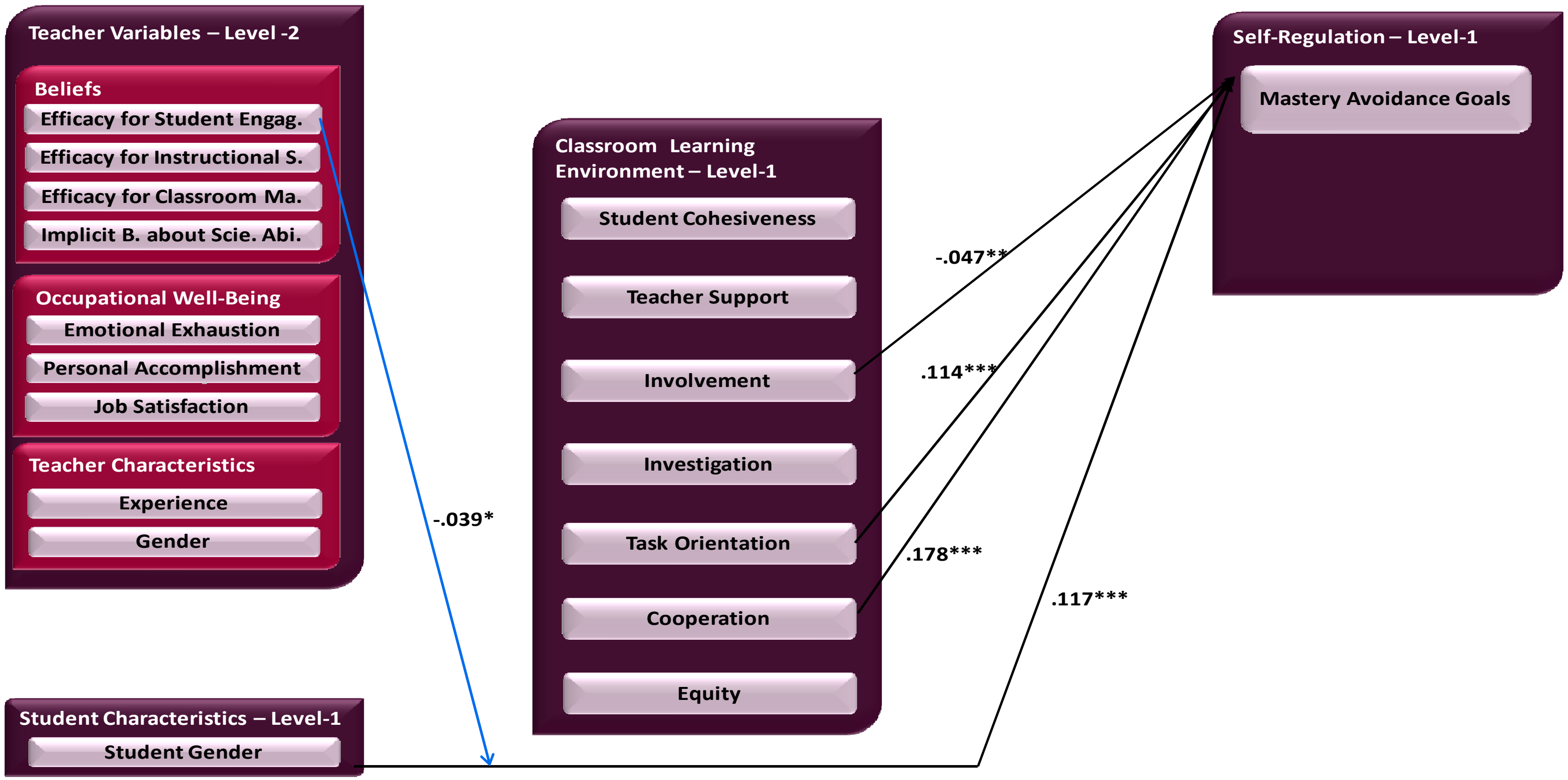

Figure 4.6 Predicting Mastery Avoidance Goals by classroom learning environment variables (level-1), student gender (level-1) and teacher variables (level-2).

Note: **p*< .05, ***p*<.01, ****p*< .001. Arrows do not indicate causal relationships. Their directions are from predictors to outcome variables. Blue arrows indicate interaction of level-1 and level-2 variables.

4.2.2.4.6 Performance Avoidance .Goals: Results of *Intercepts and Slopes as Outcomes Model*

The cross-level interactions between class level variables and student level variables for *Performance Avoidance Goals* were tested by means of Intercepts and Slopes as Outcomes model. While building Intercepts and Slopes as Outcomes Model, results of the previous models (i.e., Means as Outcomes Model and Random Coefficient model) were taken into account. Student level and class level variables were included in the present model subsequently. Firstly, as a class level variable, *Emotional Exhaustion* which was previously found as significantly associated with intercept of the *Performance Avoidance Goals* in Means As Outcomes and as student level variables, *Gender, Student Cohesiveness, Involvement, Task Orientation, Cooperation* and *Equity* which were previously found as predictors of *Performance Avoidance Goals* in Random Coefficients Model were included in the model together.

The equations for the first model in these analyses are:

Student Level (level-1) Model:

$$Performance\ Avoidance\ Goals\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2j}(ZSWHSC) + \beta_{3J} * (ZSWHINVO) + \beta_{4J} * (ZSWHTO) + \beta_{5J} * (ZSWHCOOP) + \beta_{6J} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (ZTBUEE)_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + u_{2j}$$

$$\beta_{3j} = \gamma_{30}$$

$$\beta_{4j} = \gamma_{40} + u_{4j}$$

$\beta_{5j} = \gamma_{50}$

$\beta_{6j} = \gamma_{60} + u_{6j}$

Result of the model presented above showed that *Emotional Exhaustion* was not a significant predictor of the intercept model. Therefore it was decided to be excluded from the model.

In the next step, all class level variables (i.e., *Teacher's Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Ability in Science*) were subsequently included in the randomly varying slopes of the significant predictors of the model (*Student Cohesiveness, Task Orientation* and *Equity*). Although *Gender* slope was randomly varying, since it was not significant predictor of the *Performance Avoidance Goals,* it was not tested for moderation effect.

While building final full model, the same procedures were followed with the section 4.2.2.4.1. Firstly, all class level variables were subsequently included in the slope of *Student Cohesiveness.* However, none of the class level variables was found as significantly related to *Student Cohesiveness* slope. Secondly, 9 class level variables were included in *Task Orientation* slope model. Among all class level variables only *Efficacy for Classroom Management* was significantly associated with *Task Orientation* slope. Lastly, Class level variables were included into the slope model of *Equity*. None of the class level variables were found as significantly associated with *Equity* slope model. As a final result of these four models, the full final estimation of Intercepts and Slopes as Outcomes Model was represented as the following equation:

Student Level (level-1) Model:

$$Performance\ Avoidance\ Goals\ (Y_{ij})$$
$$= \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2j}(ZSWHSC) + \beta_{3J} * (ZSWHINVO) + \beta_{4J} * (ZSWHTO) + \beta_{5J} * (ZSWHCOOP) + \beta_{6J} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + u_{1j}$$
$$\beta_{2j} = \gamma_{20} + u_{2j}$$
$$\beta_{3j} = \gamma_{30}$$
$$\beta_{4j} = \gamma_{40} + \gamma_{41} * (ZTSECM)_j + u_{4j}$$
$$\beta_{5j} = \gamma_{50}$$
$$\beta_{6j} = \gamma_{60} + u_{6j}$$

Results of the final estimation of fixed effects obtained from the final full Intercepts and Slopes as Outcomes Model for *Performance Avoidance goals* were shown in Table 4.25. Students' average score on *Performance Avoidance Goals* was not significantly associated with any of the class level variables.

Moreover, results from the Random Coefficient Model (Research Question 2c) were also included in the fixed effects of final full Intercepts and Slopes as Outcomes Model. Among the eight level-1 variables, *Student Cohesiveness* (ZSWHSC; γ = .043, se = .014, p < .01), *Task Orientation* (ZSWHTO; γ = .213, se = .016, p < .001), *Cooperation* (ZSWHCOOP; γ = .143, se = .015, p < .001), and *Equity* (ZSWHEQU; γ = .062, se = .016, p < .001) were positively and significantly related to *Performance Avoidance Goals*. However, *Involvement* (ZSWHINVO; γ = -.044, se = .015, p < .01) was found as negatively related to *Performance Avoidance Goals.* Namely, the slope coefficient of *Performance Avoidance Goals – Student Cohesiveness* indicated that students who perceived students' relationships in the classroom as more positively and friendly reported higher scores on Performance Avoidance Goals. The slope coefficient of *Performance Avoidance Goals – Task Orientation* indicated that students who perceived classroom as more task oriented reported higher scores on Performance Avoidance Goals. *Performance Approach Goals – Cooperation* slope coefficient showed that higher level of cooperation among students in classroom activities and conducting group works related to students' setting more performance avoidance oriented goals in science class. The *Mastery Avoidance Goals – Equity* slope coefficient indicated that students who had more equal learning opportunities with the other students in the same classroom were more likely to have performance avoidance oriented goals in learning science. On the other hand, The *Performance Avoidance Goals – Involvement* slope coefficient indicated that students who tended to involve in classroom activities reported setting less Performance avoidance goals in science class.

Results of final full Intercepts and Slopes as Outcomes Model indicated a cross-level interaction for *Performance Avoidance Goals.* The *Task Orientation* coefficient model significantly associated with *Efficacy for Classroom Management* (ZTSECM; $\boldsymbol{\gamma_{41}}$=-.026, se = .013, p < .05). That is, *Efficacy for Classroom Management* moderated the effect of *Task Orientation* on *Performance Avoidance Goals.* Task Orientation in science classes has less influence on students' setting performance avoidance oriented goals in the classrooms thought by the teachers who have higher confidence in using classroom management strategies.

The Performance Avoidance Goals – Task Orientation slope model is:

$$\beta_4 = \gamma_{40} + \gamma_{41} * (ZTSECM) + u_4$$

β_1 is the overall Task Orientation slope

γ_{10} is the average Performance Avoidance Goals – Task Orientation slope across the classes

γ_{11} is the effect of Efficacy for Classroom Management on the overall slope

u_1 is the random effect or error

These coefficients were found as γ_{10}= .213, γ_{11}= -.026. Incorporating these coefficients into the equation results with:

$$\beta_4 = 0.213 - 0.026(ZTSECM) + u_4$$

The results of the final estimation of variance components obtained from the full final Intercepts and Slopes as Outcomes Model for *Performance Avoidance Goals* were presented in table 4.26. The proportion of variance explained in each *Performance Avoidance Goals* slope model with significant class level predictors were calculated by comparing variance components obtained from Random Coefficient Model and final full Intercepts and Slopes as Outcomes Model as follows:

Proportion of variance explained in *Gender*, β_{1j}:

$$R^2 = \frac{\tau_{40}(Random\ Coefficient) - \tau_{40}(Intercepts\ and\ Slopes\ as\ Outco.)}{40(Random\ Coefficient)}$$

$$= \frac{0.0199 - 0.0195}{0.0199} = 0.025$$

It could be concluded that there was 2.5% reduction in the variance of the *Task Orientation* slope was accounted for by *Efficacy for Classroom Management*. However, significant differences still remained among classes (χ^2 = 453.37, p<0.01). This reduction in the proportion indicated that small amount of variations had been accounted for.

Table 4.25 Final estimation of fixed effects for Performance Avoidance Goals - Intercepts and Slopes as Outcomes Model

Fixed Effects	Coefficient	SE
ZSGOPAV (Performance Avoidance Goals), Model for Class Means1		
Intercept, γ_{00}	-.000	.019
S_FEMALE (Gender), γ_{10}	.013	.023
ZSWHSC, (Student Cohesiveness), γ_{20}	.043**	.014
ZSWHINVO (Involvement), γ_{30}	-.044**	.015
ZSWHTO (Task Orientation), γ_{40}	.213***	.016
ZTSECM (Efficacy for Classroom Management), γ_{41}	-.026*	.013
ZSWHCOOP (Cooperation), γ_{50}	.143***	.015
ZSWHEQU (Equity), γ_{60}	.062***	.016

Note. Only predictors in final model were included in the table

*$p< .05$, **$p<.01$, ***$p<.001$*

1: The all continuous student level and class level variables were grand mean centered

Table 4.26 Final estimation of variance components for Performance Avoidance Goals - Intercepts and Slopes as Outcomes Model

Random Effects	Variance Components	df	χ^2	R^2	Reliability (λ)
ZSGOPAV (Performance Avoidance Goals)					
Class mean, u_{0j}	.039	371	502.19***		.259
S_FEMALE (Gender), u_{1j}	.039	371	434.63*		.167
ZSWHSC (Student Cohesiveness), u_{2j}	.009	371	423.53*		.116
ZSWHTO (Task Orientation), u_{4j}	.020	370	453.37**	.025	.184
ZSWHEQU (Equity), u_{6j}	.021	371	439.64**		.197
Level-1 Effect, r_{ij}	.783			.165	

Note. Only predictors in final model were included in the table.

*$p< .05$, **$p<.01$, ***$p<.001$*

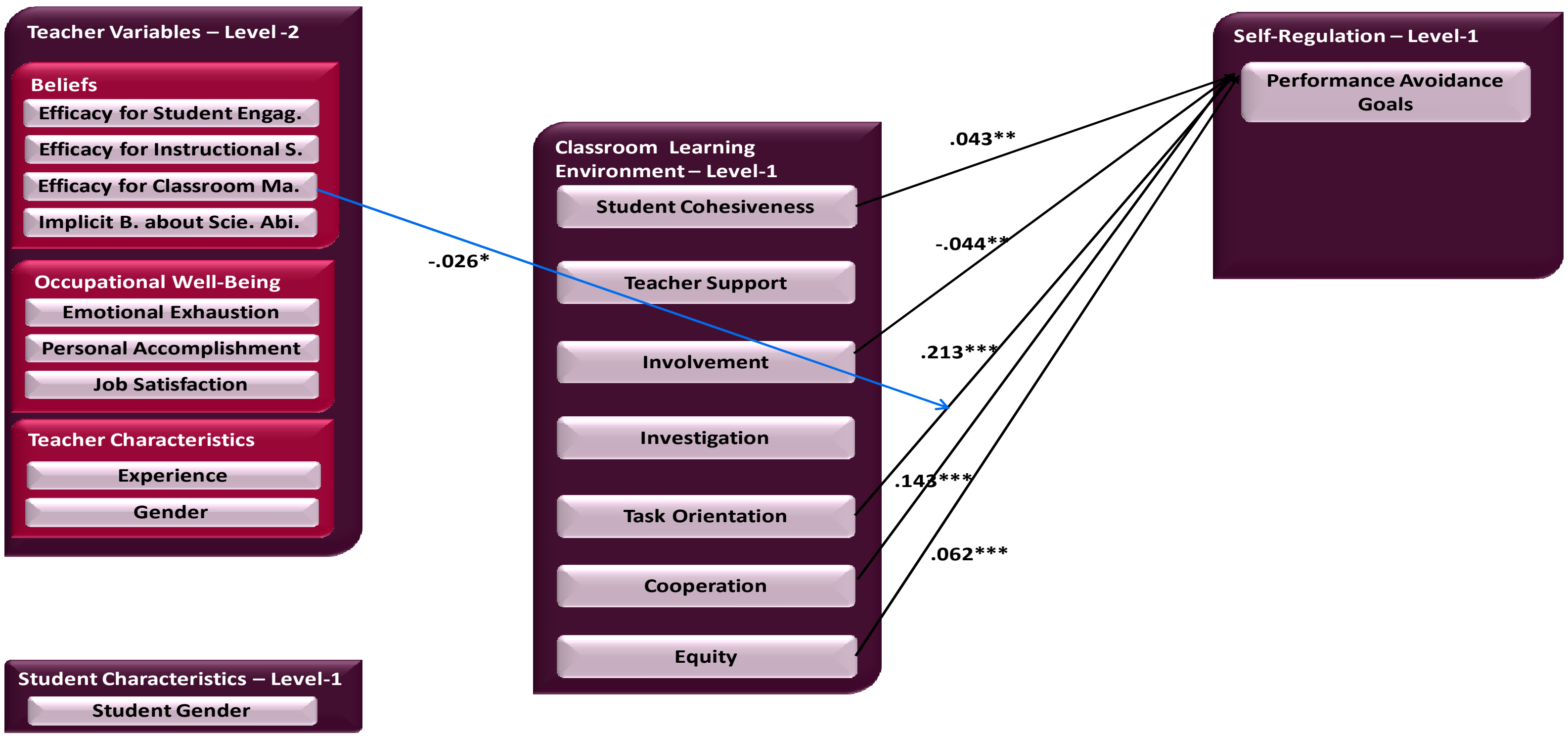

Figure 4.7 Predicting Performance Avoidance Goals by classroom learning environment variables (level-1), student gender (level-1) and teacher variables (level-2)

Note: **p*< .05, ***p*<.01, ****p*< .001. Arrows do not indicate causal relationships. Their directions are from predictors to outcome variables. Blue arrows indicate interaction of level-1 and level-2 variables.

4.2.3 Results of Research Question 3: Students' Science Achievement

The third set of HLM analyses were conducted to test the research questions focusing on students' science achievement:

3 The third research question consisted of 4 sub-questions:

3.a. To what extent do students in different classes vary in *Science Achievement*?

3.b. To what extent do class (teacher) level variables (i.e., *Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Ability in Science*) predict students' *Science Achievement*?

3.c. To what extent do student variables in terms of *Gender* and perception of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity)* predict students' *Science Achievement*?

3.d. To what extent do class (teacher) level variables (i.e., *Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Ability in Science*) influence the relationship between students' *Science Achievement,* and students' *Gender* and perception of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity)*?

4.2.3.1 Results of Research Question 3.a: One-Way Random Effects ANOVA Model

In order to test whether there are differences in means of students' Science Achievement among classes, One-Way Random Effects Analysis of Variance Model was built. The regression equation addressing this research question is as follows:

Student level (level-1) model:

$Science\ Achievement\ (Y_{ij}) = \beta_{0j} + r_{ij},$

Class level (level-2) model:

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

In these models,

Y_{ij} is Science Achievement

β_{0j} is regression intercept of class j, that is, class mean on Science Achievement

γ_{00} is the grand mean, that is, overall average score on Science Achievement for all classes.

r_{ij} is the random effect of student i in class j.

u_{0j} is the random effect of class j.

Table 4.27 presents the results of the final estimations of fixed effects obtained from one-way random effects ANOVA model. The results of this model showed that average class means, the grand-mean of Science Achievement, γ_{00}, was not statistically significantly different from zero.

Moreover, the final estimation of variance components obtained from one-way random effects ANOVA model was shown in table 4.28. Results indicated that variance component at class level (τ_{00}) were statistically significant, where τ_{00} is the variance of the true class means, β_{0j}, around the grand-mean, γ_{00}. Namely, there was substantial amount of variation among class means for Science Achievement (τ_{00} = .297,
χ^2 = 3759.38, df = 371, p<.001). Hence, these results suggested that conducting HLM analysis for this data set was appropriate and class level variables might account for the differences in the students' Science Achievement.

In order to find out the proportion of the variance at the class level, ICC was calculated for Science Achievement as follows:

$$ICC_{Science\ Achievement} = \rho = \tau_{00}/(\tau_{00} + \sigma^2). = \frac{0.710}{0.297 + 0.710} = 0.295$$

Based on this calculation, it could be concluded that 29.5% of the total variance in Science Achievement was accounted for by the between-class variance. Namely, around 30% of the variance in Science Achievement is among Classes. Moreover, as presented in table 4.28, the reliability statistics for Science Achievement was found as .90 indicating that the sample means were likely to be a reliable indicator of true class means.

Table 4.27 Final Estimation of Fixed Effects for Science Achievement: One-Way Random Effects ANOVA Model

Fixed Effect	Coefficient	SE
ZSAS (Science Achievement)		
Average class mean, γ_{00}	-.021	.030

Table 4.28 Final Estimation of Random Effects for Science Achievement– One-Way Random Effects ANOVA Model

Random Effect	Variance Component	df	χ^2	ICC(ρ)	Reliability(λ)
ZSAS (Science Achievement)					
Class mean, u_{0j}	.297	371	3759.38***	.29.5	.90
Level-1 Effect, r_{ij}	.710				

Note: ICC= infraclass correlation, *** p<.001

4.2.3.2 Results of Research Question 3.b: Means as Outcomes Model

In one-way random effects ANOVA model it was found that students' Science Achievement significantly varying around their class means and including class level variables was suggested to explain this variation in Science Achievement among classes. Therefore, to test the research question 3.b addressing the examination of class level variables in terms of whether they explain the class differences in Science Achievement, means as outcomes model was developed by the inclusion of nine level-2 (class level) predictors without the inclusion of any level-1 (student level) predictors.

The regression equation representing this research question was as follows:

Student level (level-1) model:

$$Science\ Achevement\ (Y_{ij}) = \beta_{0j} + r_{ij},$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{T\_FEMALE})_j + \gamma_{02}(ZT\_EXPER\ )_j + \gamma_{03}(ZTSESE)_j + \gamma_{04}(ZTSEIS)_j + \gamma_{05}(ZTSECM)_j + \gamma_{06}(ZTJS)_j + \gamma_{07}(ZTBUEE)_j + \gamma_{08}(ZBUPA)_j + \gamma_{09}(ZTITSA)_j + u_{0j}$$

In these models,

Y_{ij} is the outcome variable, *Science Achievement*

β_{0j} is regression intercept of class j, that is, class mean on *Science Achievement*

γ_{00} is the grand mean, that is, overall average score of *Science Achievement* for all classes

γ_{01} is the differentiating effect of teacher's gender on class mean of *Science Achievement*

γ_{02} is the differentiating effect of teacher's experience on class mean of *Science Achievement*.

γ_{03} is the differentiating effect of teacher's *Efficacy Beliefs for Student Engagement* on class mean of *Science Achievement*

γ_{04} is the differentiating effect of teacher's *Efficacy Beliefs for Instructional Strategies* on class mean of *Science Achievement*

γ_{05} is the differentiating effect of teacher's *Efficacy Beliefs for Classroom Management* on class mean of *Science Achievement*

γ_{06} is the differentiating effect of teacher's *Job Satisfaction* on class mean of *Science Achievement*

γ_{07} is the differentiating effect of teacher's feeling of emotional exhaustion on class mean of *Science Achievement*

γ_{08} is the differentiating effect of teacher's feeling of personal accomplishment on class mean of *Science Achievement*

γ_{09} is the differentiating effect of teacher's *Beliefs About Science Ability* on class mean of *Science Achievement*

r_{ij} is the level-1 residual.

u_{0j} is the level-2 residual.

τ_{00} is the residual or conditional variance, that is, class level variance in β_{0j}, after controlling other class level (level-2) variables (Raudenbush & Bryk, 2002; p.73).

This model was firstly performed with the nine level-2 predictors. Then, considering the magnitude of significant t values, best predictor was selected. Model was rebuilt by only this predictor variable. Afterwards, final model was built by subsequently adding predictors regarding the magnitude of t values. During this process, significant predictors were retained in the model while non-significant predictors were removed. Results of the final estimations of means as outcome models were presented in Table 4.29 and Table 4.30, respectively.

Results of the final estimation of fixed effects obtained from Means as Outcomes Model indicated that class means on *Science Achievement* was positively associated with teachers' Experience (ZT_EXPER; γ = .064, se = .029, p < .05), *Efficacy for Student Engagement* (ZTSESE; γ = .112, se = .029, p < .001), and *Implicit Theory of Science Ability* (ZTITSA; γ = .067, se = .029, p < .05). Namely, students tended to get higher scores from science test in the classroom thought by the science teachers who were more experienced, were more confident in student engagement in science class, or hold the belief that people's ability in science can be improved.

The final estimations of variance components obtained from means as outcomes models of *Science Achievement* was presented in table 4.30. In the present model built for students' *Science Achievement* the residual variance between classes was substantially decreased compared to the estimated variance in random effects ANOVA model (see Table 4.28 and Table 4.30). This reduction was caused by the inclusion of class level variables. The R^2 (the proportion reduction in variance or variance explained at class level) calculated via comparison of τ_{00} estimates obtained from these two models were also provided in Table 4.30.The proportion of variance explained in β_{0j} accounted for teacher variables was calculated as:

$$R^2 = \frac{\tau_{00}(Random\ ANOVA) - \tau_{00}(Means\ as\ Outcome)}{\tau_{00}(Random\ ANOVA)} =$$

$$\frac{0.2969 - 0.2723}{0.2969} = 0.083$$

Result revealed that 8.3% of the true between-class variance in *Science Achievement* was accounted for by teachers' *Experience, Efficacy for Student Engagement* and *Implicit Theory of Science Ability*. Nevertheless, based on the statistically significant chi-square statistics of the model (χ^2= 3456.50, df = 368, p< .001) it could be concluded that even after the significant class level predictors were hold constant, or control for, classes still varied significantly in students' responses to science achievement test. In other words, these class level factors did not account for all of the variation in the intercept.

Table 4.29 Final Estimation of Fixed Effects for Science Achievement – Means as Outcomes Model

Fixed Effect	Coefficient	SE
ZSAS (Science Achievement), Model for Class Means[1]		
Intercept, γ_{00}	-.021	.029
ZT_EXPER (Years of Teaching), γ_{01}	.064*	.029
ZTSESE (Efficacy for Student Engagement), γ_{02}	.112***	.029
ZTITSA(Implicit Theory of Science Ability), γ_{03}	.067*	.029

*<.05*** p<.001

Table 4.30 Final Estimation of Random Effects for Science Achievement – Means as Outcomes Model

Random Effect	Variance Component	df	χ^2	R^2
ZSAS (Science Achievement)				
Class mean, u_{0j}	.272	368	3456.50***	.083
Level-1 Effect, r_{ij}	.710			

*** p<.001

4.2.3.3 Results of Research Question 3.c: Random Coefficient Model (Model 1)

The research question 3c focusing on the student variables in terms of perceptions of classroom learning environment and gender as factors explaining the differences in students' Science Achievement was tested by means of Random Coefficient Model (Model 1). Dimensions of classroom learning environment (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation*, and *Equity*) and students' *Gender* were included in the models as student level (level-1) variables. While conducting this analysis the same procedure with the section 4.2.2.3 was followed.

The regression equation addressing the research question 3c is as follows:

Student level (level-1) model:

$$\begin{aligned} Science\ Achievement\ (Y_{ij}) &\\ = \ & \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2J} * (ZSWHSC) + \beta_{3J} * (ZSWHTS) \\ & + \beta_{4J} * (ZSWHINVO) + \beta_{5J} * (ZSWHINVE) + \beta_{6J} * (ZSWHTO) \\ & + \beta_{7J} * (ZSWHCOOP) + \beta_{8J} * (ZSWHEQU) + r_{ij} \end{aligned}$$

Teacher level (level-2) model:

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

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$$\beta_{0j} = \gamma_{q0} + u_{qj}$$

In these models,

Y_{ij} is the *Science Achievement* score of student I in class j

β_{0j} is the mean of *Science Achievement* (i.e., average scores of the all classes on science test)

β_{1j} is the differentiating effect of students' *Gender* in class j (i.e., the mean difference between male and female students' scores on science test)

β_{2j} is the differentiating effect of students' perception of *Student Cohesiveness* in class j (i.e., the degree to which perceptions of *Student Cohesiveness* differences among students related to *Science Achievement*)

β_{3j} is the differentiating effect of students' perception of *Teacher Support* in class j (i.e., the degree to which perceptions of *Teacher Support* differences among students related to *Science Achievement*)

β_{4j} is the differentiating effect of students' perception of *Involvement* in class j (i.e., the degree to which perceptions of *Involvement* differences among students related to *Science Achievement*)

β_{5j} is the differentiating effect of students' perception of *Investigation* in class j (i.e., the degree to which perceptions of *Investigation* differences among students related to *Science Achievement*)

β_{6j} is the differentiating effect of students' perception of *Task Orientation* in class j (i.e., the degree to which perceptions of *Task Orientation* differences among students relate to *Science Achievement*)

β_{7j} is the differentiating effect of students' perception of *Cooperation* in class j (i.e., the degree to which perceptions of *Cooperation* differences among students related to *Science Achievement*)

β_{8j} is the differentiating effect of students' perception of *Equity* in class j (i.e., the degree to which perceptions of *Equity* differences among students related to *Science Achievement*)

β_{qj} is the coefficient for variable q for class j after accounting for other variables

γ_{00} is the average of class means on the *Science Achievement* across the population of classes

γ_{q0} is the average *q* factor- slope of outcome variable across those classes

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

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

In this regression equation, while β_{0j} represents the intercept parameter, all other β's represent the slope parameter of each predictor variable.

Based on the results of the Random Coefficient Model for *Science Achievement*, final estimation of fixed effects and final estimation of random effects were presented in Table 4.31 and Table 4.32, respectively.

Result of the fixed effects of random coefficient model showed that *Involvement* (ZSWHINVO; γ = .135, se = .015, p < .001), *Task Orientation* (ZSWHTO; γ = .191, se = .013, p < .001), and *Equity* (ZSWHEQU; γ = .065, se = .014, p < .001) were significantly and positively associated with *Science Achievement.* However, Investigation (ZSWHINVE; γ = -.029, se = .015, p < .05) and *Cooperation* (ZSWHCOOP, γ = -.064, se = .014, p < .001) was found as negatively related to *Science Achievement*. Namely, slope coefficient of *Science Achievement – Involvement* yielded that students who tended to involve in classroom activities obtained higher scores from science achievement test. The slope coefficient of *Science Achievement – Task Orientation* indicated that students who perceived classroom as more task oriented tended to get higher score from science test. The *Science Achievement – Equity* slope coefficient indicated that students who had more equal learning opportunities with the other students in the same classroom were likely to get higher scores from science test. On the other hand, the slope coefficient of *Science Achievement – Investigation* revealed that students who tended to do more inquiry and have problem solving skills in science class were less likely to get high scores from science test. Moreover, the *Science Achievement – Cooperation* slope coefficient showed that cooperation among students in classroom activities had negative effect on science achievement.

Results of the final estimation of random effects obtained from Random Coefficient Model (see Table 4.32) showed that variance among the class means $\tau_{00} = .308$ was found as statistically significant (χ^2= 1730.44, $p< .001$). This significant variation among 372 classes suggested that incorporating class level factors into the model might explain this variability. Moreover, the slopes of *Science Achievement - Gender* (χ^2= 633.46, $p< .001$), *Science Achievement – Student Cohesiveness* (χ^2= 460.50, $p< .01$), *Science Achievement – Teacher support* (χ^2= 448.57, $p< .01$), *Science Achievement – Investigation* (χ^2 = 417.71, $p< .05$), and *Science Achievement – Equity* (χ^2 = 429.20, $p< .01$), were all varied significantly, which suggested that in some classes, the slopes were much steeper than for other classes. On the other hand, the variance components of *Involvement*, *Task Orientation*, and *Cooperation* were not significant, which implies that class differences did not have an impact on the slops for these variables. Additionally, although the variance component for *Gender*, *Student Cohesiveness,* and *Teacher Support* were found as significant, they were not significant predictors of *Science Achievement.* Therefore, though *Gender*, *Student Cohesiveness,* and *Teacher Support* were retained in the model, they were not the focus.

In order to investigate the amount of variance in *Science Achievement* explained in student level, the variances in the Analysis of Variance Model and the Random Coefficient Model were compared. The proportion of reduction in variance at student level (R^2) was calculated by comparing σ^2 estimates of Analysis of Variance Model and the Random Coefficient Model *Science Achievement* as follows:

$$R^2 = \frac{\sigma^2(Random\ ANOVA) - \sigma^2(Means\ as\ Outcome)}{\sigma^2(Random\ ANOVA)} = \frac{0.710 - 0.587}{0.710} = 0.173$$

By including these student level factors (*Gender, Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, and Equity,* as predictors of *Science Achievement*, within class variance was reduced by 17.3%. Therefore, these factors account for about 17 % of the student level variance in *Science Achievement.*

Table 4.31 Final Estimation of Fixed Effects: Random Coefficient Model for Learning Environment and Gender

Fixed Effects	*Coefficient*	SE
ZSAS (Science Achievement), Model for Class Means[1]		
Intercept, γ_{00}	-.049	.031
S_FEMALE (Gender), γ_{10}	.039	.025
ZSWHSC (Student Cohesiveness), γ_{20}	.014	.013
ZSWHTS (Teacher Support), γ_{30}	-.011	.015
ZSWHINVO (Involvement), γ_{40}	.135***	.015
ZSWHINVE (Investigation), γ_{50}	-.029*	015
ZSWHTO (Task Orientation), γ_{60}	.191***	.013
ZSWHCOOP (Cooperation), γ_{70}	-.064***	.014
ZSWHEQU (Equity), γ_{80}	.065***	.014

Note. Only predictors in final models were included in the table.

**p< .05, **p<.01, ***p<.001*

1: The all continuous student level variables were grand mean centered

Table 4.32 Final Estimation of Random Effects: Random Coefficient Model for Learning Environment and Gender

Random Effects	Variance Components	df	χ^2	Reliability	R^2
ZSAS (Science Achievement),					
Class mean, u_{0j}	.308	371	1730.44***	.745	
S_FEMALE (Gender), u_{1j}	.106	371	633.46***	.406	
ZSWHSC (Student Cohesiveness), u_{2j}	.012	371	460.50**	.165	
ZSWHTS (Teacher Support), u_{3j}	.019	371	448.57**	.192	
ZSWHINVE (Investigation), u_{5j}	.007	371	417.71*	.091	
ZSWHEQU (Equity), u_{8j}	.007	371	429.20**	.085	
Level-1 Effect, r_{ij}	.587				.173

**p< .05, **p<.01, ***p<.00*

4.2.3.4 Results of Research Question 3.d: Intercepts and Slopes as Outcomes Model

An Intercept and Slopes as Outcomes model was built to answer the research question 3e addressing the cross-level interaction between class level and student level variables. To find out which teacher characteristics influence the effect of students' perceptions of Classroom Learning Environment on the students' *Science Achievement*, the current model was built by considering the results of the previous analyses (i.e, Means as Outcomes Model and Random Coefficient Model). The first model built with the class level variables which were initially found as significantly associated with intercept of in Means as Outcomes Model (*Experience, Efficacy for Student Engagement,* and *Implicit Theory of Science Ability*) and student level variables that were initially found as predictors of *Science Achievement* in Random Coefficient Model *(Gender, /Student Cohesiveness, Involvement, Investigation, Task Orientation, Equity Self-Efficacy, Mastery Approach Goals, Performance Avoidance Goals, and Performance Approach Goals*).

The equations for the first model in these analyses are:

Student Level (level-1) Model:

$$Science\ Achievement\ (Y_{ij})$$
$$= \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2j} * (ZSWHSC) + \beta_{3j} * (ZSWHTS)$$
$$+ \beta_{4J} * (ZSWHINVO) + \beta_{5J} * (ZSWHINVE) + \beta_{6J} * (ZSWHTO)$$
$$+ +\beta_{7J} * (ZSWHCOOP) + \beta_{8j} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (ZT\_EXPER)_j + \gamma_{02} * (ZTSESE)_j + \gamma_{02} * (ZTITSA)_j + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + u_{1j}$$
$$\beta_{2j} = \gamma_{20} + u_{2j}$$
$$\beta_{3j} = \gamma_{30} + u_{3j}$$
$$\beta_{4j} = \gamma_{40}$$
$$\beta_{5j} = \gamma_{50} + u_{5j}$$
$$\beta_{6j} = \gamma_{60}$$
$$\beta_{7j} = \gamma_{70}$$
$$\beta_{8j} = \gamma_{80} + u_{8j}$$

In the model presented above showed that *Experience, Efficacy for Student Engagement,* and *Implicit Theory of Science Ability* were found as significant, and these variables were retained in the model.

Afterwards, 9 level-2 variables (i.e., *Teacher's Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Science Ability*) were incorporated in the randomly varying slopes of significant predictors of *Science Achievement*. Therefore these class level variables included into the slope model of *Investigation*, and then, into the slope model of *Equity*. On the other hand,, since *Gender*, *Student Cohesiveness,* and *Teacher support* were not significant predictors of *Science Achievement*, these slopes were not tested for moderation effect. The same procedures were followed with the section 4.2.2.4.1.

All class level variables subsequently included in the slope of *Investigation.* However, none of these variables was significantly associated with *Investigation*. Lastly, the same procedure was followed for including class level variables into the slope model of *Equity*. Result yielded that, among 9 class level variables, only teachers' *Gender* was found as significant. The final estimation of Intercepts and Slopes as Outcomes Model was represented as the following equation:

Student Level (level-1) Model:

$$Science\ Achievement\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2j} * (ZSWHSC) + \beta_{3j} * (ZSWHTS) + \beta_{4J} * (ZSWHINVO) + \beta_{5J} * (ZSWHINVE) + \beta_{6J} * (ZSWHTO) + +\beta_{7J} * (ZSWHCOOP) + \beta_{8j} * (ZSWHEQU) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (ZT\_EXPER)_j + \gamma_{02} * (ZTSESE)_j + \gamma_{02} * (ZTITSA)_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + u_{3j}$$

$$\beta_{4j} = \gamma_{40}$$

$$\beta_{5j} = \gamma_{50} + u_{5j}$$

$$\beta_{6j} = \gamma_{60}$$

$$\beta_{7j} = \gamma_{70}$$

$$\beta_{8j} = \gamma_{80} + +\gamma_{81} * (T\_FEMALE)_j + u_{8j}$$

Results of the final estimation of fixed effects obtained from the final full Intercepts and Slopes as Outcomes Model for *Science Achievement* were presented in Table

4.33. The class means on *Science Achievement* was positively associated with teachers' Experience (ZT_EXPER; γ = .069, se = .029, p < .05), *Efficacy for Student Engagement* (ZTSESE; γ = .095, se = .029, p < .01), and *Implicit Theory of Science Ability* (ZTITSA; γ = .064, se = .029, p < .05). Namely, students tended to get higher scores from science test in the classroom thought by the science teachers who were more experienced, were more confident in student engagement in science class, or hold the belief that people's ability in science can be improved.

Moreover, the results of the fixed effects obtained from the final full Intercepts and Slopes as Outcomes Model were similar to the results of Random Coefficient Model (research question 3c).. *Involvement* (ZSWHINVO; γ = .135, se = .015, p < .001), and *Task Orientation* (ZSWHTO; γ = .192, se = .013, p < .001), were significantly and positively associated with *Science Achievement.* However, Investigation (ZSWHINVE; γ = -.031, se = .015, p < .05) and *Cooperation* (ZSWHCOOP, γ = -.065, se = .014, p < .001) was found as negatively related to *Science Achievement*. Namely, slope coefficient of *Science Achievement – Involvement* yielded that students who tended to involve in classroom activities obtained higher scores from science achievement test. The slope coefficient of *Science Achievement – Task Orientation* indicated that students who perceived classroom as more task oriented tended to get higher score from science test. On the other hand, the slope coefficient of *Science Achievement – Investigation* revealed that students who tended to do more inquiry and have problem solving skills in science class were less likely to get high scores from science test. Moreover, the *Science Achievement – Cooperation* slope coefficient showed that cooperation among students in classroom activities had negative effect on science achievement. Moreover, when teacher gender was included into the *Equity* slope model, the main effect of *Equity* on *Science Achievement* was no longer significant. There are some slight differences between the coefficients obtained from Random Coefficient Model and Intercepts and Slopes as Outcomes Model. However, they were identical in terms of directions and interpretations. This difference in some coefficients might be due to the inclusion of class level variables into the Intercept and Slopes as Outcomes Model.

Results of final full Intercepts and Slopes as Outcomes Model yielded a cross-level interactions between student and class level predictors of *Science Achievement.* Teacher's *Gender* (T_FEMALE; $\boldsymbol{\gamma_{81}}$=.060, se = .021, p < .01) was significantly associated with the *Equity* slope coefficient. In other words, Teacher's gender moderated the effect of *Equity* on *Science Achievement.* For the students who thought by female science teachers, the effect of students' perceptions of equity in the classroom had more influence on their achievement in science than males.

The Science Achievement – Equity slope model is:

$$\beta_8 = \gamma_{80} + \gamma_{81} * (T\_FEMALE) + u_8$$

β_1 is the overall *Equity* slope

γ_{10} is the average *Science Achievement – Equity* slope across the classes

γ_{11} is the effect of *Gender* on the overall slope

u_1 is the random effect or error

These coefficients were found as γ_{80}= .033, γ_{81}= .060. Incorporating these coefficients into the equation results with:

$$\beta_8 = 0.033 + 0.060(T\_FEMALE) + u_8$$

Moreover, the results of the final estimation of variance components obtained from the full final Intercepts and Slopes as Outcomes Model for *Science Achievement* were presented in table 4.34. The proportion of variance explained in intercept and slope model of significant predictors of *Science Achievement* (*Equity*) with significant class level predictor (Teacher's *Gender*) was calculated by comparing variance components obtained from Random Coefficient Model (Model 2) and final full Intercepts and Slopes as Outcomes Model as follows:

Proportion of variance explained in *Science Achievement,* β_{0j}:

$$R^2 = \frac{\tau_{0j}(Random\ Coefficient) - \tau_{0j}(Intercepts\ and\ Slopes\ as\ Outco.}{\tau_{0j}(Random\ Coefficient)}$$

$$= \frac{0.30762 - 0.28381}{0.30762} = 0.078$$

Proportion of variance explained in *Equity*, β_{8j}:

$$R^2 = \frac{0.00663 - 0.00636}{0.00663} = 0.041$$

These findings revealed that teachers' *Experience, Efficacy for Student Engagement* and *Implicit Theory of Science Ability* were accounted for about 8% of the reduction in the variation of class means on *Science Achievement*. Additionally, 4% reduction in the variance of the *Equity* slope was accounted for by teacher's *Gender* However, significant differences still remained among classes both for average *Science Achievement* (χ^2= 1612.19, $p<0.001$) and *Equity* slope (χ^2= 424.03, $p<0.05$). This reduction in the proportion indicated that small amount of variations in the *Equity* slope had been accounted for while teacher gender was controlled. Similarly, small amount of reduction in the variance of the average class scores on *Science Achievement* was occurred while teachers' *Experience, Efficacy for Student Engagement* and *Implicit Theory of Science Ability* were controlled.

Table 4.33 Final Estimation of Fixed Effects of Final Full Model: Intercepts and Slopes as Outcomes Model for Science Achievement

Fixed Effects	*Coefficient*	SE
ZSAS (Science Achievement), Model for Class Means[1]		
Intercept, γ_{00}	-.049	.031
ZT_EXPER (Experience), γ_{01}	.069*	.027
ZTSESE (Efficacy for Student Engagement), γ_{02}	.095**	.028
ZTITSA (Implicit Theory of Science Ability), γ_{03}	.064*	.027
S_FEMALE (Gender), γ_{10}	.038	.025
ZSWHSC (Student Cohesiveness), γ_{20}	.013	.013
ZSWHTS (Teacher Support), γ_{30}	-.011	.015
ZSWHINVO (Involvement), γ_{40}	.135***	.015
ZSWHINVE (Investigation), γ_{50}	-.031*	.015
ZSWHTO (Task Orientation), γ_{60}	.192***	.013
ZSWHCOOP (Cooperation), γ_{70}	-.065***	.014
ZSWHEQU (Equity), γ_{80}	.032	.018
T_FEMALE (Gender), γ_{81}	.060**	.021

Note. Only predictors in final models were included in the table.

**p< .05, **p<.01, ***p<.001*

1: The all continuous variables were grand mean centered

Table 4.34 Final Estimation of Random Effects of Final Full Model: Intercepts and Slopes as Outcomes Model for Science Achievement

Random Effects	Variance Components	df	χ^2	R^2	Reliability
ZSAS (Science Achievement),					
Class mean, u_{0j}	.284	368	1612.79***	.078	.73
S_FEMALE (Gender), u_{1j}	.106	371	633.45***		.41
ZSWHSC (Student Cohesiveness), u_{2j}	.012	371	460.42**		.17
ZSWHTS (Teacher Support) u_{3j}	.018	371	448.50**		.19
ZSWHINVE (Investigation), u_{5j}	.007	371	417.60*		.09
ZSWHEQU (Equity), u_{8j}	.006	370	424.04*	.041	.08
Level-1 Effect, r_{ij}	.587			.173	

**p< .05, **p<.01, ***p<.001*

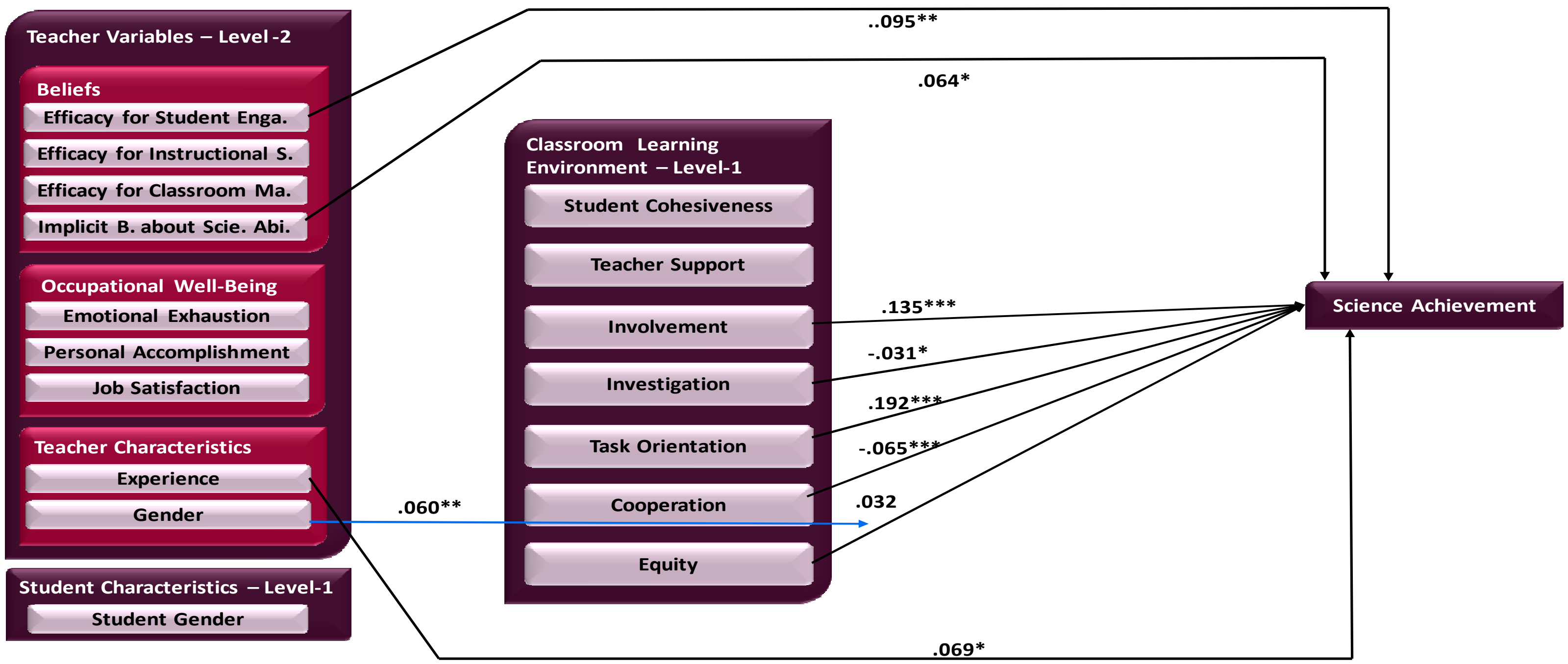

Figure 4.8 Predicting Science Achievement by classroom learning environment variables (level-1) and student gender (level-1) and teacher variables (level-2).

Note. Arrows do not indicate causal relationships. Their directions are from predictors to outcome variables. Blue arrows indicate interaction of level-1 and level-2 variables. *p< .05, **p<.01, ***p< .001

4.2.4 Results of Research Question 4: Random Coefficient Model for Mediation Effect (Model 2)

The fourth HLM analysis was conducted to test the research questions focusing on the mediator role of self-regulation on the relationship between perceived classroom environment and students' science achievement:

4 Do students' Self-Regulation variables (i.e., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals,* and *Performance Avoidance Goals*) mediate the relationship between students' *Science Achievement,* and students' *Gender* and classroom learning environment variables (i.e., *Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation,* and *Equity*)?

The research question 4 addresses the mediation effect of *Self-Regulation* variables on the relationship between *Science Achievement, and Gender* and *Classroom Learning Environment* variables. In order to test the current research question (Model 2), final estimation of the Random Coefficient Model (Model 1) that was built in section 4.2.3.3 was expanded by inclusion of the *Self-Regulation* variables (e.g., *Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals, and Performance Avoidance Goals*). The same building strategy that used in previous sections was used with the exception that even both fixed and random components of a variable were nonsignificant, it was not removed from the model (model 2) in order to compare model1 and model2 and see the mediator roles of self-regulation variables.

The regression equation addressing the research question 3c is as follows:

Student level (level-1) model:

$Science\ Achievement\ (Y_{ij})$

$$= \beta_{0j} + \beta_{1j} * (S\_FEMALE) + \beta_{2J} * (ZSWHSC) + \beta_{3J} * (ZSWHTS) + \beta_{4J} * (ZSWHINVO) + \beta_{5J} * (ZSWHINVE) + \beta_{6J} * (ZSWHTO) + \beta_{7J} * (ZSWHCOOP) + \beta_{8J} * (ZSWHEQU) + \beta_{9J} * (ZSSE) + \beta_{10J} * (ZSMC) + \beta_{11J} * (ZSGOMAP) + \beta_{12J} * (ZSGOPAV) + \beta_{13J} * (ZSGOPAP) + \beta_{14J} * (ZSGOMAV) + r_{ij}$$

Teacher level (level-2) model:

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

.

.

.

$\beta_{Qj} = \gamma_{q0} + u_{qj}$

In these models,

Y_{ij} is the *Science Achievement* score of student I in class j

β_{0j} is the mean of *Science Achievement* (i.e., average scores of the all classes on science test)

β_{1j} is the differentiating effect of students' *Gender* in class j (i.e., the mean difference between male and female students' scores on science test)

β_{2j} is the differentiating effect of students' perception of *Student Cohesiveness* in class j (i.e., the degree to which perceptions of *Student Cohesiveness* differences among students related to *Science Achievement*)

β_{3j} is the differentiating effect of students' perception of *Teacher Support* in class j (i.e., the degree to which perceptions of *Teacher Support* differences among students related to *Science Achievement*)

β_{4j} is the differentiating effect of students' perception of *Involvement* in class j (i.e., the degree to which perceptions of *Involvement* differences among students related to *Science Achievement*)

β_{5j} is the differentiating effect of students' perception of *Investigation* in class j (i.e., the degree to which perceptions of *Investigation* differences among students related to *Science Achievement*)

β_{6j} is the differentiating effect of students' perception of *Task Orientation* in class j (i.e., the degree to which perceptions of *Task Orientation* differences among students relate to *Science Achievement*)

β_{7j} is the differentiating effect of students' perception of *Cooperation* in class j (i.e., the degree to which perceptions of *Cooperation* differences among students related to *Science Achievement*)

β_{8j} is the differentiating effect of students' perception of *Equity* in class j (i.e., the degree to which perceptions of *Equity* differences among students related to *Science Achievement*)

β_{9j} is the differentiating effect of students' *Self-Efficacy* in class j (i.e., the degree to which self-efficacy differences among students related to *Science Achievement*)

β_{10j} is the differentiating effect of students' *Metacognitive Self-Regulation* in class j (i.e., the degree to which *Metacognitive Self-Regulation* among students related to *Science Achievement*)

β_{11j} is the differentiating effect of *Mastery Approach Goals* in class j (i.e., the degree to which *Mastery Approach Goals* among students related to *Science Achievement*)

β_{12j} is the differentiating effect of *Performance Avoidance Goals* in class j (i.e., the degree to which *Performance Avoidance Goals* among students related to *Science Achievement*)

β_{13j} is the differentiating effect of *Performance Approach Goals* in class j (i.e., the degree to which *Performance Approach Goals* among students related to *Science Achievement*)

β_{14j} is the differentiating effect of *Mastery Avoidance Goals* in class j (i.e., the degree to which *Mastery Avoidance Goals* among students related to *Science Achievement*)

β_{qj} is the coefficient for variable q for class j after accounting for other variables

γ_{00} is the average of class means on the *Science Achievement* across the population of classes

γ_{q0} is the average *q* factor- slope of outcome variable across those classes

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

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

Final estimation of fixed effects and random effects obtained from current Random Coefficient Model (Model 2) built for mediation effect of *Self-Regulation* variables were presented with the results of the previous Random coefficient Model (Model 1) built with *Gender* and classroom learning environment variables in the Table 4.35 and 4.36 respectively to make interpretation more clear.

Results of the final estimation of fixed effects obtained from Random Coefficient Model of this study (Model 2) showed that *Involvement* (ZSWHINVO; γ = .076, se = .014, p < .001), *Task Orientation* (ZSWHTO; γ = .045, se = .014, p < .01), *Self-*

Efficacy (ZSSE; γ = .340, se = .015, p < .001) *and Mastery Approach Goals* (ZSGOMAP; γ = .085, se = .014, p < .001) were positively and significantly associated with *Science Achievement.* On the other hand, Investigation (ZSWHINVE; γ = -.074, se = .013, p < .001) and *Performance Avoidance Goals* (ZSGOPAV; γ = -.063, se = .012, p < .001) were found as significantly but negatively related to *Science Achievement*. Namely, slope coefficient of *Science Achievement – Involvement* yielded that students who tended to involve in classroom activities obtained higher scores from science achievement test. The slope coefficient of *Science Achievement – Task Orientation* indicated that students who perceived classroom as more task oriented tended to get higher score from science test. The *Science Achievement –Self-Efficacy* slope coefficient indicated that students who had higher confidence in learning science were likely to get higher scores from science test. The slope coefficient of *Science Achievement – Mastery approach goals* yielded that students who approach success in learning science were more likely to obtain higher scores from science test. On the other hand, the slope coefficient of *Science Achievement – Investigation* revealed that students who tended to do more inquiry and had problem solving skills in science class were less likely to get high scores from science test. Moreover, the *Science Achievement –Performance Avoidance* slope coefficient showed that students' setting more performance avoidance oriented goals in learning science had negative effect on science achievement.

Results of the final estimation of variance components obtained from Random Coefficient Model of this study (Model 2) revealed that class means were statistically significantly different from each other (χ^2 = 1501.15, *p*< .001), which suggested inclusion of class level variables to account for the variability among 372 classes. Additionally, the slopes of *Science Achievement - Gender* (χ^2 = 599.02, *p*<.001), *Science Achievement – Student Cohesiveness* (χ^2 = 463.72, *p*<.01), *Science Achievement – Equity* (χ^2 = 438.07, *p*< .01), *Science Achievement – Self-Efficacy* (χ^2 = 472.77, *p*< .001), *Science Achievement – Mastery Approach Goals* (χ^2 = 426.86, *p*< .05), and *Science Achievement – Performance Approach Goals* (χ^2 = 457.23, *p*< .01), were all varied significantly, which suggested that in some classes, the slopes were much steeper than for other classes.

Regarding mediation effect, as presented in the table 4.35, although *Cooperation* and *Equity* were significant predictors of the Science Achievement (Model 1), after including Self-Regulation variables (Model 2), they became nonsignificant. It means that Self-Regulation variables mediated the relation of Classroom Learning Environment variables (i.e. *Cooperation* and *Equity*) to *Science Achievement*. Moreover, inclusion of Self-Regulation variables also resulted in removing the random effect of *Teacher Support* and *Investigation*. That is, while Self-Regulation variables were controlled, classes did not vary in terms of *Teacher Support* and *Investigation.*

In order to investigate the amount of variance in *Science Achievement* explained in student level, the variances in the Analysis of Variance Model and the Random Coefficient Model (Model 2) were compared. The proportion of reduction in variance at student level (R^2) was calculated by comparing σ^2 estimates of Analysis of Variance Model and the Random Coefficient Model *Science Achievement* as follows:

$$R^2 = \frac{\sigma^2(Random\ ANOVA) - \sigma^2(Means\ as\ Outcome)}{\sigma^2(Random\ ANOVA)} = \frac{0.710 - 0.513}{0.710} = 0.277$$

By including these student level factors (*Gender, Student Cohesiveness, Involvement, Investigation, Task Orientation, Equity, Self-Efficacy, Mastery Approach goals, Performance Avoidance Goals,* and *Performance Approach Goals*) as predictors *Science Achievement*, within class variance was reduced by 27.7%. Namely, these factors account for about 28 % of the student level variance in *Science Achievement.*

Reliability of the intercept and randomly varying slopes were also obtained HLM analysis. Results revealed that reliability of intercept (.72) was quite reliable than reliability of slopes of Gender (.36), Student Cohesiveness (.15), Equity (.09), Self-Efficacy (.19), Mastery Approach Goals (.11) and Performance Approach Goals (.12) (see Table 4.36).

Table 4.35 Final Estimation of Fixed Effects: Random Coefficient Model for Learning Environment and Gender and for Mediation Effect of Self-Regulation Variables

	Model 1		Model 2	
Fixed Effects	Coefficient	SE	Coefficient	SE
ZSAS (Science Achievement), Model for Class Means[1]				
Intercept, γ_{00}	-.049	.031	-.045	.030
S_FEMALE (Gender), γ_{10}	.039	.025	.036	.023
ZSWHSC (Student Cohesiveness), γ_{20}	.014	.013	-.002	.012
ZSWHTS (Teacher Support), γ_{30}	-.011	.015	-.022	.012
ZSWHINVO (Involvement), γ_{40}	.135***	.015	.075***	.014
ZSWHINVE (Investigation), γ_{50}	-.029*	015	-.074***	.013
ZSWHTO (Task Orientation), γ_{60}	.191***	.013	.045**	.014
ZSWHCOOP (Cooperation), γ_{70}	-.064***	.014	-.016	.013
ZSWHEQU (Equity), γ_{80}	.065***	.014	.017	.013
ZSSE (Self-Efficacy), γ_{90}			.340***	.015
ZSMC (Metacognitive Self-Regulation), γ_{100}			-.009	.013
ZSGOMAP (Mastery Approach Goals), γ_{110}			.085***	.014
ZSGOPAV (Performance Avoidance Goals), γ_{120}			-.063***	.012
ZSGOPAP (Performance Approach goals) , γ_{130}			.020	.012
ZSGOMAV (Mastery Avoidance Goals), γ_{140}			.005	.010

Note. Nonsignificant predictors were not removed from the model.

**p< .05, **p<.01, ***p<.001*

1: The all continuous student level variables were grand mean centered

Table 4.36 Final Estimation of Random Effects: Random Coefficient Model for Learning Environment and Gender and for Mediation Effect of Self-Regulation Variables

	Model 1					Model 2				
Random Effects	Variance Components	df	χ^2	Reliability	R^2	Variance Components	df	χ^2	Reliability	R^2
ZSAS (Science Achievement),										
Class mean, u_{0j}	.308	371	1730.44***	.745		.261	369	1501.15***	.723	
S_FEMALE (Gender), u_{1j}	.106	371	633.46***	.406		.085	369	599.02***	.363	
ZSWHSC (Student Cohesiveness), u_{2j}	.012	371	460.50**	.165		.009	369	463.72**	.147	
ZSWHTS (Teacher Support), u_{3j}	.019	371	448.57**	.192						
ZSWHINVE (Investigation), u_{5j}	.007	371	417.71*	.091						
ZSWHEQU (Equity), u_{8j}	.007	371	429.20**	.085		.006	369	438.07**	.088	
ZSSE (Self-Efficacy), u_{9j}						.015	369	47..77***	.193	
ZSGOMAP (Mastery Approach Goals), u_{11j}						.010	369	426.86*	.113	
ZSGOPAP (Performance Approach Goals), u_{13j}						.007	369	457.23**	.120	
Level-1 Effect, r_{ij}	.587				.173	.513				.277

*p< .05, **p<.01, ***p<.001

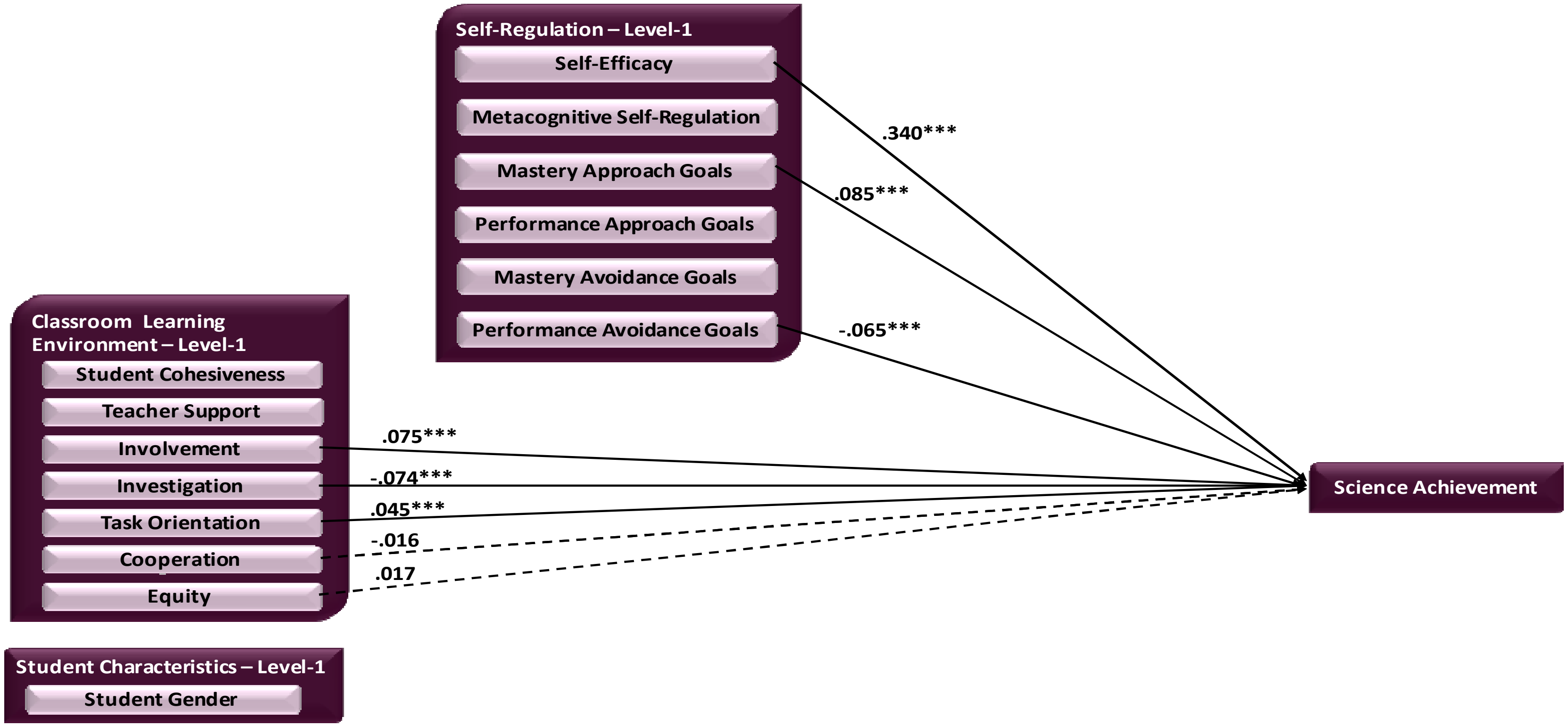

Figure 4.9 Predicting science achievement (Model 2)

Note: *p< .05, **p<.01, ***p< .001. Arrows do not indicate causal relationships. Their directions are from predictors to outcome variable. Dashed lines indicate mediated classroom environment variables by self-regulation variables.

CHAPTER V

DISCUSSION

In this chapter, results of the present study are discussed. Afterwards, conclusions, implications, and limitations are presented.

5.1 Discussion of the Results

The present study mainly focused on four main research questions and related sub-questions. Accordingly, 14 one-way random effect ANOVA models, 14 means as outcomes models, 8 random coefficient models, and 7 intercepts and slopes as outcomes models were built by using Hierarchical Linear Modeling (HLM) analysis to answer the research questions. The results of these models are discussed in the following sections for each research question, separately.

5.1.1 Research question 1: Predicting Classroom Learning Environment

The first research question attempted to find out whether classes differ in students' perceptions of classroom learning environment or not, and to explore the class (or teacher) level variables explaining the differences in students' perception of classroom learning environment among classes. The present study has a clustered multilevel structure. Namely, all students are nested within their respective classes (or teachers). Therefore, it is assumed that the students in the same classroom are more likely to resemble on several variables than the students from different classes. Thus, in order to test the first research question, HLM analyses were performed.

In the present study, 7th grade students' perceptions of classroom learning environment was assessed by the 7 dimensions of What is Happening in this Class (WIHIC): Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity. During data analyses, firstly, one-way random effect ANOVA model which is also known as unconditional model was built for each classroom learning environment dimension separately. None of the student level or class level variables was included in unconditional models. Results revealed that significant variations did exist among the classes in students' responses to each dimension of classroom learning environment (i.e., Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity). Thus, performing an HLM analysis for this data set was appropriate.

Afterwards, in order to assess the percent of variance in each classroom learning environment dimension due to the differences between classes, Intraclass Correlation Coefficients (ICC) were computed. ICC also represents the degree of group homogeneity in a nested data. The ICCs obtained from this study indicated that 7% of the total variance in Student Cohesiveness, 12% of the total variance in Teacher Support, 7% of the total variance in Involvement, 8% of the total variance in Investigation, 7% of the total variance in Task Orientation, 9% of the total variance in Cooperation, and 7% of the total variance in Equity were accounted for class level variables. The remaining variances of each variable were within classes and accounted for by student variables. According to Hox (2010), intraclass correlations of .10 seem reasonable and .15 could be regarded as high in educational and organizational contexts. Hox (2010) also suggested using .05, .10, and .15 as small, medium, and large values respectively for ICCs in general cases. Accordingly, in this study, while ICC for Teacher Support was moderate, for other variables, ICCs seemed low. While considerable amount of variance was related to class (or teacher) variables for the Teacher Support, there were some distinctions between classes in terms of other variables. These results implied that majority of students' perceptions of classroom environment are predicted by student characteristics rather than class (or teacher) level variables. Although a few studies have reported variance partitioning of the WIHIC using multilevel analysis, results of the current study are consistent with the most of the previous studies. For example, den Brok et al. (2006) investigated the between class variance of the WIHIC scales with 655 eight grade science students from 26 classes from 11 schools in California. They performed separate Random Coefficient ANOVA models by using HLM for each dimension of the WIHIC scale. The researchers found low ICC values for most of the subscales, more specifically: .02 for Student Cohesiveness, .18 for Teacher Support, .05 for Involvement, .06 for Investigation, .02 for Task Orientation, .07 for Cooperation, and .12 for Equity. Similarly, in another study (Dorman, 2009) with a larger sample from primary and secondary schools, ICCs for class level were ranged between .06 (Task Orientation) and .19 (Teacher Support).

Finally, with an attempt to explore the class (or teacher) level predictors accounting for between class variations in students' perception of the each dimensions of classroom learning environment, means as outcomes models were built for each outcome variables. The class (or teacher) level variables included Teacher's Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Ability in Science.

Regarding students' perceptions of *Student Cohesiveness*, results revealed that only Experience and Efficacy for Student Engagement were found to be significant predictors while controlling other variables. Namely, teachers with more teaching experience and teachers who were more confident in student engagement were perceived as creating more friendly climate among the students in the classroom. These teachers let students to know one another, to set close relationships, to get along with other students, and to be open to help other students and to work with each other. However, Experience and Efficacy for Student Engagement accounted for small amount of the variance (about 6%) in the between class differences in mean Student Cohesiveness.

Students' perception of *Teacher Support* was the most sensitive dimension of the classroom environment to teacher level variables. While teachers' Gender, Efficacy for Student Engagement, Job Satisfaction, and Emotional Exhaustion were found positive and significant predictors of Teacher Support, Experience was found as a negative predictor of Teacher Support. These results indicated that female teachers and teachers with greater job satisfaction, with more confidence in student engagement, and with more frustration, were more likely to provide support and help for their students, to show interest, and to behave more friendly. Moreover, these teachers tended to care about students' problems and they would change the teaching method depending on students' needs. On the other hand, more experienced teachers were found to demonstrate such teacher supportive behaviors at lower levels. Among these significant teacher variables, Job Satisfaction was the best predictor of the Teacher Support (γ = .093). Although, in this study, most of the teacher variables(Gender, Efficacy for Student Engagement, Job Satisfaction, Emotional Exhaustion, and Experience) significantly predicted students' perceptions of Teacher Support, these factors accounted for small amount of the variance (about 14%) in the between class differences in mean Teacher Support.

Perceived *Involvement*, *Cooperation*, and *Equity* were significantly predicted only by Efficacy for Student Engagement. That is, in the classrooms taught by highly efficacious teachers in student engagement, students were more likely to participate in discussions, share their ideas, show attentive interest, enjoy class, cooperatively work with other students, enroll in teamwork, and share learning materials with other students. Moreover, these teachers who feel higher confidence in student engagement are more likely to treat students equally. Namely, they provide same amount of opportunity in class discussions, praise, help, and encouragement for all students. Moreover, Efficacy for Student Engagement was accounted for about 7%, 4%, and 5% of the variance in the between class differences in mean Involvement, Cooperation and Equity, respectively. This indicated that teachers' confidence in student engagement explained less than 10% of the differences among classes for these dimensions of classroom environment.

For perceived *Investigation* and *Task Orientation*, results of the analyses showed that Efficacy for Student Engagement was positive and Efficacy for Classroom Management was negative predictors of Investigation and Task Orientation. This result indicated that teachers who have more confidence in student engagement but less confidence in using classroom management strategies tend to create a classroom climate which engages students in developing inquiry skills and using them in problem solving and investigation. Moreover, Efficacy for Student Engagement and Efficacy for Classroom Management were accounted for less than 10% of the variance in the between class differences in mean Investigation and Task Orientation.

The overall findings indicated that teachers' Efficacy for Student Engagement was positively related to all dimensions of classroom learning environment, and it was the best predictor of the 6 of the 7 dimensions of classroom learning environment. These findings supported the past research revealing that teachers' self-efficacy beliefs are related to favorable behaviors of teachers in the classroom such as giving better feedbacks to students, providing greater academic focus in the classroom, investing more effort to teaching, being open to new ideas, and showing persistence when faced with obstacles (see Tschannen-Moran et al. 1998). These favorable teacher behaviors have potential to positively influence the classroom environment. Moreover, results of Guo et al.'s (2012) study showed that teachers with higher self-efficacy were more likely to create a classroom environment that support elementary students' learning and to set warm relationships. Therefore, it is reasonable to find out that teachers who feel high confidence for engaging all students and encourage them to do well in school work are more likely to create better classroom environment.

Another finding in this study was the negative relation of Efficacy for Classroom Management to Investigation and Task Orientation. Indeed, in the classroom where students are encouraged to conduct investigations and use inquiry skills in problem solving, it is reasonable that teacher might experience difficulties in managing the classroom. However, from another point of view, some of the past studies revealed that highly efficacious teachers provide classroom environments in which they use more humanistic classroom management strategies (Woolfolk & Hoy, 1990), and prefer more student-centered teaching (Czerniak & Schriver, 1994). However, both of these studies used different measures of self-efficacy than that of the present study. In the present study, TSES, which did not emphasize the quality of the strategies that teachers used to manage the disruptive behaviors in the classroom, was used to measure teachers' efficacy beliefs in classroom management. Its only focus is on the teachers' confidence to successfully managing the classroom. However, the nature of the management techniques might be more useful indicator of the quality of classroom environment than the degree of teachers' feeling confidence for classroom management. Therefore, Turkish science teachers' classroom management strategies should be examined deeply to understand these negative associations. For example, if a teacher mostly uses strict behaviors in classroom management, instead of using more educational and pedagogical methods, this might negatively influence students' interest in class, their desire to make inquiry, and accomplishment of planned activities.

Another interesting finding of this study is that none of the dimensions of classroom environment was significantly associated with Efficacy for Instructional Strategies. Teachers who were highly confident in using variety of instructional strategies depending on students' needs or course context were logically expected to create qualified learning environments that encourage students to involve in classroom discussions and engage in cooperatively working with other students when doing assignments, and provide teacher support to students to facilitate their learning. However, findings of the present study contradict to some studies which suggest that teacher efficacy positively influences the classroom learning environment that they create (e.g., Czerniak & Schriver, 1994; Guo et al. 2010; Guo et al. 2012; Woolfolk & Hoy, 1990). Indeed, the conceptualization of teacher self-efficacy plays an important role in comparison of the findings. Since there is no study investigating the influence of 3 aspects of teacher efficacy suggested by Tschannen-Moran and Woolfolk Ho (2001) on classroom environment, the findings of the present study are not comparable. Thus, more studies are needed for better description of the relationship between dimensions of teacher efficacy and classroom environment perceptions.

Considering teacher burnout and job satisfaction, results revealed that these variables only significantly predicted Teacher Support, but not remaining 6 dimensions of classroom learning environment. More specifically results revealed that teachers who were satisfied with teaching profession and do not have intention to quit job, and teachers who feel frustrated and emotionally drained from work are more likely to treat students as friendly and supportive. These findings for job satisfaction are reasonable because previous studies revealed that teachers' job satisfaction was positively related to their performance at work (e.g., Ololube, 2006), extra-role behaviors toward students, organization (e.g., Somech & Drach-Zahavy, 2000), and quality of the learning environment (e.g., Demirtas, 2010; Klusmann et al. 2008). Considering burnout, although few empirical studies in learning environment research were interested in teacher burnout, results of the available studies contradict to the findings of the present study. For example, Dorman's (2003a) study based on a structural model with teachers perceptions of classroom environment (assessed by CES) and burnout (assessed by MBI-ES) revealed that Task Orientation and Interaction were negatively related, and Cooperation was positively and significantly related to Personal Accomplishment. Moreover, Cooperation and Order and Organization were found negatively associated with Emotional Exhaustion. Additionally, past research suggested that burnout negatively associated with teachers' instructional performance and student outcomes (Klusmann et al. 2008). Burnout teachers fail to establish effective relationship with their students; provide less information, praise, and acceptance of students' ideas; and avoid interactions (Tatar & Yahav, 1999). However, present study revealed that teacher burnout does not have an important role in explaining the differences between classes regarding students' perceptions of classroom environment. Moreover, opposite to common expectation, teachers' emotional exhaustion was found as a positive predictor of teacher support. Namely, teachers who were perceived as more supportive reported higher emotional exhaustion. According to Maslach and Leiter's (1999) research agenda, while burnout was regarded as a factor affecting teachers' and students' behaviors and experiences, it was also assumed as being affected from various factors including the nature of social environment, school setting, and work, as well as teachers' and students' personal characteristics. Moreover, Maslach and Leiter's (1999) model also indicated the contribution of student behaviors such as disruptive actions in the classroom, disrespect, and inattentiveness on teacher burnout. Therefore, in the present study, one possible reason of the negative association between emotional exhaustion and teacher support mat be that teachers' working with children, showing interest to their problems, and supporting their learning might have increase emotional exhaustion of the teachers. Since this study was limited to provide causal relations, it is not possible to understand the nature of this relationship. Therefore, qualitative research methods, such as interviews with students and teachers, or observations in the classrooms, might shed light on this issue.

Considering teacher Gender, it was found as a significant predictor of only Teacher Support among 7 subscales of classroom environment. That is, students perceived female teachers more friendly and more supportive in the classroom than male teachers. However, considering other dimensions of learning environment, male and female teachers were perceived almost equal in terms of the quality of the learning environment that they create. These findings supported the previous research with elementary school students by using WIHIC. In previous studies, researchers found significant gender effect favoring female teachers in some dimensions of classroom environment (e.g., den Brok et al. 2006). However, in a study with Turkish elementary science students, Rakici (2004) found teacher Gender (favoring males) as significantly related to only Cooperation among the all dimensions of learning environment.

Another teacher characteristic that was tested in this study was the year of teaching experience. Experience was positively related to Student Cohesiveness while negatively related to Teacher Support. Namely, experienced teachers were perceived as they were less supportive to students and were less likely to care students' problems, they showed less interest to students, and they treated less friendly. On the other hand, students in the classrooms taught by experienced teachers perceived classroom more cohesive, knew each other in the class, set close relationship with other students, and enjoyed working with other students. These results are in line with the Wubbels and den Brok's (2002) study that examined the student-teacher interaction in secondary schools with a longitudinal data. Although they used different methodology than that of the present study, their results revealed that when teachers get experienced, they did not set close relationship with students, behaved less friendly, and had less tolerance to disruptive behaviors. Conversely, in the early years of their career, teachers were perceived to provide more pleasant, supportive, and cooperative climate in classroom, and students enjoyed attending classes. The association of elementary science teachers' experience with learning environment based on the aspects of WIHIC has not been studied yet. Therefore, in order to make a more reliable comparison, replication of this study is required.

An interesting finding of the current study was that teachers' belief about students' ability (incremental theory) in science was not found significantly related to any of the dimensions of classroom learning environment. However, according to Bussis et al. (1976), "teachers' characteristic beliefs about children and learning have pervasive effect on their behavior, influencing the learning environment that they create for children and for themselves" (p.16, as cited in Lynott & Woolfolk, 1994). Moreover, past research revealed that teachers' instructional strategies are influenced from their implicit theories that they hold about students' intelligence, ability, personality etc. (e.g., Lee, 1996; Lynott & Woolfolk, 1994; Swam & Snyder, 1980). Therefore it was expected to find out a positive association between teachers implicit theories about students' ability in science and classroom environment perceptions. Namely, it was expected to find that, in the classrooms where teacher believed that students' ability in science was not fixed and it can be improved, students would perceive classroom environment more qualified. However, based on the results of this study, it seems that teachers' implicit beliefs about students' ability in science do not have enough power to influence students' perceptions of classroom environment.

Finally, findings about explained variances in each dimension of classroom environment revealed that these teacher variables (Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Ability in Science) mostly accounted for less than 10 % of the between class variances. Although many researchers assumed that teachers play a very important role in characterizing classroom environment, findings of this study partly contradict with this assumption. However, since very limited number of teacher variables was incorporated in this study, this schema might have been different with different teacher characteristics. Moreover, in classroom environment research, a few studies were empirically interested in some specific teacher characteristics (e.g., Dorman, 2003a). The present study contributes to the literature through examining the role of teacher variables which were regarded as indicators of teacher quality (e.g., Bolyard & Moyer-Packenham, 2008; Klusman, et al., 2008; Patrick & Smart, 1998) in students' perceptions of classroom learning environment in science classes.

5.1.2 Research question 2: Predicting Students' Self-Regulation

The focus of the second research question was to examine whether there were differences in components of students' self-regulation, which student and teacher variables were accounting for these differences between and within class variances, and whether there were interactions between student and teacher variables when explaining self-regulation components. Since the obtained data were nested within classes, HLM method was used to analyze the data. Therefore, the similarities of the responses of the students in the same classrooms to the scales were not ignored, and more plausible results were aimed to be obtained.

The components of self-regulation investigated in this study included Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals, and Performance Avoidance Goals. For the 6 components of Self-Regulation, separate one-way ANOVA models (unconditional models) were built to find out whether there were class differences. These models did not include any student or teacher variable. Results showed that significant variations did exist among the classes for each component of Self-Regulation. Therefore, conducting HLM analyses seemed reasonable.

ICCs were computed to explore the percent of variance due to differences between classes. The ICCs obtained from this study indicated that 11% of the total variance in Self-Efficacy, 8% of the total variance in Metacognitive Self-Regulation, 6% of the total variance in Mastery Approach Goal Orientation, 4% of the total variance in Performance Approach Goal Orientation, 3% of the total variance in Mastery Avoidance Goal Orientation, and 5% of the total variance in Performance Avoidance Goal Orientation were accounted by the between-class variance. Applying Hox's (2010) rule of thumb suggesting 05, .10, and .15 as small, medium, and large values respectively for ICCs in general cases, it can be said that Performance Approach Goal Orientation, and Mastery Avoidance Goal Orientation were hardly able to distinguish between classes in this study. Moreover, while between class variances of Metacognitive Self-Regulation, Mastery Approach Goal Orientation, and Performance Avoidance Goal Orientation were found low, for Self-Efficacy, ICC indicated moderate level of variance accounted for class (or teacher) variables. These findings imply that majority of students' perceptions of self-regulation are predicted by student level variables rather than class (or teacher) level variables. These results are in line with the previous research with psychological constructs. For example, Tas (2008) used HLM to analyze the data obtained from 7th grade science students in Turkey. ICCs indicated 4.4%, between class variance for Mastery Goal Orientation and 3.5% between class variance for Performance Approach Goal orientation. Moreover, for student rating of achievement goals, Dicke, Ludtke, Trautwein, Nagy, and Nagy (2012) found ICC values ranging from .00 to .17 in English, Math, German, Second Foreign Language, and Biology courses. In another study, Yildirim (2012) used PISA 2003 data of 4,855 fifteen year-old Turkish students. For motivational beliefs, ICC values in this study yielded that proportion of variances accounted for class variables were 17% for math self-efficacy, 6% for anxiety, 7% for intrinsic value, and 4% for instrumental value. Yildirim (2012) also found ICC for cognitive and metacognitive strategy use as 5%. Moreover, Anderman (2002) analyzed the data obtained from 15,457 students. ICCs for psychological outcomes indicated low proportion of between class variances: 4% for depression, 5% for optimism, 3% for social rejection, and 4% for school problems. Finally, Peters (2013) found that proportion of variance in math-self-efficacy at class level was about 7%. Therefore, finding small percent of variances due to class differences is not surprising when working with psychological constructs. In the present study, although classes did not differ so much in the mean for Performance Approach Goal Orientation and Mastery Avoidance Goal Orientation, it is worth to pay attention to the influence of teacher characteristics on these constructs. Namely, because of the nested structure of the data, and group dependencies, an ordinary least squares analysis of the data would likely yield misleading results.

In order to find out class level variables (i.e., Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Ability in Science) that significantly predict Self-Regulation, means as outcomes model was tested for each component of self-regulation (i.e., Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals, and Performance Avoidance Goals). Then, random coefficient models were built separately for each component of Self-Regulation to explore the student level variables (i.e., Gender, Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity). Finally, the significant student and class level predictors that were found in means as outcomes models and random coefficients models were incorporated into the intercepts and slopes as outcomes model.

Moreover, interaction of the student and class level variables were included in this model. Thus, the results of the final models are discussed below for each components of Self-Regulation, separately.

5.1.2.1 Predicting Students' Self-Efficacy

HLM analyses with Self-Efficacy revealed that, at student level, Student Cohesiveness, Involvement, Investigation, Task Orientation, Cooperation, and Equity were found as significantly associated with students' Self-Efficacy. That is, most of the dimensions of classroom learning environment perceptions were significantly related to Self-Efficacy. These factors accounted for about 40% of the within class variance in students' Self-Efficacy beliefs in science. In other words, a considerable amount of variance in student Self-Efficacy was explained by students' perception of classroom learning environment. These findings supported Haertel et al's (1981) meta-analysis study indicating that student's perception of classroom learning environment was a good predictor of students' cognitive, affective, and behavioral outcomes. Several researchers found significant association between Self-Efficacy and some aspects of classroom learning environment assessed by WIHIC (i.e., Dorman, 2001; Dorman et al. 2003; Dorman et al. 2006). Therefore, the findings of the present study are in line with the previous research.

These results yielded that students' efficacy belief in learning science is more likely to get higher when they perceived classroom environment as more cohesive. That is, when they have the perception that, in their classroom, students set close relationship with other students, know each other, and help their friends. This finding contradicts with Dorman's (2001) study that found no association between academic efficacy and Student Cohesiveness. In the present study, it was also found that if students involve in the classroom discussions, share their ideas in the classroom, participate in classroom activities, have inquiry skills, and be able to use them in problem solving, they tend to develop higher confidence in learning science. This result is in line with Dorman's (2001) study that found a positive association between math self-efficacy and Involvement.

Students with higher Self-Efficacy reported higher level Task Orientation, namely they accomplish planned activities, be ready for class on time, carefully follow the class, and know the goals of the course. Task Orientation, among the all predictors, was the best predictor of the students' Self-Efficacy beliefs (γ = .348, se = .013). The similar results were found between math Self-Efficacy and Task Orientation in Dorman's (2001) study with secondary school students in Australia (β =.27), and Dorman et al's (2003) study with Australian, British, and Canadian secondary school students (β = .30). Task orientation was found to be the best predictor of students' academic efficacy in both of these studies. For Self-Efficacy in science, results of the stepwise analysis in Dorman et al's (2006) study also indicated Task Orientation as the best predictor of the Self-Efficacy (β = .53). Moreover, results of the present study also revealed that the association between Task Orientation and Self-Efficacy was moderated by teachers' Experience and Personal Accomplishment. It yielded that, while the other variables were controlled, in the classrooms that taught by more experienced teachers, this association became weaker. Conversely, in the classrooms that were taught by the teachers who feel higher accomplishment in work, the relation of Task Orientation to student Self-Efficacy was stronger.

On the other hand, students' efficacy beliefs were found to be negatively associated with students' perception of Cooperation after other predictor variables in the model were controlled. This finding indicates that highly efficacious students might not prefer to cooperatively work with other students, share their course materials with friends, and be a part of group work. Rather, they may prefer study and work individually. Conversely, students with lower confidence in learning science might ask help from other students. Since they have low efficacy belief for individually accomplishing a specific task, these students may prefer or be directed by the teachers to work cooperatively with other students to benefit from their abilities. This finding is in line with Dorman's (2001) and Dorman et al's (2003) studies that found negative association between self-efficacy and Cooperation. However, comparison of the coefficients obtained from zero order correlation analysis (r = .35) and multilevel analysis (γ = -.114) for the association between Self-Efficacy and Cooperation showed opposite signs, which might indicate the negative suppression effect (Tabachnick & Fidell, 2007). Therefore, we need to be cautious while interpreting the results due to possible suppression effect. For more discussion about this negative association, section 5.1.5 should be seen.

Results also revealed that students who perceived classroom environment as Equal were more likely to have higher Self-Efficacy. Namely, in the classrooms where students get equal learning opportunities, praise, help, and encouragement from the teacher, students are more likely to develop higher confidence in learning science. These findings are in line with Dorman's (2001), and Dorman et al's (2003) studies which found positive association between Self-Efficacy and Equity. Surprisingly, a negative interaction was found between Equity and teachers efficacy for Instructional Strategies concerning students' science self-efficacy. Specifically, the association between student's Self-Efficacy and Equity is found to be weaker in the classrooms taught by the teachers who have higher confidence in using variety of instructional strategies to foster students' learning. This finding can be explained as follows: in classrooms, there might be some situations in which teacher should use different instructional strategies to facilitate the learning of a group (or individual) of students. For example, if a student has a difficulty in solving a science problem because of his/her low ability in making calculations, teacher might give permission to this student to use a calculator. Furthermore, the teacher may communicate and pay attention mostly to the less able students. Thus, although using these kinds of instructional strategies might be perceived as unequal learning opportunities by the students, students of these teachers may develop higher self-efficacy. Therefore, this finding seems to be reasonable. However, it worth mentioning that abovementioned explanation is speculative and replication of this study with different samples integrating qualitative data collection procedures is important to validate the results.

The other student level variables, Teacher Support and student Gender, did not significantly predict Self-Efficacy. Regarding Teacher Support, past research indicated mixed results. For example, while Dorman (2001) found significantly negative association, Yildirim (2012) found significantly positive association between perceived Teacher Support and self-efficacy in math. In another study, Dorman et al. (2006) found significantly positive association between these two variables. Since this relation was examined in a limited number of studies, more studies are needed to make a clear conclusion. Besides, regarding Gender, although past research indicated mixed results, findings of this study supported Arisoy's (2007), Karaarslan and Sungur's (2011), and Kiran and Sungur's (2012) studies at which female and male Turkish elementary school students reported almost equal degree of Self-Efficacy in learning science.

At the class level, teachers' Emotional Exhaustion and Personal Accomplishment significantly predicted student Self-Efficacy. These results indicated that students tend to develop higher efficacy beliefs in science course when they are taught by the teacher who experienced higher Emotional Exhaustion (indicator of high higher burnout) and higher Personal Accomplishment (indicator of lower burnout). Although these two variables are indicators of burnout, Maslach and Jackson (1881) stated that Personal Accomplishment dimension was independent of Emotional Exhaustion, and they cannot be thought as the opposite constructs. Despite to the lack of empirical studies examining the association between student Self-Efficacy and teacher burnout, researchers assumed negative association between teacher burnout and students' affective outcomes (e.g., Klusmann et al. 2008; Maslach & Leiter, 1999). For example, according to the research agenda of Maslach and Leiter (1999), burnout is negatively related to teachers' behaviors in classrooms, and in turn, it reduces students' learning and performance, perception of Self-Efficacy in school, feeling competent as learners, intrinsic motivation, and creativity. Moreover, Klusmann et al.'s (2008) study indicated positive association between teachers' occupational well-being (conceptualized as low level emotional exhaustion and high job satisfaction) and students' positive motivational experience in mathematics lessons. These studies are in line with the finding of this study that higher student Self-Efficacy is associated with teachers' feeling of higher Personal Accomplishment. However, there is a contradiction in terms of Emotional

Exhaustion, although the effect was found as quite small. Since the present study is a correlational study, it is impossible to explain the reasons of this relation. Therefore, more studies are needed to shed light on this unexpected association, especially with qualitative methods such as interviews or video recording in the class, or with causal study designs. Still, based on the Maslach and Leiter's (199) reciprocal model, the possible reason might be that some teachers might exert extra effort in teaching to be successful; such as spending more time with students, doing extra works, showing more interest to students' problems, and invest much into their teaching. While these teacher behaviors may contribute to teachers' feeling of emotionally frustrated, they are also potential factors to enhance students' confidence in learning science.

Finally, the strength of the relation of student Self-Efficacy with Teacher Support, Investigation, Task Orientation, and Equity significantly varied from class to class[2]. For example, students' Self-Efficacy in learning science was influenced from their perception of Task Orientation more in some classes than in other classes. Hence, these differences between classes could be accounted for class level variables. In the present study, teachers' years of Experience and Personal Accomplishment were explained about 13% of the variation between classes in the relationship between Self-Efficacy and Task Orientation. Moreover, teachers' efficacy for Instructional Strategies was accounted for about 9% of the variation between classes in the relationship between Self-Efficacy and Equity. However, although the teacher variables were tested for each slope, all of the variance components still remained significant. This implies that different class level variables could be tested to explain this variability between the classes. In order to find out the class level variables that explain the variances of slopes among classes, more complete data that include different class level variables are needed. On the other hand, the variance components of Student Cohesiveness, Involvement, and Cooperation were not found as significant, which yielded that the strength of this association is same across the

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[2] Since Teacher Support is not a significant predictor, the randomly varrying slopes among classess for the relationship between Teacher Support and Self-Efficacy is not the focus here.

all classes, and class level variables did not have an impact on the slops for these variables.

5.1.2.2 Predicting Students' Metacognitive Self-Regulation

Results of the HLM analysis showed that, at student level, all variables that were incorporated into the model (i.e., Gender, Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity) were found to be significantly associated with students' Metacognitive Self-Regulation. A considerable amount of variance (44.1%) in students' use of metacognitive learning strategies in science class was explained by students' Gender and perception of classroom learning environment. The findings supports Haertel et al's (1981) meta-analysis study revealing that student's perception of classroom learning environment is a good predictor of students' cognitive, affective, and behavioral outcomes. In science education in Turkey, several researchers also found significant associations between some aspects of classroom learning environment and metacognitive strategy use (i.e., Ozkal et al. 2009; Sungur & Gungoren, 2009; Yilmaz-Tuzun & Topcu, 2010). Therefore, it might be deduced that the findings of the present study are in line with the past research. According to Thomas (2003), "Investigating how students experience and perceive their classroom in relation to its metacognitive orientation, and how such experiences and perceptions influence their metacognition, has the potential to further research into metacognition and to provide a framework to guide teachers who seek to enhance students' metacognition" (p.179). Therefore, as discussed below, these results are expected to shed light to future research, and to be a clear guide for teachers.

The results indicate that students are more likely to use metacognitive learning strategies in science classess where they have close relationships with classmates, involve in classroom discussions, share their ideas with the whole class, do more inquiry, have problem solving skills, are more task oriented, have equal learning opportunities with the other students in the same classroom, and receive more support from teacher. Among the classroom environment perception variables, Task

Orientation was found to be the best predictor of using metacognitive learning strategies (γ = .324. se = .013). Overall, these results indicated that in high quality learning environments, students tended to use metacognitive strategies at higher levels in learning science. These findings are in line with Thomas's (2003) study. Considering social constructivist learning and situated learning theories, Thomas (2003) suggested that sociocultural processes and structure of the learning environment contribute students' learning and developing metacognition. Thus, he determined 8 characteristics to define metacognitively oriented learning environments: (1) Metacognitive Demands, (2) Teacher Modeling and Explanation, (3) Student-Student Discourse, (4) Student-Teacher Discourse, (5) Student Voice, (6) Distributed Control, (7) Teacher Encouragement and Support, and (8) Emotional Support. Moreover, one of the focuses of constructivist learning environment is enhancing students' metacognition (Gunstone, 1994). Therefore, it is reasonable to find out significant associations between metacognitive strategy use and all of the dimensions of WIHIC scale which was developed by considering contemporary learning approaches such as constructivism. Additionally, this study also supports the findings of an empirical study conducted by Yildirim (2012) in Turkey. The author found that, when students' Gender and socioeconomic status were controlled, perceived Teacher Support was significantly and positively associated with cognitive and metacognitive strategy use in learning math.

On the other hand, in the present study, Cooperation was found as negatively associated with students' use of metacognitive strategies after other predictor variables in the model were controlled. It seems that higher level of cooperation among students in classroom activities and conducting group works negatively influence students' use of metacognitive learning strategies in science class. These finding was not expected, and contradicts with some studies suggesting that cooperative learning facilitates developing students' metacognitive skills (Kuhn & Dean, 2004; Schraw, 1995; Schraw & Moshman, 1995; Schraw et al. 2006). However, all group works not necessarily encourage students' to use metacognitive strategies. In a successful group work, all group members should enroll in planning, monitoring, and evaluating of learning processes within the group (see Goss, Galbraith, & Renshaw, 2002; Hinsz, 2004). On the other hand, the present study is limited with students' responses to questions on planning, monitoring, and evaluating their learning science, individually. Therefore, only reporting individual metacognitive skills do not give clue about how and where students gain these skills. If a group work does not encourage students to use metacognitive skills as a group, it is not reasonable to expect it to increase students' metacognition (see Chalmers, 1990; Schraw, 1998). Moreover, in this study, considering the negative association, it can be said that if students perceive classroom environment as cooperative and if this group works are not based on using metacognitive strategies, they may not develop individual metacognitive skills. Instead they might relay mostly on peers' knowledge and skills at the same group. Therefore, to make a clear conclusion about this result, the nature of the cooperative learning in the classrooms should be investigated in the relation to development of students' individual metacognitive skills by using different research methods such as observation in the classroom and interview with teacher and students. On the other hand, comparison of the coefficients obtained from zero order correlation analysis ($r = .40$) and multilevel analysis ($\gamma = -.059$) for the association between Metacognitive Self-Regulation and Cooperation showed opposite signs, which might indicate the negative suppression effect (Tabachnick & Fidell, 2007). Therefore, we need to be cautious while interpreting the results due to possible suppression effect. For additional discussion about this negative association, section 5.1.5 should be seen.

Another variable in the model which significantly related to Metacognitive Self-Regulation was Gender. Accordingly, female students were found to be better in planning, monitoring, and regulating their learning processes in science classes than males. Although previous research yielded inconsistent results, the present study supports the findings of some research indicating that female students use metacognitive learning strategies more than males (e.g., Al Khatib, 2010; Topcu & Yilmaz-Tuzun, 2009; Zimmerman & Martinez-Pons, 1990). To give an example, Zimmerman and Martinez-Pons (1990) found that female students significantly were superior to male students in record keeping and monitoring, environmental structuring, and goal setting and planning. In a study with the students across the grades from 5th to 8th in Turkey, Topcu and Yilmaz-Tuzun (2009) found that female students developed better metacognition in their science course than male students. Conversely, in another study, in which 1517 seventh grade students in Turkey were administered MSLQ to assess Metacognitive Self-Regulation, Akyol et al. (2010) revealed no gender differences in students' use of metacognitive self-regulation learning strategies in science course. However, although Akyol et al.'s(2010) study is more comparable for the present study in terms of sample characteristics, domain, and measures, the analysis methods were different. Their results were based on the canonical correlation which focuses on the correlation of two sets of variables that are formed by linear combination of the variables in each group (Tabahnick & Fidell, 2007). On the other hand, in this study, HLM analysis, which is more robust method than canonical correlation analysis (Raudenbush & Bryk, 2002), was used to consider dependence of the students' responses to the instruments. Conducting new studies with more comprehensive variables are needed to make a clear conclusion about the association between Gender and Metacognitive Self-Regulation. Besides, HLM also provide the chance of testing cross level interactions to investigate the class level variables that are accounted for the differences among classes. Results of this study also showed that teachers' Efficacy for Instructional Strategies moderated the association between Gender and Metacognitive Self-Regulation. That is, in the classrooms taught by the teachers with higher Efficacy for Instructional Strategies, the association between Gender and Metacognitive Self-Regulation was weaker. It seems that by using variety of instructional strategies in science class, teacher could eliminate the gender gap in students' use of metacognitive strategies. However, the significant random component of gender slope indicated that there should be different class level variables to explain the differences among classes in terms of the strength of this association.

Another cross level interactions was for Investigation. Science teachers' Efficacy for Instructional Strategies moderated the relation of students' perceptions of

Investigation in science class to Metacognitive-Self-Regulation. Explicitly, students' perception of Investigation in science class had less influence on Metacognitive-Self-Regulation in the classrooms taught by the teachers who had higher confidence in using variety of instructional strategies in science class. Although the effects were low (about 6%), this finding is surprising. Because, teachers with strong sense of efficacy beliefs are expected to facilitate students learning processes and to develop desired attitudes (see Tschannen-Moran & Woolfolk Hoy, 1998). Self-efficacious teachers are more likely to try different methods to meet students' needs, and open to innovations and to new ideas (Tschannen-Moran & Woolfolk Hoy, 1998). A possible reason might be that teachers who have higher efficacy for implementing variety of instructional strategies to facilitate student learning might increase students' metacognitive skills by successfully implementing different strategies as well-as encouraging students to do inquiry in the class. Namely, in these classes, besides Investigation, students' metacognitive skills may also rely on different learning methods. This study is limited to find out an answer to why teachers' Efficacy for Instructional Strategies weaker the association between Metacognitive Self-Regulation and Investigation. Hence, further research is needed to understand the underlying reasons.

At class level, result showed that Experience and Personal Accomplishment were significant predictors, and these variables explained 7.3% of the variance in the between class difference in mean Metacognitive-Self-Regulation. Teacher experience was negatively associated with Metacognitive Self-Regulation. This finding suggested that in the classrooms that taught by inexperienced teachers, students are more likely to use metacognitive learning strategies. The possible reason might be that, in this study, novice science teachers are graduated from the universities with enough knowledge to implement appropriate strategies to make students develop Metacognitive Self-Regulation skills in science class. With the aim of improving scientific literacy, the educational reform of 2004 in Turkey resulted in great changes in elementary school science curriculum. While the old curriculum was mostly teacher centered focusing on the one-way transmission of knowledge from teacher to students, the new curriculum based on constructivist philosophy which focuses on students' active construction of knowledge and making inquiry to understand their world. The innovations were simultaneously integrated into the teacher training programs in higher education while sufficient in-service teacher training programs were not provided to elementary science teachers (Akdeniz, 2008, Tekbiyik & Akdeniz, 2008). After the reform, teacher education programs focused on preparing teachers who are knowledgeable about the educational innovations to meet the goals of the new curriculum. Related to the new curriculum, in a study with elementary science teachers, Gunes, Dilek, Hoplan, and Gunes (2011) reported that more experienced teachers had less satisfaction with the new curriculum. Therefore, even when the curriculum changes, the experienced teachers may not easily give up their usual methods that they use in the classroom over the years (Tekbiyik & Akdeniz, 2008), and in turn they may fail to implement innovations and new strategies in their classrooms. Accordingly, they may not be as successful as novice teachers in encouraging students to plan, monitor, and evaluate the processes when constructing their knowledge in science. This result that teacher experience was negatively associated with students' use of metacognitive learning strategies is promising for Turkish science education, because it suggests that novice teachers are more successful to engage students to develop metacogntive learning skills. Their success might takes its origin from their pre-service teacher education program which takes the latest issues and innovations in the field of science education and new elementary science curriculum into consideration. The other class variable that was found as significant was Personal Accomplishment. This result was expected, because high level of Personal Accomplishment is an indicator of low level of burnout, and reflects the degree of teachers' positive evaluation of their performance and feeling energetic when teaching. Although there is a lack of studies directly examining the relation of teachers' Personal Accomplishment to students' metacognition, past research associated lower level of burnout with the positive student outcomes (e.g., Klusman et al, 2008).

Finally, the strength of the association between students' Metacognitive Self-Regulation and Gender, Investigation, Task Orientation, and Equity vary from class to class. In other words, while the relationship between Metacognitive Self-Regulation and any of these variables is stronger in some classes, it is weaker in other classes. These results indicate that inclusion of class level variables could account for the variations among classes. In the present study, teachers' Efficacy for Instructional Strategies was accounted for about 6% of the variation between classes in the relationship of Metacognitive Self-Regulation to Gender and Investigation. However, the variance components of Gender, Investigation, Task Orientation, and Equity still significantly varied among classes. Therefore, it seems that variations of the strength of the relationships between Metacognitive Self-Regulation and these variables could be explained by different class level variables different from the variables used in this study. Moreover, the variance components of Student cohesiveness, Teacher support, Involvement, and Cooperation were not found to be significant. Thus, the associations between Metacognitive Self-Regulation and any of these variables are in same magnitude in all classes, and class level variables do not have an influence on the slopes of these variables.

5.1.2.3 Predicting Students' Achievement Goals

HLM analyses with achievement goal variables revealed that, at student level, Mastery Approach Goals were positively and significantly associated with Gender, Student Cohesiveness, Task Orientation, and Equity, but negatively and significantly associated with Cooperation. These factors accounted for about 46% of the student level variance in Mastery Approach Goals. Performance Approach Goals were positively and significantly associated with Gender, Student Cohesiveness, Task Orientation, and Equity. These factors accounted for about 23% of the student level variance in Performance Approach Goals. Mastery Avoidance goals were positively and significantly associated with Gender, Task Orientation, and Cooperation, but negatively and significantly associated with Involvement. These factors accounted for about 8% of the student level variance in Mastery Avoidance Goals. Performance

Avoidance Goals were significantly and positively associated with Student Cohesiveness, Task Orientation, Cooperation, and Equity, but negatively and significantly associated with Involvement. These factors accounted for about 17% of the student level variance in Mastery Avoidance Goals. Overall, it can be said that fair amount of variances in Mastery Approach Goals, Performance Approach Goals, and Performance Avoidance Goals were explained by students' perception of classroom learning environment and gender. However, perceived classroom learning environment and Gender explained only small amount of variance in Mastery Avoidance Goals.

Results of the HLM analyses for achievement goal variables indicated that of the seven classroom environment scales used in the present study, Task Orientation had the most powerful effect on students' adoption of achievement goals. While it was associated with all four types of achievement goals, it was the best predictor of Mastery Approach Goals, Performance Approach Goals, and Performance Avoidance Goals. When all predictors in the models were controlled, an increase in Task Orientation by 1 standard deviation unit would increase Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals, and Performance Avoidance Goals by .50, .37, .11, and .21 standard deviation units, respectively. These findings suggested that students who perceived classroom learning environment as more task oriented where they accomplish the planned activities and stay on the subject, they were more likely to adopt Performance Approach Goals, Performance Avoidance Goals, and Mastery Avoidance Goals, as well as Mastery Approach Goals. However, considering the standardized regression coefficients, the influence of task orientation on Mastery Approach Goals was the highest. Therefore, it can be said that students who accomplish the planned activities, know how much work they have to do, try to understand the work in the class, and pay attention during the class are most likely to study to master a task and learn the subject. This finding is consistent with the Ames' (1992) study which aimed to describe how classroom structures influence goals. In that study, Ames (1992) included task as one of the important structure of the classroom environment that lead students to adopt mastery (approach) goal orientation. According to Ames (1992), students adopting mastery (approach) goals are supported by the task structure of the classroom that focus on meaningful aspects of learning activities; are designed for novelty, variety, and student interest; offer reasonable challenge to students; help students establish short-term, self-referenced goals; and support development and use of effective learning strategies. Thus, applying these into present study, it can be inferred that if the students value mastering a given task, know the purpose of the task and how much effort they should exert to accomplish the task, pay attention to the tasks in the class, and try to understand the task, these students tend to be intrinsically motivated to learn deeply the course subject and more potent to develop mastery approach goals.

Another classroom learning environment variable that was found positively and significantly associated with achievement goals was Equity. Students who perceive classroom learning environment as more equal where students have same amount of opportunity in classroom discussions and activities, and receive equal amount of praise, encouragement, and help from teacher are more likely adopt Mastery Approach Goals, Performance Approach Goals, and Performance Avoidance Goals. An increase in Equity by 1 standard deviation unit would increase Mastery Approach Goals, Performance Approach Goals, and Performance Avoidance Goals by .15, .07, and .06 standard deviation unit, respectively. These standardized regression coefficients indicated that in the classrooms in which students had equal learning opportunities, students were most likely to develop Mastery Approach Goals, although they also may develop small amount of performance goals. These results are reasonable, because treating students in the same classroom equally and providing same learning opportunities may create a classroom atmosphere in which students are not forced to compete with each other, to focus on performing better than others, or to avoid looking stupid or dumb to others. If students are treated differently because of student behaviour and academic achievement, this might be perceived as an external factor to push students to set more performance oriented goals such as besting others and avoiding poor performance. Similar to Equity, Student Cohesiveness was also found as positive and significant predictor of achievement goals. Students who perceive classroom as cohesive, where the students are friendly, know and help each other, and get along well with others, tend to develop Mastery Approach Goals, Performance Approach Goals, and Performance Avoidance Goals. Although Student Cohesiveness had almost equal degree of relation to these goals, the effects were very small (.047, .032, and .043 for Mastery Approach Goals, Performance Approach Goals, and Performance Avoidance Goals, respectively). From this finding, it can be concluded that if the students perceive classroom environment as cohesive and friendly, they slightly tend to compete with and to beat other students, and to avoid from looking stupid. Besides, friendly classroom climate has only a slight role in fostering students' Mastery Approach Oriented Goals. Mastery Avoidance Goals were found significantly associated with neither Equity nor Student Cohesiveness.

Regarding Cooperation, results revealed that students, who perceive classroom environment as cooperative, are more likely to develop Mastery Avoidance and Performance Avoidance Goals. Additionally, although results showed a negative association between Cooperation and Mastery Approach Goals, the effect was very small (γ = -.028) when compared with Mastery Avoidance Goals (γ = .178) and Performance Avoidance Goals (γ = 143). These findings indicated that when students were encouraged to work cooperatively on homework, projects, and class activities, they were more likely to develop avoidance goals. That is, these students avoid misunderstanding or not mastering the subject, and inferiority. These findings contradict with the findings of Lau, Lien, & Nie's (2008) study with 9th grade students in Singapore. Although they employed structural equation model assuming the causal effect of achievement goals on participation in group work in math class, the authors found that the task (mastery) avoidance goal was negatively associated with group participation, while task (mastery) approach goal and performance-approach goal were positively related to group participation. Moreover, they failed to find a significant association between performance-avoidance goal and group participation, although bivariate correlation analysis was suggested negative and significant relation between avoidance goals and group participation. In another study, Thoomen, Sleegers, Peetsma, & Oort (2011) performed multilevel analyses to find out the role of teachers' teaching and their efficacy beliefs in explaining variation in student motivation including Mastery Goal and Performance Avoidance Goal. Results revealed that cooperative learning did not significantly predict Mastery Goal and Performance Avoidance Goal. In the present study, since students' performance, during a group work, partially relies on the other students' performances, these students might feel as if they lose the control of their own learning and avoid from not mastering the subject. Additionally, since the performance of an individual student is important for the whole group members, participating in a group work might increase students' avoidance for looking dumb among the other group members. On the other hand, another possible reason might be that although students are encouraged to work cooperatively, they are not informed how to conduct a group work effectively. Science teachers in Turkey may fail to guide students when they do group work. The present study is limited to find out the reasons of positive association between both avoidance goals and Cooperation. Therefore, the Cooperation in the classroom should be examined qualitatively to deeply understand why students adopt avoidance goals when they are encouraged to work cooperatively. On the other hand, when interpreting the associations between Mastery Approach Goals and Cooperation, it should be noted that the zero order correlation coefficient ($r = .36$) and multilevel regression coefficient ($\gamma=-.028$) for this relationship yielded opposite signs, which might be the indicator of negative suppression effect (Tabachnick & Fidell, 2007). Thus, the interpretation of the negative association between Mastery Approach Goals and Cooperation should be cautiously done. Thus, section 5.1.5 should be seen for additional discussion.

The last classroom learning environment variable that was significantly related to achievement goals was Involvement. Results revealed that while Involvement was not a significant predictor of Mastery Approach Goals and Performance Approach Goals, it was negatively associated with Mastery Avoidance Goals and Performance

Avoidance Goals. This indicated that students who have attentive interest, participate in discussions, do additional work and enjoy the class are less likely to adopt avoidance goals. These results are reasonable because, students' active involvement in class shows that the atmosphere in the classroom encourage students to share ideas (no matter they are correct or not), engage them to share their own ideas with the classroom and ask questions to the teacher without hesitation, and opinions of students are valued in these classrooms. Therefore, students in these classrooms may not feel shame when they give incorrect answers or avoid looking stupid. Moreover, these students may not need to avoid from misunderstanding or not mastering the subject because they can easily ask questions to teacher and students, and have the opportunity to learn the subject by this way. However, standardized regression coefficients indicated that the effects are very small. Namely, 1 standard deviation unit increase in Involvement is associated with .047 and .044 standard deviation unit decrease in Mastery Avoidance Goals and Performance Avoidance Goals, respectively. Therefore, even significant relations were found, involvement does not play a very important role in students' goal orientation. For additional discussion on the interpretation of the negative association of Involvement with Mastery Avoidance Goals and Performance Avoidance Goals, section 5.1.5 should be seen. Because, since the sign of the coefficients obtained from zero order correlation analysis and multilevel analysis are opposite to each other, it was suspected about a negative suppression effect (Tabachnick & Fidell, 2007). Thus, the interpretation of the negative associations of Involvement with Mastery Avoidance Goals and Performance Avoidance Goals should be cautiously done. Moreover, in this study it was found that Teacher Support and Investigation was not significantly related to any of the goal orientation types.

Considering gender, female students reported higher Mastery Approach Goals, Performance Approach Goals, and Mastery Avoidance Goals than male students. However, no significant gender difference was found in Performance Avoidance Goals. For gender-achievement goal relation, although past research mostly yielded mixed results, this study supports the findings of some studies in which female students reported higher Mastery Approach Goals (e.g., Arisoy, 2007; Elliot & McGroger, 2001; Finney & Davis, 2003; Gherasim et al. 2012) and higher Performance Approach Goals (e.g., Tas, 2008), and in which no gender difference was found for Performance Avoidance Goals (e.g., Elliot & McGroger, 2001). On the other hand, results of the present study contradicted to some studies in which either significant gender difference favoring boys was found or no gender difference was found for Mastery Approach Goals, Performance Approach Goals, and Performance Avoidance Goals, (e.g., Elliot & McGroger, 2001; Gherasim et al. 2012).

The overall results for student level variables revealed that perceived classroom learning environment has a considerable predictive power in explaining students' achievement goals. In general, this finding supports the past studies on the influence of classroom environment (although they focus on different aspects of classroom learning environment than used in this study) on achievement goals (e.g., Ames, 1992; Ames & Archer, 1988; Church et al. 2001; Lau, Lien, & Nie, 2008; Sungur & Gungoren, 2009; Sungur & Senler, 2010; Thoomen, Sleegers, Peetsma, & Oort, 2011). In majority of the past research, classroom learning environment was regarded as classroom goal structures as suggested by Ames (1922). However, in classroom learning environment research, few studies examined this relation. For example, recently, WIHIC is widely used all around the world in learning environment research to investigate the classroom structures, students' perceptions, the influence of classroom learning environment on student outcomes, etc. The WIHIC consisted of the classroom learning environment dimensions that were found significantly associated with a lot of student outcomes in past research, and it reflects the contemporary educational approaches to science classes. Therefore, it is very important to shed light on the association of classroom learning environment with students' development of different types of achievement goals by considering the aspects of classroom learning environment that were focused in WIHIC. Since this association was rarely studied in learning environment research (by using learning environment scales such as WIHIC and CLES), it makes it hard to compare the findings of this study with other studies. Therefore, more studies are needed by using classroom learning environment scales to make a clear conclusion.

At the class level, results of HLM analyses (based on intercepts and slopes as outcome models) revealed that none of the class (or teacher) level variables (i.e., Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Ability in Science) were significantly associated with the class mean variations in each achievement goal type. This indicated that the mean differences between classes in achievement goals were not accounted for the teacher variables used in the present study, after controlling other variables in the models. Thus, there should be different class level variables to account for these variations between classes. On the other hand, some cross level interactions were found, namely class level variables moderated the relation of some student level variables to achievement goals. Firstly, teacher experience moderated the association between Gender and Mastery Approach Goals. That is, in the classrooms that taught by more experienced teachers, the difference between female and male students' setting Mastery Approach Goals got smaller. Moreover, teachers' Self-Efficacy for Student Engagement moderated the association between Gender and Mastery Avoidance Goals. Namely, when students were taught by a teacher with higher confidence in engaging all the students in the classroom, the difference between female and male students' Mastery Avoidance Goals got smaller. This result is reasonable in the sense that since the teacher with a strong efficacy belief in student engagement feels confident in motivating all the students and creating a classroom climate that encourage all the students to do well in the class (Tschannen-Moran & Woolfolk Hoy, 2007), they tend to take individual differences into consideration to facilitate all students' learning. Thus, they may alleviate the gender difference in the classroom in Mastery Avoidance Goal setting. Another interaction was found between students' perception of Task Orientation and teachers' Efficacy for Classroom Management when predicting Performance Avoidance Goals. Namely, in the classrooms taught by the teachers with strong efficacy beliefs for classroom management, the association between Task Orientation and Performance Avoidance Goals are weaker than in the classrooms taught by the teachers with low efficacy belief for classroom management. Considering the research question 1, results revealed negative association between Task Orientation and Efficacy for Classroom Management. However, although Task Orientation positively associated with all types of achievement goals, only the strength of the association between Task Orientation and Performance Avoidance Goals was significantly influenced (reduced) from teachers' confidence for management of the classroom. Although, standardized regression coefficient indicated very small moderation effect (γ = -. 026) and Efficacy for Classroom Management explained only small amount of the proportion (2.5%) in the variations between classes in the association between Task Orientation and Performance Avoidance Goals, as stated before, investigation of the nature of the management strategies that Turkish science teachers use to control the classroom is important to shed light on this negative interaction effect. For Performance Approach Goals and classroom environment relationships, four teacher variables were found as moderator. More specifically, teachers' Efficacy for Student Engagement negatively moderated (γ = -. 044) and Job Satisfaction positively (γ =. 033) moderated the relationship between Performance Approach Goals and Task Orientation. These results indicated that, in the classrooms that taught by the teachers with lower confidence in engaging all the students or with higher job satisfaction, the influence of students' perception of Task Orientation on their setting Performance Approach Goals was higher. Besides, Teachers' Efficacy for Instructional Strategies positively (γ = .037) moderated and Personal Accomplishment (γ = -.028) negatively moderated the relationship between Performance Approach Goals and Equity. These results indicated that in the classrooms that taught by the teachers who have higher confidence in using various instructional strategies in their teaching or have low Personal Accomplishment (low Personal accomplishment is indicator of high burnout), the relationship between Performance Approach Goals and Equity get higher. These two findings mentioned above indicated that these teacher variables have very low moderation effects, but these effects are surprising. Since teachers' efficacy beliefs were generally found positively associated with job Satisfaction (e.g., Caprara et al. 2006; Collie, Shapka, & Perry, 2012; Skaalvik & Skaalvik, 2010) and negatively associated with Burnout (e.g., Egyed & Short, 2006; Evers, Brouwers, & Tomic, 2002), it was expected that the moderation effect of these variables would be in same direction. Additionally, because of the lack of the empirical studies on the effect of teacher self-efficacy on students' goal orientation, the comparison of these results is limited. Therefore, in order to better understand these associations, more empirical studies should be conducted. Conducting new studies with qualitative research methods is also important to find out the possible reasons of these associations.

Overall results with the class (or teacher) level variables indicated that teacher characteristics do not play a very important role in students' adoption of achievement goals. Although their effects were very small, dimensions of teachers' Self-Efficacy Beliefs, Job Satisfaction, Personal Accomplishment, and Experience took some roles in moderating the relation of student Gender and perceived classroom learning environment to achievement goals. These results support the findings of the literature review study by Klassen et al. (2011). In that review, the authors found only a few studies, conducted before 2009, examining the association between teacher self-efficacy and student outcomes, and they concluded that these relationships were modest and were not as high as previously suggested by the most researchers. In the present study, teachers' gender and implicit beliefs about students' ability in science neither predicted the class mean differences in achievement goals between classes nor interacted with student variables. Regarding teachers' gender, findings of the present study supported the Dicke, Ludtke, Trautwein, Nagy, and Nagy's (2012) study which yielded no significant teacher gender effect in students' ratings of Mastery Goals, Performance Approach Goals, and Performance Avoidance Goals in 5 different subjects: English, Math, German, Second Foreign Language, and Biology. Dicke, Ludtke, Trautwein, Nagy, and Nagy (2012) only found significant teacher gender (favoring females) effect in Performance Approach Goals in Math. Considering implicit belief of teachers, these findings were unexpected. Because, previous research indicated that teachers' implicit theories of intelligence tend to influence their creation of mastery or performance goal oriented classroom environment (see Shim et al. 2013). For example, in an empirical study with 336 elementary students, Leroy et al. (2007) found that teachers who hold entity theory were less likely to create autonomy supportive climates in the classroom. That is, entity teachers reported creating a climate which had less potential to foster intrinsic motivation of students. However, Ames (1992) indicated that students' autonomy in the classroom supports their setting more mastery oriented goals. Therefore, to make a clear conclusion, more empirical studies considering the effect of teacher variables when examining the students' achievement goals are needed.

5.1.3 Research question 3: Predicting Students' Science Achievement by Classroom Learning Environment Variables

The third research question focused on whether there were differences in means of students' Science Achievement among classes or not; to find out the student level and class (or teacher) level variables that accounted for within and between class variances; and whether there were interactions between student and teacher variables when explaining students' achievement in science. HLM was used to analyze the data, since the obtained data were in hierarchical structure which was nested within classes. Therefore, the similarities of the responses to the scales of the students in the same classrooms would not be ignored and more plausible results would be obtained by this way.

In order to find out whether there were class differences or not, a one-way ANOVA model (unconditional models) was built. This model did not include any student or teacher variable. Results yielded significant variations among the classes for Science achievement. Therefore, conducting HLM analysis seemed reasonable. Then, in order to explore the percent of variance due to differences between classes, ICC was computed. The ICC obtained from this study for Science Achievement was about .295. In other words, in seventh grade classrooms, about 30 percent of the variance was attributable to the differences between classrooms and 70.5 percent of the variance in Science Achievement was attributable to the differences among students in the same classroom. Considering Hox's (2010) rule for general cases, which suggests using .05, .10, and .15 as small, medium, and large values for ICCs respectively, this study yielded large ICC.

With the aim of finding class level variables (i.e., Gender, Experience, Efficacy for Student Engagement, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, Emotional Exhaustion, Personal Accomplishment, and Implicit Theory of Ability in Science) that significantly predict the differences in class means of Science Achievement, means as outcomes model was tested. Afterwards, random coefficient models were built to explore the related classroom learning environment variables at student level variables (i.e., Gender, Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity). Finally, the significant student and class level predictors that were found in means as outcomes models and random coefficients models were incorporated into the intercepts and slopes as outcomes model as well as interaction of the student and class (or teacher) level variables. Thus, the results of the final estimation of intercepts and slopes as outcomes model also cover the results of means as outcomes model and random coefficient models. Therefore, similar to the previous section, only results of the intercepts and slopes as outcomes models are discussed for Science Achievement.

Results of the HLM analysis revealed that students' Science Achievement was significantly associated with Involvement, Investigation, Task Orientation, Cooperation, and Equity. These factors accounted for 17.3% of the within class variance in Science Achievement. The remaining 82.7%, however, was accounted by other variables that were not included in the model. It should be noted that 70.5 percent of the variance in Science scores was within classes. In other words, these student level variables explained about 12 % (17.3 x 70.5%) of the total variance in seventh grade students' Science Achievements. In general, this finding supported past research on the link between student outcomes and Classroom Learning

Environment (e.g., Haertel et al. 1981; Walberg et al. 1986). For example, in a meta-analysis study including 734 correlates from 12 studies on 823 classes in 8 subject areas, Haertel et al. (1981) found that student perception of social-psychological environment of their classes is a good predictor of students' cognitive, affective, and behavioral outcomes. Moreover, Waldrip et al. (2009) stated that using WIHIC when examining classroom learning environments is beneficial for identifying and describing teacher effectiveness and predicting student outcomes. Therefore, it can be said that Classroom Learning Environment was accounted for considerable amount of variance in seventh grade students' achievement in science in Turkey.

In the present study, Task Orientation was found to be the best predictor of the Science Achievement (γ = .192, se = .013). It means that, students who perceived the classroom as more task oriented such that students accomplish the given tasks and planned activities and focus on the works they were expected to do were more likely to get better scores from science achievement test. The second best predictor of Science Achievement was found as Involvement (γ = .135, se = .015). This finding yielded that students who tended to involve in classroom discussions, share their ideas in the classroom, do additional work, enjoy the class, and have attentive interest were more likely to get higher scores from science test. These findings were expected and support the results of Snyder's (2005) study that explored the association between middle school students' perception of classroom learning environment (assessed by WIHIC) and science achievement (assessed by classroom grades). Sample included about 840 middle school science students from 24 classrooms. Based on the bivariate correlations between science achievement and each dimension of classroom environment, Snyder (2005) selected only Task Orientation and Involvement (because they have highest correlation) to include in multiple regression analysis. Results revealed that Task Orientation (Beta = .275) and Involvement (Beta = .085) were both significant predictors of student achievement, and these variables accounted for 10% of the variation in achievement scores.

After controlling other variables in the model, in the present study, Investigation and Cooperation was found negatively associated with Science Achievement. Namely, students who reported more emphasis on inquiry and problem solving skills in their science classes such as thinking about the evidences of statements, carrying out investigations to test their ideas and to answer the questions that puzzle them, explaining the meaning of statements, diagrams, and graphs, and solving problems by using information from these investigations, got lower scores from science test. Moreover, in the classrooms where students were encouraged more to cooperate with other students in the classrooms in doing assignments, in performing teamwork, on projects in the class, and in class activities, students obtained lower scores from Science Achievement test. These findings were counter-intuitive, because inquiry is one of the most important elements of a constructivist science class where students construct their knowledge by doing investigations, asking questions, interpreting graphs and diagrams, and using these skills in problem solving. These problem solving skills were expected to facilitate students' learning science. However, past research on the link between inquiry and science achievement yielded mixed results. Several studies found positive association between inquiry-based science and science achievement (e.g., Geier et al. 2008; Wolf & Fraser; 2008). On the other hand, there are also studies that found a negative association between these variables (e.g., Atar & Atar, 2012; Areepattamamil & Freeman, 2011; Lavonen & Laaksonen, 2009). Additionally, some studies reported no significant association between these variables (e.g., Allen & Fraser, 2007; Wolf & Fraser; 2008). For example, in a study based on TIMSS 2003 data, Kaya (2008) examined the association between inquiry based science learning and science achievement in five countries. Results revealed significantly negative association for US and Australia, significantly positive association for Singapore, and no association for Scotland and Japan. Effect sizes ranged from .004 to .007 indicating trivial effect (Cohen, 1988). According to Tretter and Jones (2003), inquiry-based science teaching did not have an important influence in students' science achievement. In another study, in Turkey, Ceylan and Berberoglu (2007) examined TIMSS 1999 data for the association between science achievement and student centered learning activities such as doing experiments, working on projects, discussing about daily life problems and about assignments, and working in small groups. Results indicated a negative relation between student-centered learning activities and science achievement scores. This unexpected finding in some degree was attributed to that the achievement test is mostly focus on assessments of the objectives of the curriculum instead of assessing student centered learning outcomes. Similarly, in the present study, questions in the science achievement test were mostly based on cognitive processes such as knowledge and comprehension and had little emphasize on inquiry. Therefore, there was little consistency between inquiry and measured science achievement in this study. This association might be assessed by better and more appropriate outcome measure. Thus, this unexpected association is questionable and it warrants the further investigation. Besides, when interpreting this negative association, it should be noted that coefficients obtained zero order correlation ($r = .19$) and multilevel analysis ($\gamma = -.029$) yielded opposite signs, which might indicate a negative suppression effect (Tabachnick & Fidell, 2007). To avoid misinterpretation of this negative association between science Achievement and Investigation, section 5.1.5 should be seen for additional discussion. Regarding Cooperation, in a constructivist learning environment, it is inevitable that peers learn from each other, enroll in group works, and work on projects and class activities together. However, the present study yielded negative association between Cooperation and Science Achievement. Similar results were found in Wolf and Fraser's (2008) study with 1434 middle-school science students from 71 classes. Results of the simple correlation indicated positive and significant relation of science achievement with 3 subscales of WIHIC (Investigation, Task Orientation, and Equity) where the individuals were the unit of analysis. On the other hand, result of the multiple correlation analysis with the individuals as a unit of analysis indicated that Teacher Support ($\beta = -.15$), Task Orientation ($\beta = .08$), Equity ($\beta = .16$), and Cooperation ($\beta = -.10$) were significant independent predictors of achievement. In their study, Wolf and Fraser (2008) investigated the unexpected negative association between cooperation and science achievement through interviews with students. Their findings indicated that some students' science achievement was negatively affected as they were distracted by other students during group work. On the other hand, some others found group work helpful since their understanding was improved as they received explanations on their misunderstandings. Mainly, the study revealed that more cooperation may prevent students from trying to understand the information individually, and lead them receive the answers from others. This brings less understanding and thus lower science achievement. Similarly, in a meta-analysis study, Dignath, Buettner, and Langfeldt (2009), for students' academic performance, strategy use, and motivation, found significantly higher effect sizes of interventions that did not train students by means of group work than of those that did. On the other hand, in another meta-analysis study by Lou et al. (1996), it was found that group work has a small positive effect on student achievement. Their findings suggest that grouping students may not be enough to contribute to students learning. Instead, some conditions such that forming small groups, giving clear directions and introducing task, and teaching students about working in a group effectively, providing effective guidance are important points that should be taken into consideration when engaging students to work cooperatively. Therefore, the quality and the nature of cooperation in science classrooms are more important than whether cooperative learning is taken place in the classroom. Since the present study is limited to identify how cooperative learning and investigations are taken place in the classrooms, future research is needed to figure out the actual situation in Turkish elementary schools. On the other hand, for additional discussion on the interpretation of the negative association of Cooperation and Science Achievement, section 5.1.5 should be seen. Because, since the sign of the coefficients obtained from zero order correlation analysis ($r = .18$) and multilevel analysis ($\gamma = -.064$) are opposite to each other, we are suspected about a negative suppression effect (Tabachnick & Fidell, 2007). Thus, the interpretation of the negative associations of Cooperation and Science Achievement should be cautiously interpreted.

Moreover, although Equity was found as a positive and significant predictor of Science Achievement in random coefficient model, it became nonsignificant in intercepts and slopes as outcomes model. Because, the strength of the association between Equity and Science Achievement was significantly different from class to class, and to find out the potential variables that were accountable for these differences, class variables were incorporated. Results revealed that teacher gender moderated the link between Equity and Science Achievement, and main effect remained nonsignificant. Besides, the present study failed to find significant relation of Science Achievement to perceived Teacher Support and Student Cohesiveness.

Considering overall findings about the relationship between classroom learning environment and science achievement, it can be said that this study supports some of the past research that found significant associations between some aspects of WIHIC and elementary students' Science Achievement (e.g., Allen & Fraser, 2007; Helding & Fraser, 2013; Rakici, 2004; Rita & Martin-Dunlop, 2011). However, these significant aspects differ from study to study. Moreover, the direction of the association might be opposite to the other studies. For example, Rita and Martin-Dunlop (2011) administered WIHIC and a standardized biology achievement test to 261 high school students. Results of multiple regression analysis ($R=.55$) yielded that while Teacher Support ($\beta = .14$), Investigation ($\beta = .25$), and Equity ($\beta = .21$) were positive significant predictors, Student Cohesiveness ($\beta = -.19$) was negative significant predictor of achievement. In order to explain this negative association, the authors reported that "students could be distracted from learning if they know other students in the class and, therefore, make friends easily in the class" (p.34). Similarly, in another study with elementary students ($n=380$) in Turkey, Rakici (2004) performed a multiple regression analysis to investigate the association between WIHIC scales and Science Achievement (students' previous semester science grades). Results showed that student cohesiveness ($\beta = -.135$) was a negative predictor while Teacher Support ($\beta = .136$), Involvement ($\beta = .202$), Task Orientation ($\beta = .170$), and Equity ($\beta = .174$) were positive and significant predictors of Science Achievement. Moreover, these variables accounted for 22% of the variance in science achievement. Comparing with the present study, although significant variables were different, the higher amount of explained variance (22% vs. 12%) can be attributed to the statistical methods in some degree. It should be considered that HLM is more parsimonious analysis than multiple regression analysis. In another study, Allen and Fraser (2007) administered WIHIC (Cooperation dimension was not included) to 4th and 5th grade students. Results of simple correlation revealed that none of the perceived dimension of WIHIC significantly related to either final school science grade or a standardized science test score. Besides, results of multiple correlation analysis were not significant for both of these outcomes with six dimensions of WIHIC. However, in Chionh and Fraser's (1998) study, higher achievement was found related to higher student cohesiveness. Moreover, Helding and Fraser (2013) found a significant and positive relationship between biology achievement and Involvement, Investigation, and Equity in a simple correlation analysis, while the multiple regression ($R=.15$) analysis indicated a significant association only with Equity ($\beta = .14$). Therefore, results of the present study contradict with some of these studies when the associations are examined with subscales. Although statistical method that used in this study (HLM analysis) provide more robust results than the analyses that used in the studies mentioned above, further investigations are needed to understand why different studies found different aspects of classroom learning environment significantly (positively or negatively) associated with Science Achievement in different studies.

The last student level variable that was tested in the same model was student Gender. Results revealed that male and female students did not differ in their mean scores on science achievement test. This study support the majority of the past research on the effect of Gender on Science Achievement (e.g., Akyol et al. 2010; Cavas, 2011; Marino, 2010; Senler & Sungur, 2009). However, there were some studies in the literature stating that either female students (e.g., Britner & Pajares, 2006; Hacieminoglu et al. 2009) or male students (e.g., Beaton, et al., 1996; Penner, 2003) had higher science achievement. Additionally, some studies suggested that this significant association between Gender and Science Achievement might be disappeared when considering other variables such as achievement level, grade level, country, and motivation (e.g., Areepattamannil et al. 2011; Kaya, 2008; Tas, 2013). Therefore, to make a clear conclusion about this association, all of the variables included in the regression models should be considered together. A suitable study to compare with the present study is Tas' (2013) study with 7th grade students in Turkey. Although the same statistical method and similar standardized science achievement tests were used in both studies, results were contradictory in some degree. In the present study, without any other variable, Gender was found as a significant predictor of Science Achievement (favoring females). However, incorporating Task Orientation as a second predictor made Gender nonsignificant. On the other hand, in Tas' (2013) study, significant Gender effect favoring female students became nonsignificant after incorporating homework self-regulation variables. From here, these studies revealed that the association between Gender and Science Achievement might be mediated by different variables.

At the class level, teachers' years of Experience, Efficacy for Student Engagement, and Implicit Theories of Science Ability significantly predicted class mean differences in Students' achievement in science class. These factors accounted for about 8% of the variance in the between class differences in mean Science Achievement. The remaining 92% however, was accounted for by other variables that were not included in this study. It should be noted that 29.5 percent of the variance in Science Achievement was between classes. Therefore, teachers' years of Experience, Efficacy for Student Engagement, and Implicit Theories of Science Ability explained the total of 2.4 percent (8 x 29.5%) of the variance in the seventh grade students' Science Achievement in Turkey. Thus, the predictive ability of these variables in students' achievement in science was very low.

Relative to the other two variables, Teachers' Efficacy for Student Engagement had stronger link with Science Achievement (γ = .095, se = .028). Namely, in the classrooms taught by the science teachers with higher confidence in engaging all students to learn, the students had higher achievement in science. On the other hand, other subscales of teacher self-efficacy, namely Efficacy for Instructional Strategies and Efficacy for Classroom Management, were not found as significant predictors of students' Science Achievement. Although the positive association between teacher self-efficacy and student outcomes was assumed by a lot of researchers, few empirical study investigated this association (Klassen et al., 2011) and their results are mixed (see Klassen et al. 2011; Vasquez, 2008). Findings of the present study partly support the past research which found positive association between teacher efficacy beliefs and student achievement (e.g., Anderson et al. 1988; Ross, 1992). However, the measures of self-efficacy in these studies were different than the present study, and they did not focus on 3 components of teacher self-efficacy measured in this study. In another study using the same conceptualization of teacher self-efficacy with the present study, Vasquez (2008) analyzed the data from 110 English language arts teachers and their 2061 students from 9^{th} and 10^{th} grades in Florida by using HLM analysis. Results revealed that none of the three dimensions of teaching efficacy was found as significant predictor of students' reading achievement gains when controlling students' race, grade, and socioeconomic status. Moreover, this association is still unknown in the field of science. Therefore, more studies are needed to shed light on how teachers' efficacy beliefs influence students' achievement in science.

Considering teacher Experience, the present study indicated that, in the classrooms taught by more experienced science teachers, students were more likely to get higher scores from science achievement test (γ = .069, se = .027). Past research generally found no significant effect of experience on Science Achievement (e.g., Goldhaber & Brewer, 2000; Harp, 2010; Monk, 1994; Zhang, 2008; Zuelke, 2008). However, results of Kaya's (2008) study based on TIMSS 2003 data revealed mixed results for different countries. In Turkey, Atar and Atar (2012) found a significant and positive association between teacher experience and students' science achievement scores in TIMSS 2007 study. However, effect size was found as very small (.02). Since this association was rarely studied in Turkey, more studies are needed to make a plausible conclusion.

The last class level variable that was found as positive and significant predictor of Science Achievement was implicit beliefs about ability in science. Students had higher achievement in science in the classrooms taught by the teachers who believed that students' ability in science was not fixed and could be improved. This finding was expected, because teachers' implicit theories influence their behaviors and attitudes in the classroom (Deemer, 2004; Lee, 1996; Lynott & Woolfolk, 1994). For example, Lee (1996) found that teachers with incremental theory were more likely to give average scores, effort-oriented feedback, and learning-oriented assignments, and preferred forming heterogeneous groups while teachers with entity theory were more likely to give non-average scores, ability-oriented feedback, and performance-oriented assignments, and preferred to form homogeneous groups. Moreover, Swam and Snyder (1980) stated that teachers' beliefs about the students' ability influence their teaching approaches which in turn influence students' achievement. Therefore, it is reasonable to conclude that teachers who believe that students' ability in learning science can be improved are more likely to foster students' Science Achievement.

5.1.4 Research question 4: Predicting Students' Science Achievement by Classroom Learning Environment and Self-Regulation Variables

The last research question addressed the extended version of random coefficient model in the third research question. Namely, for the fourth research question, besides gender and classroom learning environment variables (i.e., Gender, Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity), the predictive effect of self-regulation variables (i.e., Self-Efficacy, Metacognitive Self-Regulation, Mastery Approach Goals, Mastery Avoidance Goals, Performance Approach goals, Performance Avoidance Goals) on students' Science Achievement was investigated.

Results of the analysis showed that, among the self-regulation variables, Self-Efficacy, Mastery Approach Goals, and Performance Avoidance Goals significantly predicted students' achievement scores. After incorporating self-regulation variables, the explained variance in Science Achievement at the student level increased from

17.3% to 27.7%. It should be noted that 70.5 percent of the variance in Science scores was within classes. In other words, these student level variables (i.e., Gender, classroom learning environment, and self-regulation) explained about 20 % (17.3 x 70.5%) of the total variance in seventh grade students' Science Achievements. These findings, in general, support Risemberg and Zimmerman's (1992) study which indicated that the students who can initiate learning tasks, set their own goals, decide on appropriate strategies for the realization of the goals, and then monitor and evaluate their own progress are tend to be more successful than the students who rely on teachers for performing these same functions.

Considering Self-Efficacy, results revealed that, among the all student level variables in the model, self-efficacy was the best predictor of students' achievement in science (γ = .340, se = .015). A standard deviation unit increase in students' self-efficacy would increase students' science achievement by .34 standard deviation unit. According to the interpretation of Cohen's d (Cohen, 1988), the effect size of self-efficacy was small ($0.2 < d < 0.5$). Namely, the students who had higher confidence in learning science were more likely to be more successful in science class than the students with low confidence in learning science. This finding was expected, because students' belief about their capabilities in performing an academic task is a strong indicator of their achievement (Bandura, 1986; Britner & Pajares, 2006; Schunk & Pajares, 2005). In several domains such as math, language, and reading, studies have demonstrated a positive relationship between self-efficacy and academic achievement (e.g., Bandura et al. 1996; Greene et al. 2004; Klassen & Kuzucu, 2009; Linnenbrink & Pintrich, 2002; Schunk & Pajares, 2005; Yildirim, 2012; Zhang & Zhang, 2003). Additionally, in the field of science, empirical studies on the linkage between science achievement and self-efficacy yielded similar positive results across the world (Areepattamannil et al. 2011; Britner, 2008; Britner & Pajares, 2001; Britner & Pajares, 2006; Chen & Usher, 2013; Kaya, 2008; Kupermintz, 2002; Meece & Jones, 1996; Pintrich & De Groot, 1990) including Turkey (e.g., Gungoren, 2009; Ozkan, 2003; Yerdelen et al. 2012). For example, Kaya (2008) found self-confidence as a positive and significant predictor of science achievement in US, Japan, Singapore, Scotland, and Australia. In another study conducted in Turkey, Yerdelen et al. (2012) examined self-regulatory processes that predict students' being high or low achiever in biology course by administering Motivated Strategies for Learning Questionnaire (MSLQ) to 252 students. Results showed that among 15 constructs including intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy for learning and performance, test anxiety, rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, peer learning, and help seeking; self-efficacy was the best predictor of being high or low achiever in biology.

Another important outcome of this study is the significant relationships between students' Science achievement and Mastery Approach Goals (γ = .085, se = .014) and Performance Avoidance Goals (γ = -.63, se = .012). More specifically, 1 standard deviation unit increase in students' Mastery Approach Goals and 1 standard deviation unit decrease in students' Performance Avoidance Goals would increase Science Achievement scores by .085 and .063 standard deviation unit, respectively. These findings indicated that students who set goals that focus on understanding and who approach success in learning science were more likely to obtain higher scores from science test. This finding is reasonable because according to Greene and Miller (1996), the empirical evidence of various studies revealed that when individuals adopt mastery goals, they use cognitive and metacognitive strategies at higher levels. Students who set mastery goals prefer more challenging tasks, use more effective learning strategies, and have higher confidence in learning than students who set performance goals (Ames, 1992; Ames & Archer, 1988; Pintrich, 2000; Wolters, 2004). On the other hand, the present study failed to find Mastery avoidance goals and Performance approach goals as significant predictors of science achievement. Past research on the relation of achievement goals to academic achievement yielded inconsistent results (see Limenbrink-Garcia et al. 2008). However, findings of the present study are consistent with the studies that found significantly positive relation of Mastery (approach) Goals (e.g., Barzegar, 2012; Hsieh, Sullivan, & Guerra, 2007, Tas, 2008; Tas, 2013) and negative relation of Performance Avoidance Goals (e.g., Barzager, 2012; Elliot and McGregor, 2001; Hsieh, Sullivan, & Guerra, 2007) to academic achievement. On the other hand, when interpreting the negative association between Performance Avoidance goals and Science Achievement, it should be noted that coefficients obtained zero order correlation ($r = .04$) and multilevel analysis ($\gamma = -.063$) yielded opposite signs, which might indicate a negative suppression effect (Tabachnick & Fidell, 2007). Therefore, when interpreting the negative association between Performance Avoidance goals and Science Achievement, additional discussion in section 5.1.5 should also be taken into consideration.

Finally, no association was found between Metacognitive Self-Regulation and Science Achievement when other variables in the model were controlled. Namely, students' awareness of their actions, and planning, monitoring, and evaluating their learning processes do not seem to contribute to their achievement in science. Sperling et al.'s (2002) review of the literature on the relationship between achievement and metacognition across the studies using different measures of metacognition and different methods indicated that relationship between metacognitive skills and achievement was complicated and was not clear. Besides, in science education, while experimental studies mostly suggested positive association (Beeth, 1998a; 1998b; Fredriksen, 1998; Georghiades, 2004; Mason, 1994a; 1994b; Yuruk, 2007), studies using self-report questionnaires yielded inconsistent results. For example, in Turkey, Yumusak et al. (2007) and Yerdelen et al. (2012) found no significant association between metacognitive strategy use (assessed by MSLQ) and biology achievement of high school students. However, Topcu and Yılmaz-Tuzun (2009) found positive association between achievement and metacognitive skills (assessed by Jr. MAI) for: (1) 4th and 5th graders, (2) 6th, 7th, and 8th graders in Turkey. Although the causal studies using metacognitive interventions yielded positive association with achievement consistently, studies based on self-report questionnaires indicated mixed results. On the other hand, several studies showed that students' use of metacognitive strategies was influenced from motivational beliefs (e.g., Dembo & Eaton, 2000; Pintrich & De Groot, 1990; Sungur, 2007; Tung-hsien, 2004). According to Sungur (2007), these studies mainly address self-efficacy, goal orientations, and task value. In the present study, nonsignificant association between Metacognitive Self-Regulation and Science Achievement was interpreted after controlling the effect of Self-Efficacy and achievement goals. Namely, Metacognitive Self-Regulation might have been mediated by other self-regulation variables in the model. Therefore, from this point of view, the findings of the present study seem to be reasonable.

Comparison of Model 1 (in this model Science Achievement was predicted by gender and classroom learning environment perceptions) and Model 2 (this model is extended version of Model 1 by adding self-regulation variables to examine their mediator role in the relationship between perceived classroom learning environment and Science Achievement) indicated that, after incorporation of self-regulation variables, among the classroom learning environment variables, Cooperation and Equity became nonsignificant predictors of Science Achievement. Namely, after controlling for self-regulation variables, Cooperation and Equity were not significantly associated with Science Achievement any more. These variables significantly predicted Science Achievement in the absence of self-regulation variables. Therefore, self-regulation variables seem to mediate the relationship between students' perception of classroom learning environment and Science Achievement. This finding was anticipated, because some researchers found relationships between classroom learning environment and self-regulation variables (e.g., Arisoy, 2007; Church et al. 2001; Dorman, 2001; Dorman et al. 2003; Dorman et al. 2006; Ozkal et al. 2009; Sungur & Gungoren, 2009; Yilmaz-Tuzun & Topcu, 2010). As explained in section 5.1 3, the effect of Classroom Learning Environment on Self-Regulation variables was supported in the present study too. Although empirical studies on the mediation effect of Self-Regulation variables (i.e., Self-Efficacy, Metacognitive Self-Regulation, and Achievement goals) on the association between classroom learning environment and achievement are so rare, they are consistent in their findings that self-regulation variables mediated the relationship between classroom learning environment and academic achievement (e.g., Church et al. 2001; Fast, et al., 2010; Peters, 2013; Patrick et al. 2007; Sungur & Gungoren, 2009; Yildirim, 2012). Therefore, it can be concluded that the findings of the present study are in line with the previous research.

Results of the final estimation of variance components obtained from Random Coefficient Model of this study (Model 2) revealed that class means were statistically significantly different from each other (χ^2 = 1501.15, p< .001). It suggested the inclusion of class level variables to account for the variability among 372 classes. Additionally, the slopes for Gender, Student Cohesiveness, Equity, Self-Efficacy, Mastery Approach Goals, and Performance Approach Goals were all varied significantly, which suggested that in some classes, the slopes were much steeper than that of other classes. Namely while the relationships between Science Achievement and these predictors were stronger in some classes, they were weaker in other classes. The variability among classes also suggested that class differences took effect on the randomly varying slopes, and class level variables might account for some of the differences. However, contrary to their fixed parts, the variance components of Involvement, Investigation, Task Orientation, and Performance Avoidance Goals were not significant which yielded that class differences did not have an impact on the slopes for these variables. Moreover, although the variance component for Gender, Student Cohesiveness, Equity, and Performance Approach Goals were found as significant, they were not significant predictors of Science Achievement. Additionally, inclusion of Self-Regulation variables also resulted in removing the random effect of Teacher Support and Investigation (random effects of these variables were significant in model 1). That is, while Self-Regulation variables were controlled, classes did not vary in terms of the association between Science Achievement and Teacher Support and Investigation.

5.1.5 Further Discussion

In addition to the discussion above, it should be noted that, from the statistical perspective, some unusual associations were found between some variables. Namely, for some specific variables, comparison of the correlation coefficient that was obtained from simple correlation analysis and standardized beta coefficient that was obtained from HLM analysis yielded opposite signs. In the present study, these opposite signs in coefficients were found for the relationships between: Cooperation and Self-Efficacy, Cooperation and Metacognitive Self-Regulation, Cooperation and Mastery Approach Goals, Cooperation and Science Achievement, Involvement and Mastery Avoidance Goals, Involvement and Performance Avoidance Goals, Investigation and Science Achievement, and Performance Avoidance Goals and Science Achievement. These associations might point presence of negative suppression effect which "occurs when the sign of a regression weigh of an IV is the opposite of what would be expected on the basis of its correlation with the DV" (Tabachnick & Fidell, 2007, p. 155). Bivariate correlation coefficient for all of these variables found to be positive and significant. However, correlation coefficients are very inadequate to represent the unique predictive ability of the variables since a simple correlation does not account for the overlap between independent variables.

Suppression effect immerges when independent variables were highly correlated with each other, but weakly correlated with dependent variables. In the present study, for example, investigation of correlation coefficients indicated that bivariate correlations among Cooperation, Involvement, and Investigation were higher than .60 whereas their bivariate correlations with Science Achievement were lower than .30.

Pandey and Elliot (2010) summarized the advantages of using suppressor variables in multiple regression analyses as: (1) "determining more accurate regression coefficients associated with independent variables", (2) "improving overall predictive power of the model", and (3) "enhancing accuracy of theory building (p.35). Further, Pandey and Elliot (2010) stated that excluding suppressor variable from a model may yield underestimated regression coefficients of the suppressed variables, decrease the predictive power of the model, and increase the probability of making Type II error. Because, a suppressor variable serve as irrelevant variance cleaner, that is, it removes the outcome-irrelevant variation in another independent variable which may mask that variables' actual relationship with the dependent variable. Additionally, researchers' being aware of the suppression phenomena prevents them to exclude variables from further analysis due to its lack of correlation with dependent variable or its having opposite sign to the expected sign (Pandey & Elliot, 2010).

In the present study, Cooperation, Involvement, and Performance Avoidance goals seems as negative suppressor variables, in some models, that they suppress (or explain) the outcome-irrelevant variances of other predictors in the model. Therefore, when interpreting these associations, it should be noted that these variables had negative association with the dependent variables only after other variables in the model were controlled for, although without other predictors in the models they had positive coefficients.

The similar suppression effects are seen in previous research that conducted multiple regression analysis with classroom learning environment variables (e.g., Dorman, 2001; Dorman et al. 2003; Wolf & Fraser, 2007) and achievement goal variables (e.g., Lau, Liem, & Nie, 2008). However, sometimes researchers failed to recognize the suppression, and tried to find reasonable explanation for these theoretically unexpected relations. Accordingly, researchers should be careful about the suppressor effect when using these variables in their research. Because, the zero-order correlation between the subscales of some instruments used in this study (i.e., WIHIC and AGQ) generally may be found higher than their associations with some outcome variables such as achievement and self-efficacy.

5.2 Conclusion

The purpose of this study was to explore the seventh grade students' perception of classroom learning environment, self-regulation, and science achievement in relation to some student level and class (or teacher) level variables. The data from seventh grade students and their science teachers in public elementary schools across the

Turkey were analyzed by using several two-level HLM with student variables at the level-1 and teacher variables at the level-2.

The findings from several models showed that students' perceptions of classroom learning environment predicted self-regulation variables as well as science achievement. Among the 7 aspects of classroom learning environment, Task Orientation was more powerful in predicting student outcome variables while Cooperation and Involvement were suspected as suppressor variables in some models. Afterwards, in prediction of Science Achievement, it seems that self-regulation variables mediate the relationship between perceived classroom learning environment and Science Achievement. Moreover, students' confidence in learning science was found to be the best predictor of Turkish elementary students' achievement in science, which was followed by Mastery Approach Goals. Surprisingly, Metacognitive self-regulation did not significantly predicted Science Achievement while other student variables in the model were controlled. However, deep examination of the data revealed that the linkage between Metacognitive Self-regulation and Science Achievement was mediated by Self-Efficacy. Therefore, providing students with highly qualified classroom learning environment may enhance students' use of self-regulation strategies, which in turn appears to increase students' achievement in science class.

At the class level, teacher variables were mostly found to be significantly associated with classroom learning environment dimensions when comparing with self-regulation variables and achievement. Especially, Efficacy for Student Engagement was the most influential variable that has significant associations with all dimensions of classroom learning Environment. On the other hand, significant associations were rarely found between the teacher variables and self-regulation variables. For example, teachers' Gender, Efficacy for Instructional Strategies, Efficacy for Classroom Management, Job Satisfaction, and Implicit Theories of Science Ability did not predict any of the self-regulation variables. Therefore, it can be concluded that most of the teacher variables are associated with classroom learning environment dimensions which are important predictors of student self-regulation and Science Achievement. However, examination of the explained variances that were accounted for teacher variables in all models indicated that the influence of teacher variables on student outcomes were not as high as suggested by several theoretical researchers.

Finally, randomly varying variance components of most of the student level variables indicated that for these variables, the strength of the association with outcome variables was stronger in some classes and weaker in other classes. In an attempt to explain these class differences, the selected teacher variables were not adequate. Accordingly, there could be various other class variables in explaining the differences between classes.

5.3 Implications

The present study provides a comprehensive investigation of science education in elementary schools in Turkey. It takes teacher characteristics, classroom context, and student outcomes into consideration, and examines intercorrelations among them. Besides, this study is the first study in the Turkish elementary science education research, which adds such broad information about the teaching and learning processes in the classroom that reflects the responses of a huge sample to various variables. Therefore, findings of this study are significant for teachers, teacher educators, educational policy makers, and educational researchers.

The results of this study indicated that the quality of classroom learning environment has substantial influence on students' use of self-regulation strategies, and achievement in science. These findings imply that science teachers should encourage students to work cohesively, that is, to set close relationship with other students, know each other, and help their friends in the same class. They should provide more support to students, that is, show interest to students, care students' problems, and treat friendly. Additionally, science teachers should engage students to involve in the classroom discussions, share their ideas, and participate in the activities. Science teachers should also provide task oriented environment, that is, students should give importance to accomplish planned activities, to be ready for class on time, carefully follow the class, and to know the goals of the course. In addition, students should be treated equally, and be provided with same amount of opportunity in class discussions, praise, help, and encouragement. Since all these aspects of classroom learning environment were selected as reflecting the latest issues and innovations in science education, providing such a learning environment will encourage students to construct their knowledge, and learn meaningfully instead of memorizing, and in turn help to reach educational goals of the curriculum. Therefore, science teachers could use this information to enhance their service to students, and to improve the teaching and learning process in the classroom. For example, among these 7 dimensions of perceived classroom learning environment, providing task oriented classroom is the most potent dimension effecting students' achievement and self-regulation. Therefore, if a teacher could take students' attention to the tasks, and emphasize the importance of the completion of the tasks, most probably these foster students' gains in both self-regulation skills and achievement in science.

These results also have some implications for teacher educators that teachers should be trained about how to create such a qualified classroom learning environment. For example, when students do a group work, teacher should form small groups of students, inform them about the purpose of the work, encourage them to set common goals, give clear instructions, and so on. If teacher fails to give feedback to students, does not follow their work, and does not provide guidance, even students work as a group, actually, it cannot be regarded as a cooperative work. This might be achieved by designing undergraduate courses especially focusing on these subjects or in method course these strategies should be frequently emphasized. Moreover, in teaching practice course pre-service teachers might be asked to implement these strategies into their macro teaching and be given effective feedbacks that specifically focus on the 7 dimensions of the classroom learning environment that was addressed in the present study. Besides, pre-service teachers should be provided more opportunities to practice in the real classrooms, and get feedback from mentor teachers about their weakness and strengths about the atmosphere in the classroom that they create.

Another implication of this study is that teachers should create classroom learning environment according to students' needs and interests. Because, this study revealed that classroom learning environment is an important predictor of students' self-efficacy, metacognitive self-regulation, and achievement goals. Besides, these self-regulation strategies mediate the relationship between classroom learning environment and science achievement. Therefore, to enhance students' achievement in science, teachers should motivate students to learn science by increasing their confidence to learn science and by setting more mastery approach goals rather than performance goals and mastery avoidance goals. These self-regulation components could be enhanced by providing a qualified classroom learning environment that based on WIHIC dimensions as mentioned above. However, teachers can also use some particular strategies. To give an example, to enhance students' self-efficacy, teachers should focus on four sources of self-efficacy: mastery experiences, vicarious experience or role modeling others, social persuasion, and physiological states (Bandura, 1986). More specifically, teachers may emphasize students' successful experiences and encourage them to master a task and give constructive feedbacks and verbal praise. These strategies may be helpful to increase students' confidence in their capabilities. Additionally, during evaluation processes, teacher may make private evaluation rather than public, may make students thought mistakes as part of learning, may focus on learning progress rather than only focusing on the results. These strategies may also be helpful for students' to develop mastery oriented goals (Ames, 1992).

Additionally, Turkish science teachers should be aware of that female students use metacognitive learning strategies more, and set more mastery approach goals, mastery avoidance goals, and performance approach goals than male students. Therefore, they should use appropriate instructional strategies to enhance male students' self-regulation in science classes and decrease the gap between male and female students. For example, by TARGET classification, Ames (1992) defined 6 classroom structures that influence students' developing mastery oriented goals: Task, Authority, Recognition, Grouping, Evaluation, and Time use. Based on this approach, the tasks may be designed in such a way to foster male students' interest. Besides, teachers may give more autonomy and control to male students in decision making to increase their self-regulation skills.

At the class level, the results imply that teachers' efficacy for student engagement has the most predictive power on both perceived classroom learning environment and student outcomes. It was found to be significantly associated with the entire classroom learning environment variables, mastery approach goals, and science achievement. Teacher self-efficacy is more malleable during teacher education (Bandura, 1977) and it is hard to change when it has established (Tschannen-Moran, Hoy, & Hoy, 1998). Therefore, as well as their courses, pre-service teachers should be provided more opportunities for real classroom teaching to gain mastery experience; should be given more chance for vicarious experiences through observing mentor teacher in classroom; and should receive more guidance, support, and performance feedbacks emphasizing positive attributes from mentor teacher (Wan, 2005), and should experience teaching practice in gradually increasing complexity level (e.g., less crowded classrooms and well-equipped schools in terms of availability of resources are better at the beginning) (Tschannen-Moran, Hoy, & Hoy, 1998) to establish high efficacy beliefs during teacher education. Accordingly, in higher education programs, there should be some arrangement to facilitate these practices in teacher education.

Since only a few study empirically investigated the association between these teacher variables on students' cognitive and affective outcomes over the years, the findings of this study could be regarded as remarkable for educational researchers. Past research on the quality of teacher assumed strong influence of teacher characteristics on students' learning outcomes. However, in the present study, included teacher variables were found as having only small influence on student outcomes. Therefore, the results of this study are expected to provide guidance for the further investigations. Besides, replication of this study is suggested for generalizability of the results, and other teacher variables should also be studied with student outcomes to test their relation.

To sum up, the present study mainly suggests increasing the quality of classroom learning environment to enhance students' self-regulation in science, which in turn increases students' achievement in science class.

5.4 Limitations and Recommendations

The present study has also some limitations and recommendations. Firstly, since it is a cross sectional study, it is limited to provide causal relationships. Therefore, to understand how teacher variables affect classroom learning environment and student outcomes, and how classroom learning environment affects student outcomes, the use of experimental or longitudinal research designs is recommended. Secondly, the data rely on the students' and teachers' self-report, and it might not reflect the actual situation. Therefore, classroom observations, diary writing, and think aloud methods might be beneficial for deeper understanding of classroom learning environment, students' self-regulation, and teachers' beliefs and well-being.

Another recommendation might be to include students' prior achievement and socioeconomic status into the models to control their possible effects on students' responses. Past research suggests that students' responses to school related outcomes have potential to be influenced from students' entry characteristics such as gender, socioeconomic status, and prior achievement (see Anderson, 1982). Therefore, controlling these variables in future research is important. Moreover, this study revealed that when predicting the class differences in student outcomes, some amount of variance remained unexplained even after incorporating some class level variables. It should be noted that this study is limited with only 9 teacher variables. Therefore, more class level variables should be tested to explain the differences between classes in perceived classroom learning environment, self-regulation, and science achievement.

In the present study, the proposed associations were examined in the science domain, and student data were only obtained from 7th graders. Thus, whether the relationships are similar in other domains and grade levels or not is not answered in this study. Besides, since these variables rarely studied together in the studies across the world, replication of this study in other countries, in other domains, and with other grades is important for generalizability of the results.

Finally, researchers should be aware of the possible suppression effect when they use WIHIC questionnaire and AGQ. Because, in the present study, it was found that zero-order correlation between the subscales of both instruments were higher than their correlation with dependent variables. This might yield a suppression effect. Namely, multiple regression analysis might produce some coefficients whose signs are opposite to the signs of the coefficients that obtained from bivariate correlation analysis. Thus, researcher should be carefully interpret the results, and inform the readers about this issue to avoid misinterpretations of unexpected results.

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APPENDICES

Appendix A

STUDENT QUESTIONNAIRE

FORM ID

Sevgili Öğrenciler;
Bu çalışma ile sizin öğrenim yaşantınızla ilgili bilgiler alınması hedeflenmektedir. Lütfen her cümleyi dikkatle okuduktan sonra, size uygun gelen seçeneği mutlaka işaretleyiniz. Unutmayınız ki, bu bir test değildir ve doğru ya da yanlış cevap yoktur. Sorulara vereceğiniz cevaplar, araştırma amacıyla kullanılacak, kişisel bilgi ve görüşleriniz kesinlikle gizli tutulacaktır. Çalışmaya vereceğiniz destek için çok teşekkür ederiz.

Doç. Dr. Semra SUNGUR — ODTÜ
Araş. Gör. Sündüs YERDELEN — ODTÜ

LÜTFEN ANKETİ **KURŞUN KALEMLE** VE YUVARLAKLARIN İÇİ TAMAMEN DOLACAK ŞEKİLDE DOLDURUNUZ. ANKETİ BURUŞTURUP KATLAMAYINIZ.

A. KİŞİSEL BİLGİLER

1. Cinsiyetiniz nedir?:
① Kız ② Erkek

2. Doğum tarihiniz (yıl olarak):
① 1994 ② 1995 ③ 1996
④ 1997 ⑤ 1998 ⑥ 1999
⑦ Diğer: ....

3. Kardeş sayısı (sizin dışınızda):
① 0 ② 1 ③ 2
④ 3 ⑤ 4 ⑥ 5 ve üstü

4. Geçen dönemki Fen ve Teknoloji dersi karne notunuz:
① 1 ② 2 ③ 3 ④ 4 ⑤ 5

5. Anneniz çalışıyor mu?:
① Çalışıyor ② Çalışmıyor
③ Düzenli bir işi yok ④ Emekli

6. Babanız çalışıyor mu?
① Çalışıyor ② Çalışmıyor
③ Düzenli bir işi yok ④ Emekli

7. Anne ve babanızın eğitim düzeyi nedir?

Anne	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

9. 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 26-100 tane ④ 101-200 tane
⑤ 200 taneden fazla

10. Evinizde bir çalışma odanız var mı?
① Evet ② Hayır

11. Ne kadar sıklıkla eve gazete alıyorsunuz?
① Hiçbir zaman ② Bazen ③ Her zaman

12. Evinizde bilgisayar var mı?
① Evet ② Hayır

13. Bilgisayarınız varsa, internet bağlantısı var mı?
① Evet ② Hayır

14. Bilgisayar kullanıyorsanız, bilgisayar kullanma amacınızı ve sıklığını, aşağıda işaretleyiniz.

Hiç bir zaman 1 — Bazen 2 — Her zaman 3

		Hiçbir zaman	Bazen	Her zaman
a.	Oyun oynamak için	①	②	③
b.	Face book gibi paylaşım sitelerine girmek için	①	②	③
c.	Ödev yapmak için	①	②	③
d.	Araştırma yapmak için	①	②	③

BU KISMI KAĞIDINIZI YIRTMADAN KOPARTINIZ

dataofis FORM NO: U-101

-1-

DEVAMI İÇİN ARKA SAYFAYI ÇEVİRİNİZ.

B.1.a. Aşağıdaki ifadeler 1'den 7'ye kadar derecelendirilmiştir. Bu ifadelerin sizi ne derecede yansıttığını işaretleyiniz.

Beni hiç yansıtmıyor ⟵⟶ Beni tam olarak yansıtıyor

1 2 3 4 5 6 7

1.	Fen ve teknoloji dersinden çok iyi bir not alacağımı düşünüyorum.	① ② ③ ④ ⑤ ⑥ ⑦
2.	Fen ve teknoloji dersi ile ilgili okumalarda yer alan en zor konuyu bile anlayabileceğimden eminim.	① ② ③ ④ ⑤ ⑥ ⑦
3.	Fen ve teknoloji dersinde öğretilen temel kavramları öğrenebileceğimden eminim.	① ② ③ ④ ⑤ ⑥ ⑦
4.	Fen ve teknoloji dersinde, öğretmenin anlattığı en karmaşık konuyu anlayabileceğimden eminim.	① ② ③ ④ ⑤ ⑥ ⑦
5.	Fen ve teknoloji dersinde verilen sınav ve ödevleri en iyi şekilde yapabileceğimden eminim.	① ② ③ ④ ⑤ ⑥ ⑦
6.	Fen ve teknoloji dersinde çok başarılı olacağımı umuyorum.	① ② ③ ④ ⑤ ⑥ ⑦
7.	Fen ve teknoloji dersinde öğretilen becerileri iyice öğrenebileceğimden eminim.	① ② ③ ④ ⑤ ⑥ ⑦
8.	Dersin zorluğu, öğretmen ve benim becerilerim göz önüne alındığında, fen ve teknoloji dersinde başarılı olacağımı düşünüyorum	① ② ③ ④ ⑤ ⑥ ⑦

B.1.b. Aşağıdaki ifadeler 1'den 7'ye kadar derecelendirilmiştir. Bu ifadelerin sizi ne derecede yansıttığını işaretleyiniz.

Beni hiç yansıtmıyor ⟵⟶ Beni tam olarak yansıtıyor

1 2 3 4 5 6 7

1.	Fen ve teknoloji dersi sırasında başka şeyler düşündüğüm için önemli kısımları sıklıkla kaçırırım.	① ② ③ ④ ⑤ ⑥ ⑦
2.	Fen ve teknoloji dersi ile ilgili bir şeyler okurken, okuduklarıma odaklanabilmek için sorular oluştururum.	① ② ③ ④ ⑤ ⑥ ⑦
3.	Fen ve teknoloji dersi ile ilgili bir şeyler okurken bir konuda kafam karışırsa, başa döner ve anlamak için çaba gösteririm.	① ② ③ ④ ⑤ ⑥ ⑦
4.	Eğer Fen ve teknoloji dersi ile ilgili okumam gereken konuları anlamakta zorlanıyorsam, okuma stratejimi değiştiririm.	① ② ③ ④ ⑤ ⑥ ⑦
5.	Yeni bir konuyu detaylı bir şekilde çalışmaya başlamadan önce çoğu kez konunun nasıl organize edildiğini anlamak için ilk olarak konuyu hızlıca gözden geçiririm.	① ② ③ ④ ⑤ ⑥ ⑦
6.	Fen ve teknoloji dersinde işlenen konuları anladığımdan emin olabilmek için kendi kendime sorular sorarım.	① ② ③ ④ ⑤ ⑥ ⑦
7.	Çalışma tarzımı, dersin gereklilikleri ve öğretmenin öğretme stiline uygun olacak tarzda değiştirmeye çalışırım.	① ② ③ ④ ⑤ ⑥ ⑦
8.	Genelde derse gelmeden önce konuyla ilgili bir şeyler okurum fakat okuduklarımı çoğunlukla <u>anlamam</u>.	① ② ③ ④ ⑤ ⑥ ⑦
9.	Fen ve teknoloji dersine çalışırken, konuları sadece okuyup geçmek yerine ne öğrenmem gerektiği konusunda düşünmeye çalışırım.	① ② ③ ④ ⑤ ⑥ ⑦
10.	Fen ve teknoloji dersine çalışırken iyi anlamadığım kavramları belirlemeye çalışırım.	① ② ③ ④ ⑤ ⑥ ⑦
11.	Fen ve teknoloji dersine çalışırken, çalışmalarımı yönlendirebilmek için kendime hedefler belirlerim.	① ② ③ ④ ⑤ ⑥ ⑦
12.	Ders sırasında not alırken kafam karışırsa, notlarımı dersten sonra düzenlerim.	① ② ③ ④ ⑤ ⑥ ⑦

B.2. Aşağıda FEN VE TEKNOLOJİ sınıfının genel atmosferi ile ilgili sorular yer almaktadır. Soruları yanıtlarken sadece FEN VE TEKNOLOJİ dersini düşünerek belirtilen ifadelere ne derecede katıldığınızı ya da katılmadığınızı gösteren seçeneği işaretleyiniz.

Hiçbir zaman 1 — Çok az 2 — Bazen 3 — Sık sık 4 — Her zaman 5

1.	Sınıfımdaki öğrenciler ile yakın arkadaşlık kurarım.	① ② ③ ④ ⑤
2.	Sınıfımdaki diğer öğrencileri yakından tanıyorum.	① ② ③ ④ ⑤
3.	Bu sınıftaki öğrenciler ile uyum içindeyim.	① ② ③ ④ ⑤
4.	Sınıftaki herkes arkadaşımdır.	① ② ③ ④ ⑤
5.	Bu sınıftaki diğer öğrencilerle birlikte çalışırım.	① ② ③ ④ ⑤
6.	Derslerinde zorluk çeken arkadaşlarıma yardım ederim.	① ② ③ ④ ⑤
7.	Sınıftaki diğer öğrenciler beni severler.	① ② ③ ④ ⑤
8.	Sınıftaki diğer öğrencilerden yardım alırım.	① ② ③ ④ ⑤
9.	Öğretmen benimle kişisel olarak ilgilenir.	① ② ③ ④ ⑤
10.	Öğretmen bana yardım etmek için ders işleme şeklini değiştirebilir.	① ② ③ ④ ⑤
11.	Öğretmen benim duygularımı dikkate alır.	① ② ③ ④ ⑤
12.	Öğretmen, derslerle ilgili bir problemim olduğunda bana yardımcı olur.	① ② ③ ④ ⑤
13.	Öğretmen benimle diyalog kurar.	① ② ③ ④ ⑤
14.	Öğretmen benim problemlerimle ilgilenir.	① ② ③ ④ ⑤
15.	Öğretmen sınıf içinde benimle konuşmak için yanıma gelir.	① ② ③ ④ ⑤
16.	Öğretmenin sorduğu sorular konuları anlamama yardımcı olur.	① ② ③ ④ ⑤
17.	Sınıfta fikirlerimi rahatlıkla tartışabilirim.	① ② ③ ④ ⑤
18.	Sınıf tartışmalarında fikirlerimi rahatça söyleyebilirim.	① ② ③ ④ ⑤
19.	Öğretmen bana sorular sorar.	① ② ③ ④ ⑤
20.	Fikirlerim ve önerilerim sınıf tartışmalarında kullanılır.	① ② ③ ④ ⑤
21.	Öğretmene sorular sorarım.	① ② ③ ④ ⑤
22.	Diğer öğrencilere fikirlerimi açıklarım.	① ② ③ ④ ⑤
23.	Sınıftaki arkadaşlarım, problemlerin nasıl çözüleceği konusunda benim görüşlerimi alırlar.	① ② ③ ④ ⑤
24.	Sınıfta, verilen problemleri nasıl çözdüğümü açıklamam istenir.	① ② ③ ④ ⑤
25.	Fikirlerimin doğruluğundan emin olmak için araştırmalar yaparım.	① ② ③ ④ ⑤
26.	Sınıfta tartışılan konuları destekleyen kaynaklar bulmam istenir.	① ② ③ ④ ⑤
27.	Tartışmalarda ortaya çıkan problemleri çözmek için araştırmalar yaparım.	① ② ③ ④ ⑤
28.	Sınıfta işlenen konuların, şekillerin ve grafiklerin anlamını açıklarım.	① ② ③ ④ ⑤
29.	Kafamı karıştıran konuları cevaplayabilmek için araştırmalar yaparım.	① ② ③ ④ ⑤
30.	Öğretmenin sorduğu soruları cevaplamak için araştırmalar yaparım.	① ② ③ ④ ⑤
31.	Araştırmalar yaparak soruların cevaplarını bulmaya çalışırım.	① ② ③ ④ ⑤
32.	Araştırmalardan elde ettiğim bilgiler ile problemleri çözerim.	① ② ③ ④ ⑤
33.	Çalışmanın belirli bir kısmını yapmak benim için önemlidir.	① ② ③ ④ ⑤
34.	Çalışmak istediğim kadar çalışırım.	① ② ③ ④ ⑤
35.	Bu dersin amaçlarını biliyorum.	① ② ③ ④ ⑤
36.	Ders başladığında derse hazır olurum.	① ② ③ ④ ⑤
37.	Bu sınıfta neyi başarmak için çabaladığımı biliyorum.	① ② ③ ④ ⑤
38.	Ders sırasında dikkatimi toparlamaya çalışırım.	① ② ③ ④ ⑤
39.	Sınıftaki yapılan çalışmaları anlamaya çalışırım.	① ② ③ ④ ⑤
40.	Ne kadar çalışmam gerektiğini bilirim.	① ② ③ ④ ⑤
41.	Ödevlerimi yaparken diğer öğrencilerle işbirliği yaparım.	① ② ③ ④ ⑤
42.	Ödevlerimi yaparken arkadaşlarımla kitap ve kaynaklarımı paylaşırım.	① ② ③ ④ ⑤
43.	Sınıfta grup çalışmaları yapılırken iş bölümü yapılır.	① ② ③ ④ ⑤
44.	Sınıfta verilen projelerde diğer öğrencilerle çalışırım.	① ② ③ ④ ⑤
45.	Sınıftaki diğer öğrencilerden öğrendiğim şeyler olur.	① ② ③ ④ ⑤
46.	Bu sınıfta diğer sınıf arkadaşlarımla çalışırım.	① ② ③ ④ ⑤
47.	Sınıf içi faaliyetlerde diğer sınıf arkadaşlarımla işbirliği yaparım.	① ② ③ ④ ⑤
48.	Sınıf arkadaşlarım sınıftaki hedeflerine ulaşmak için benle çalışır.	① ② ③ ④ ⑤
49.	Öğretmen sınıftaki diğer öğrencilerin verdiği cevaplara gösterdiği dikkati, benim cevaplarıma da gösterir.	① ② ③ ④ ⑤
50.	Öğretmenden, diğer öğrencilerle aynı ölçüde yardım alırım.	① ② ③ ④ ⑤
51.	Sınıftaki diğer öğrenciler ile aynı derecede söz hakkı alırım.	① ② ③ ④ ⑤
52.	Bana sınıftaki diğer öğrencilerle aynı biçimde davranılır.	① ② ③ ④ ⑤
53.	Öğretmenden sınıftaki diğer öğrenciler ile aynı derecede destek alırım.	① ② ③ ④ ⑤
54.	Sınıf tartışmalarına katılmak için diğer öğrenciler ile aynı fırsatı elde ederim.	① ② ③ ④ ⑤
55.	Çalışmalarım sınıftaki diğer öğrenciler ile aynı oranda takdir edilir.	① ② ③ ④ ⑤
56.	Sınıftaki diğer öğrenciler ile aynı derecede soruları cevaplama olanağı elde ederim.	① ② ③ ④ ⑤

-3- DEVAMI İÇİN ARKA SAYFAYI ÇEVİRİNİZ.

BU KISMI KAĞIDINIZI YIRTMADAN KOPARTINIZ

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B.3. Aşağıdaki soruları yanıtlarken sadece Fen ve Teknoloji dersini düşünerek belirtilen ifadelere ne derecede katıldığınızı ya da katılmadığınızı gösteren seçeneği işaretleyiniz.

Hiçbir zaman	Nadiren	Bazen	Çoğunlukla	Her zaman
1	2	3	4	5

1.	Fen ve teknoloji dersinin içeriğini mümkün olduğunca iyi anlamak benim için önemlidir.	① ② ③ ④ ⑤
2.	Fen ve teknoloji dersinde amacım sınıftaki diğer öğrencilerden daha kötü performans sergilemekten kaçınmaktır.	① ② ③ ④ ⑤
3.	Diğer öğrencilerden daha iyisini yapmak benim için önemlidir.	① ② ③ ④ ⑤
4.	Fen ve teknoloji dersinden mümkün olduğunca çok şey öğrenmek istiyorum.	① ② ③ ④ ⑤
5.	Fen ve teknoloji dersinde beni sıklıkla motive eden şey, diğerlerinden daha kötü performans sergileme korkusudur.	① ② ③ ④ ⑤
6.	Fen ve teknoloji dersinde verilen her şeyi tam olarak öğrenmek arzusundayım.	① ② ③ ④ ⑤
7.	Fen ve teknoloji dersinde amacım, diğer pek çok öğrenciden daha iyi bir not almaktır.	① ② ③ ④ ⑤
8.	Fen ve teknoloji dersinde öğrenebileceğimden daha azını öğrenmekten korkuyorum.	① ② ③ ④ ⑤
9.	Fen ve teknoloji dersindeki tek amacım diğerlerinden daha başarısız olmanın önüne geçmektir.	① ② ③ ④ ⑤
10.	Fen ve teknoloji dersinde öğrenilecek her şeyi öğrenemeyebileceğimden sıklıkla endişe duyuyorum.	① ② ③ ④ ⑤
11.	Fen ve teknoloji dersinde diğerlerine göre daha başarılı olmak benim için önemlidir.	① ② ③ ④ ⑤
12.	Bazen fen ve teknoloji dersinin içeriğini istediğim kadar iyi anlayamayacağımdan korkuyorum.	① ② ③ ④ ⑤
13.	Fen ve teknoloji dersinde amacım başarısız olmaktan kaçınmaktır.	① ② ③ ④ ⑤
14.	Fen ve teknoloji dersinde beni sıklıkla motive eden şey başarısız olma korkusudur.	① ② ③ ④ ⑤
15.	Fen ve teknoloji dersinde sadece başarısız olmaktan kaçınmak istiyorum.	① ② ③ ④ ⑤

C. FEN VE TEKNOLOJİ TESTİ

Anketler içerisinde size verilen Fen ve Teknoloji Testini dikkatli bir şekilde çözerek yanıtlarınızı aşağıdaki cevap anahtarına işaretleyiniz.

1.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
2.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
3.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
4.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
5.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
6.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
7.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
8.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
9.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
11.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
13.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14.	Ⓐ	Ⓑ	Ⓒ	Ⓓ

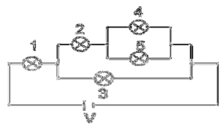
Appendix B

SCIENCE ACHIEVEMENT TEST

FEN VE TEKNOLOJİ TESTİ

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

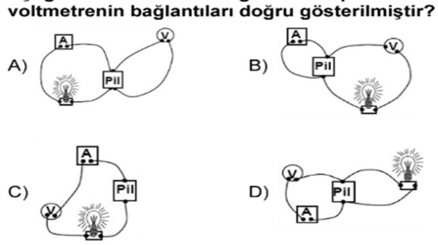
1.



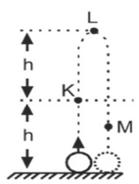
Şekilde verilen elektrik devresindeki eşdeğer ampullerden en az ışık veren iki ampul hangileridir?

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?**

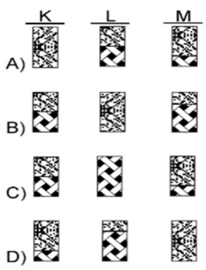


3.

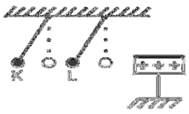


Şekilde düşey doğrultuda yukarı doğru atılan bir topun izlediği yol görülmektedir.
Buna göre; topun K, L, M noktalarındaki potansiyel enerji ve kinetik enerji dağılımları hangisindeki gibi olur?

{ : Potansiyel enerji : Kinetik enerji
Sürtünmeler önemsenmeyecek. }



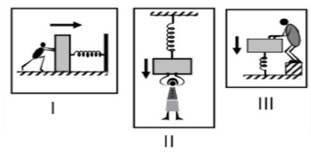
4.



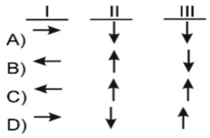
Şekildeki durumun sağlanabilmesi için özdeş K ve L kürelerinin yük durumları hangisinde doğru verilmiştir?

	K	L
A)	+	+
B)	+	Nötr
C)	-	+
D)	-	-

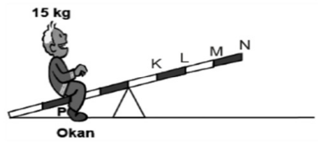
5. Üç öğrenci I, II ve III teki yaylara oklarla gösterilen yönlerdeki kuvvetleri uyguluyorlar.



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



6.



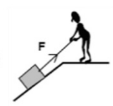
Şekildeki eşit bölmeli tahterevallinin P noktasında oturan 15 kg ağırlığındaki Okan denge konumuna getirilmek istenmektedir.
Buna göre aşağıdakilerin hangisinde denge <u>sağlanmaz</u>?

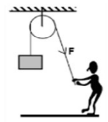
A) K ye 30 kg ağırlığındaki Ziya oturduğunda
B) L ye 15 kg ağırlığındaki Göktuğ oturduğunda
C) M ye 10 kg ağırlığındaki Selim oturduğunda
D) N ye 20 kg ağırlığındaki Hakan oturduğunda

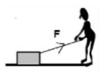
7. **Fiziksel anlamda iş yapılabilmesi için;**

- Kuvvet uygulanmalı
- Kuvvet etkisindeki cisim yol almalıdır.

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

A) 

B) 

C) 

D) 

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

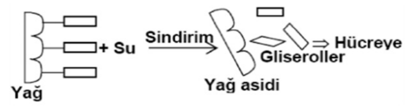
11. **Göze gelen ışık ışınları ilk önce aşağıdakilerin hangisinden geçer?**

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>?

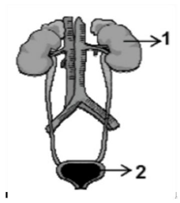
A) Atık maddelerin vücuttan uzaklaştırılması
B) Besinlerin ağızdan yemek borusuna iletilmesi
C) Besinlerin bulamaç hâline getirilmesi
D) Besinlerin kana geçirilmesi

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 C

TEACHER QUESTIONNAIRE

Sayın Fen ve Teknoloji öğretmeni,

Bu ankette size öğretmenlik mesleğine karşı tutumlarınıza ve algılarınıza yönelik çeşitli sorular sorulmaktadır. Lütfen her cümleyi dikkatle okuduktan sonra, size uygun gelen seçeneği mutlaka işaretleyiniz. Unutmayın Doğru ya da Yanlış cevap yoktur. Sizden hiçbir şekilde kimliğinizi belirten bir bilgi istenmemektedir ve anketlere verdiğiniz cevaplar araştırmacılar tarafından gizli tutulacaktır. Bu nedenle sorulara içtenlikle cevap vermenizi rica ederiz.

Katkılarınızdan dolayı teşekkür ederiz.

Doç. Dr. Semra SUNGUR
ODTÜ

Araş. Gör. Sündüs YERDELEN
ODTÜ

Bölüm A.

KİŞİSEL BİLGİLERİNİZ

1. Cinsiyetiniz: ① Kadın ② Erkek **2. Yaşınız:**______ **3. Üniversite eğitimi gördüğünüz fakültenin adı:** ______________________ **4. Üniversite eğitimi gördüğünüz bölümün adı:** ______________________ **5. Kaç yıldır öğretmenlik yapıyorsunuz?**________	**6. Şu andaki eğitim durumunuz?** ① Lisans ② Yüksek lisans ③ Doktora ④ Diğer________________ **7. Girdiğiniz sınıflardaki ortalama öğrenci sayısı:**______ **8. Haftalık ders saatiniz:**_____ **9. Evli misiniz?** ① Evet ② Hayır **10. Çocuğunuz var mı?** ① Evet ② Hayır **11. Çocuğunuz var ise sayısı:** ① 1 ② 2 ③ 3 ④ 4 ⑤ 5 ⑥ 6 ve üstü

1

Bölüm B.

B. 1. Aşağıda belirtilen ifadelere ne derecede katıldığınızı ya da katılmadığınızı gösteren seçeneği işaretleyiniz.	Yetersiz		Çok Az Yeterli		Biraz Yeterli		Oldukça Yeterli		Çok Yeterli
1. Sınıfta fen ve teknoloji dersini olumsuz yönde etkileyen davranışları kontrol etmeyi ne kadar sağlayabilirsiniz?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
2. Fen ve teknoloji dersine az ilgi gösteren öğrencileri motive etmeyi ne kadar sağlayabilirsiniz?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
3. Öğrencileri fen ve teknoloji dersinde başarılı olabileceklerine inandırmayı ne kadar sağlayabilirsiniz?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
4. Öğrencilerin fen ve teknoloji dersini öğrenmeye değer vermelerini ne kadar sağlayabilirsiniz?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
5. Fen ve teknoloji dersinde öğrencilerinizin iyi bir şekilde değerlendirilmesine olanak sağlayacak soruları ne ölçüde hazırlayabilirsiniz?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
6. Fen ve teknoloji derslerinde öğrencilerin sınıf kurallarına uymalarını ne kadar sağlayabilirsiniz?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
7. Fen ve teknoloji dersini olumsuz yönde etkileyen ya da derste gürültü yapan öğrencileri ne kadar yatıştırabilirsiniz?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
8. Fen ve teknoloji derslerinde farklı öğrenci gruplarına uygun sınıf yönetim sistemini ne kadar iyi oluşturabilirsiniz?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
9. Fen ve teknoloji derslerinde farklı değerlendirme yöntemlerini ne kadar kullanabilirsiniz?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
10. Fen ve teknoloji derslerinde öğrencilerin kafası karıştığında ne kadar alternatif açıklama ya da örnek sağlayabilirsiniz?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
11. Çocuklarının fen ve teknoloji dersinde başarılı olmalarına yardımcı olmaları için ailelere ne kadar destek olabilirsiniz?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
12. Fen ve teknoloji derslerinde farklı öğretim yöntemlerini ne kadar iyi uygulayabilirsiniz?	①	②	③	④	⑤	⑥	⑦	⑧	⑨

B.2. Aşağıda belirtilen ifadelere ne derecede katıldığınızı ya da katılmadığınızı gösteren seçeneği işaretleyiniz.	Kesinlikle Katılıyorum	Katılıyorum	Biraz Katılıyorum	Biraz Katılmıyorum	Katılmıyorum	Kesinlikle Katılmıyorum
1. Kişiler fen ve teknolojiye yönelik belli bir yeteneğe sahiptir ve bunu değiştirmek için pek bir şey yapamazlar.	①	②	③	④	⑤	⑥
2. Kişilerin Fen ve teknolojiye yönelik yetenekleri tamamen kendileriyle ilgili bir şeydir ve onu çok fazla değiştiremezler.	①	②	③	④	⑤	⑥
3. Dürüst olmak gerekirse, insanlar fen ve teknoloji alanında ne kadar yetenekli olduklarını değiştiremezler.	①	②	③	④	⑤	⑥
4. Kişiler fen ve teknoloji konularında yeni bir şeyler öğrenebilirler fakat fen ve teknolojiye yönelik temel yeteneklerini değiştiremezler.	①	②	③	④	⑤	⑥

B.3. Aşağıda belirtilen ifadelere ne derecede katıldığınızı ya da katılmadığınızı gösteren seçeneği işaretleyiniz.

		Hiçbir Zaman	Çok Nadir	Bazen	Çoğu Zaman	Her Zaman
1.	İşimden soğuduğumu hissediyorum.	⓪	①	②	③	④
2.	İş dönüşü kendimi ruhen tükenmiş hissediyorum.	⓪	①	②	③	④
3.	Sabah kalktığımda bir gün daha bu işi kaldıramayacağım hissediyorum.	⓪	①	②	③	④
4.	Öğrencilerimin ne hissettiğini hemen anlarım.	⓪	①	②	③	④
5.	Bütün gün insanlarla uğraşmak benim için gerçekten çok yıpratıcı.	⓪	①	②	③	④
6.	Öğrencilerimin sorunlarına en uygun çözüm yollarını bulurum.	⓪	①	②	③	④
7.	Yaptığım işten tükendiğimi hissediyorum.	⓪	①	②	③	④
8.	Yaptığım iş sayesinde insanların yaşamına katkıda bulunduğuma inanıyorum.	⓪	①	②	③	④
9.	Çok şeyler yapabilecek güçteyim.	⓪	①	②	③	④
10.	İşimin beni kısıtladığını hissediyorum.	⓪	①	②	③	④
11.	İşimde çok fazla çalıştığımı hissediyorum.	⓪	①	②	③	④
12.	Doğrudan doğruya insanlarla çalışmak bende çok fazla stres yaratıyor.	⓪	①	②	③	④
13.	Öğrencilerimle aramda rahat bir hava yaratırım.	⓪	①	②	③	④
14.	Öğrencilerimle yakın bir çalışmadan sonra kendimi canlanmış hissederim.	⓪	①	②	③	④
15.	Bu işte birçok kayda değer başarı elde ettim.	⓪	①	②	③	④
16.	Mesleki hayatımın sonuna geldiğimi hissediyorum.	⓪	①	②	③	④
17.	İşimdeki duygusal sorunlara serinkanlılıkla yaklaşırım.	⓪	①	②	③	④

B.4. Aşağıda belirtilen ifadelerde sizi en iyi yansıtan seçeneği işaretleyiniz.

1.	Mesleğinizi tüm yönleriyle ele aldığınızda, öğretmen olarak çalışmaktan ne kadar zevk alıyorsunuz?	**Hiç** ①	②	③	④	**Çok fazla** ⑤
2.	Eğer bu gün mesleğinizi seçme şansınız olsaydı, öğretmen olmayı seçer miydiniz?	**Kesinlikle hayır** ①	②	③	④	**Hiç düşünmeden evet** ⑤
3.	Öğretmenlik mesleğini bırakmayı hiç düşündünüz mü?	**Hiçbir zaman** ①	②	③	④	**Her zaman** ⑤

Katkılarınız için teşekkür ederiz.

Appendix D

INSTRUCTION FORM

UYGULAMA YÖNERGESİ

Sayın Öğretmen,

Bu yönerge ölçme araçlarının uygulanması sürecinde uygulamayı yapacak olan öğretmene yardımcı olmak amacıyla düzenlenmiştir. Çalışmanın amacı öğrencilerin ve öğretmenlerin Fen ve Teknoloji dersine yönelik tutum ve davranışlarını incelemektir. Araştırma sonuçlarının Türkiye'deki eğitim sisteminin geliştirilmesine katkı sağlayacağı umulmaktadır. Uygulamanın doğru bir şekilde yürütülmesi, araştırmanın geçerliği açısından çok önemlidir. Bu nedenle uygulama sürecinde aşağıda belirtilen hususlara dikkat etmenizi rica eder, araştırmaya sağlayacağınız katkılardan dolayı şimdiden teşekkür ederiz.

1- Okuldaki 7. sınıflardan bir tanesini kura ile belirleyerek, öğrenci anketlerini bu sınıftaki öğrencilere uygulayınız. Öğretmen anketinin ise **seçilen bu sınıfın dersine giren Fen ve Teknoloji öğretmeni** tarafından doldurulması gerekmektedir. Bu konudaki hassasiyetiniz için çok teşekkür ederiz.
2- Anketlerin Fen ve Teknoloji dersi **dışındaki** herhangi bir derste uygulanması gerekmektedir.
3- Zarf içerisinde:
   1 adet öğretmen anketi,
   25 adet öğrenci anketi,
   25 adet Fen ve Teknoloji testi bulunmaktadır.
4- Lütfen her bir öğrenciye **1 adet anket** ve **1 adet test** veriniz.
5- Unutmayınız; öğrencilerden ve öğretmenden kimliğini belirten hiçbir bilgi istenmemektedir.
6- Anketlere verilen cevapların gizli tutulacağı konusunda öğrencilerinize lütfen hatırlatma yapınız.
7- Ölçme araçlarının tanıtımı ve uygulamasına yönelik açıklamalar ölçme araçlarının başında yer almaktadır. Bu **açıklamaların öğrenciler tarafından okunmasını sağlamanız** araçların doğru bir biçimde cevaplanması açısından son derece önemlidir.
8- Öğretmen ve öğrencilerin sorulara samimi ve dürüst cevaplar vermesi, cevap sürecinde öğrencilerin birbirinden ve öğretmenden etkilenmemesi araştırmanın güvenirliği açısından çok önemlidir. Bu nedenle uygulamayı yapan öğretmenin uygun ortamı hazırlaması çok önemlidir. Bu konudaki hassasiyetiniz için teşekkür ederiz.
9- Uygulama için 1 ders saati önerilmektedir. Anketi ve testi bitiremeyen öğrencilere ise ek süre verilmesini önemle rica ederiz.

Aşağıdaki kontrol listesi, uygulama sürecinin aşamalarında uygulayıcıya yardımcı olmak amacıyla sunulmaktadır.

	Faaliyetler	Evet	Hayır
1.	7. sınıf düzeyinde bir şube kura ile seçildi.	☐	☐
2.	Bu sınıfın Fen ve Teknoloji dersine giren öğretmen belirlenerek anketi doldurması sağlandı.	☐	☐
3.	Öğrencilere 1 adet anket ve 1 adet test verildi.	☐	☐
4.	Öğrencilerin anket uygulama yönergelerini okumaları sağlandı.	☐	☐
5.	Öğrencilerin uygulamayı doğru anlayarak uyguladıkları kontrol edildi.	☐	☐
6.	Öğrencilerin anketin ve testin tamamını cevaplamaları sağlandı.	☐	☐
7.	Öğretmen ve öğrencilerden toplanan anketler ve testler zarfa konuldu.	☐	☐

Uygulamaya yönelik her türlü sorunuz için lütfen araştırmacılarla iletişime geçiniz.
Teşekkürlerimizle.

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Araş. Gör. Sündüs YERDELEN
Ortadoğu Teknik Üniversitesi
İlköğretim bölümü
İletişim: 0312 2104059
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Appendix E

HIERARCHICAL LINEAR MODEL ASSUMPTIONS

E.1 Assumption Tests for the Model with Classroom Learning Environment Dimensions as Outcomes

The most important indicator of the tenability of hierarchical linear modelling assumptions is the comparison of the multilevel standard errors to robust standard errors. If this comparison of the standard errors yielded substantially different values, this might be an indicator of violation of important assumptions (Mass & Hox, 2004). Below, firstly, multilevel standard errors and robust standard errors are showed for each classroom learning environment variable as outcomes. Afterwards, normality of level-1 residuals, homogeneity of variances, multivariate normality and linearity assumptions were checked.

E.1.1 Assumption tests for Student Cohesiveness

The differences between standard errors in Table E.1 and E.2 are not large, which yielded that there is no serious violation of the assumptions.

Table E.1 Final estimation of fixed effects for Student Cohesiveness as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSWHSC, γ_{00}	.009	**.017**	.558	.577
ZT_EXPER, γ_{01}	.042	**.017**	2.45	.015
ZTRESE, γ_{02}	.047	**.017**	2.74	.007

Table E.2 Final estimation of fixed effects (with robust standard errors) for Student Cohesiveness as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSWHSC, γ_{00}	.009	**.017**	.558	.577
ZT_EXPER, γ_{01}	.042	**.017**	2.48	.014
ZTRESE, γ_{02}	.047	**.017**	2.76	.006

E.1.1.1 Assumption of Normal Distribution of Level-1 Residuals – Student Cohesiveness

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

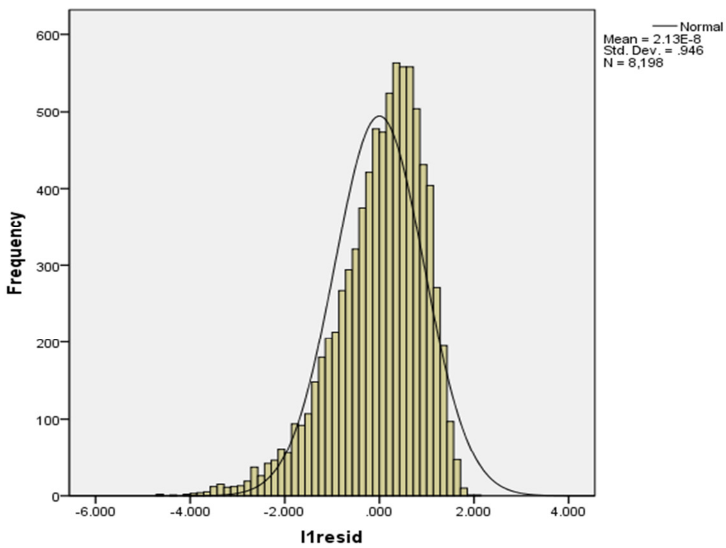


Figure E.1 Histogram of the level-1 residuals

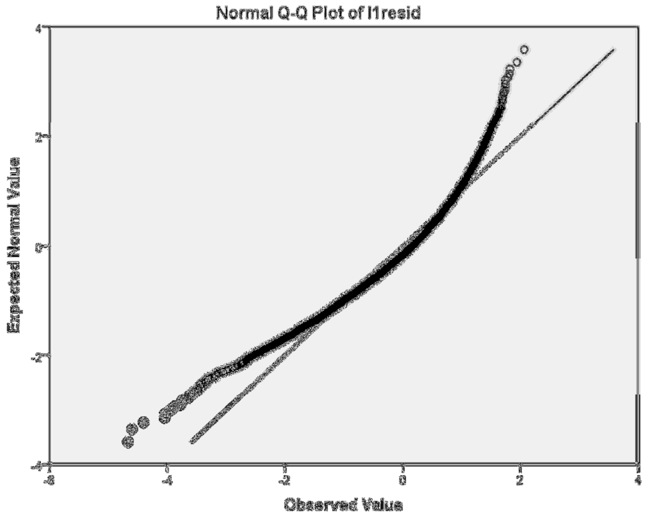


Figure E.2 Q-Q plot of the level-1 residuals

E.1.1.2 Homogeneity of Variance Assumption – Student Cohesiveness

H statistic was found as 627.78761 with 371 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.3) indicated a few groups which have smaller and higher dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

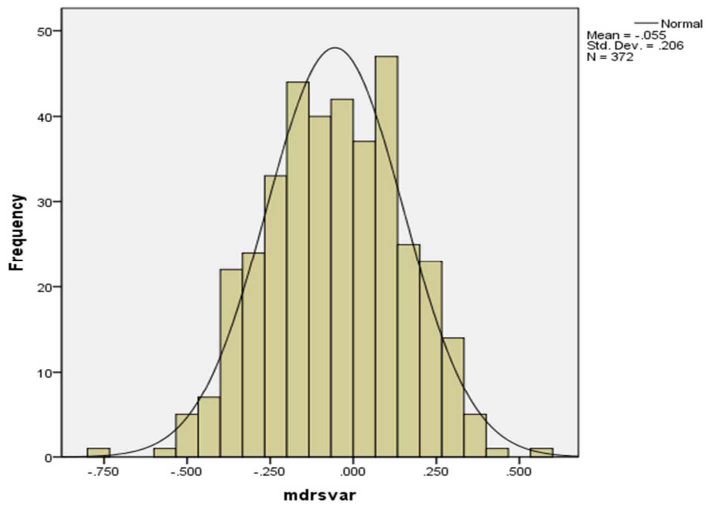


Figure E. 3 Histogram of MDRSVAR

E.1.1.3 Multivariate Normality Assumption –Student Cohesiveness

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

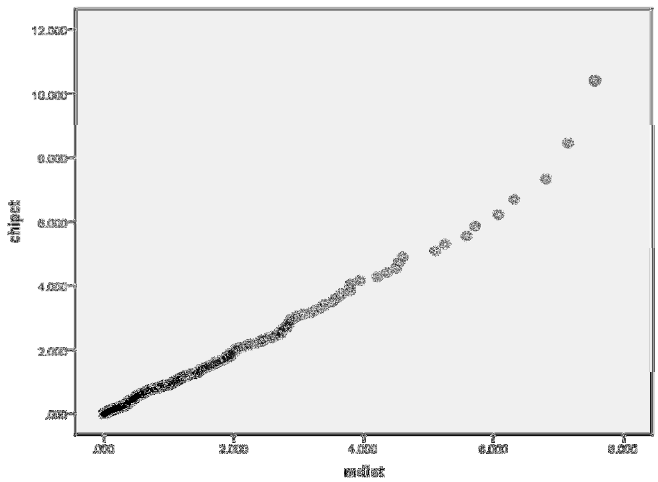


Figure E.4 Pilot of CHIPCT vs MDIST

E.1.1.4 Assumption of Linear Relationship between Level-2 Predictors and Student Cohesiveness

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.5 and E.6). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

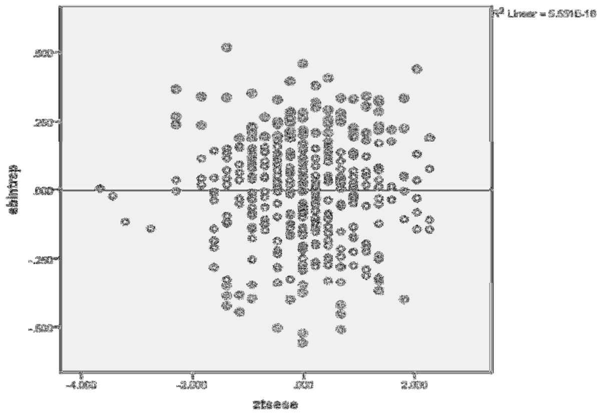


Figure E.5 EB residuals for intercept against teachers' Efficacy for Student Engagement

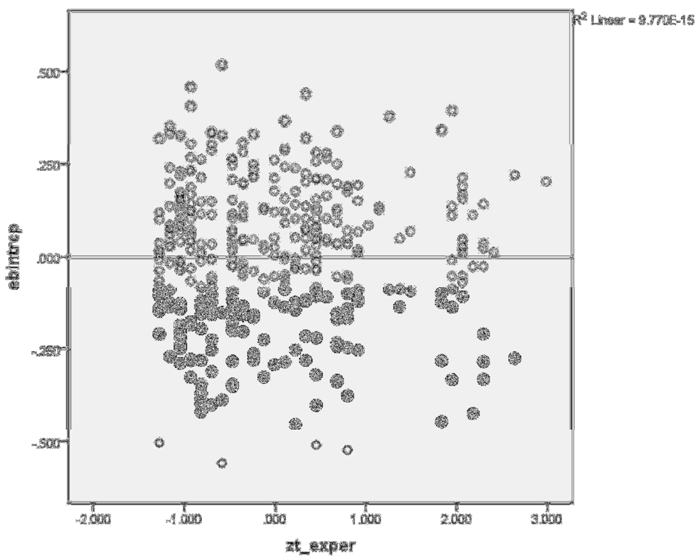


Figure E.6 EB residuals for intercept against teachers' Experience

E.1.2 Assumption Tests for Teacher Support

The differences between standard errors in Table E.3 and E.4 are not large, which yielded that there is no serious violation of the assumptions.

Table E.3 Final estimation of fixed effects for Teacher Support as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSWHTS, γ_{00}	-.038	**.029**	-1.28	.202
T_FEMALE, γ_{01}	.088	**.041**	2.166	.031
ZT_EXPER, γ_{02}	-.056	**.020**	-2.752	.007
ZTSESE, γ_{03}	.065	**.021**	3.170	.002
ZTJS, γ_{04}	.093	**.028**	3.302	.001
ZTBUEE, γ_{05}	.060	**.028**	2.199	.028

Table E.4 Final estimation of fixed effects (with robust standard errors) for Teacher Support as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSWHTS, γ_{00}	-.038	**.028**	-1.330	.185
T_FEMALE, γ_{01}	.088	**.041**	2.143	.033
ZT_EXPER, γ_{02}	-.056	**.021**	-2.670	.008
ZTSESE, γ_{03}	.065	**.021**	3.120	.002
ZTJS, γ_{04}	.093	**.025**	3.728	.000
ZTBUEE, γ_{05}	.060	**.026**	2.277	.023

E.1.2.1 Assumption of Normal Distribution of Level-1 Errors – Teacher Support

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

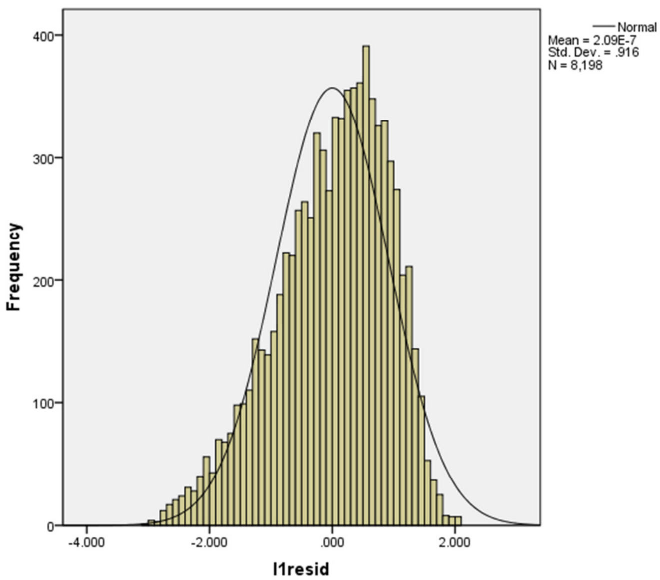


Figure E.7 Histogram of the level-1 residuals

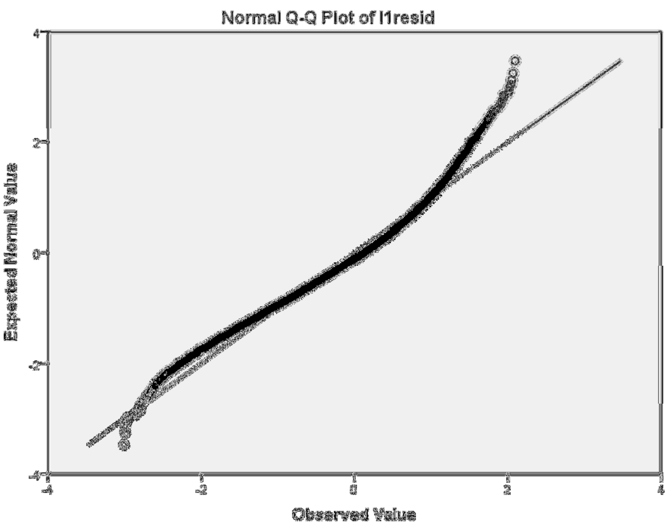


Figure E.8 Q-Q plot of the level-1 residuals

E.1.2.2 Homogeneity of Variance Assumption – Student Cohesiveness

H statistic was found as 554.34961 with 371 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.9) indicated a few groups which have smaller dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

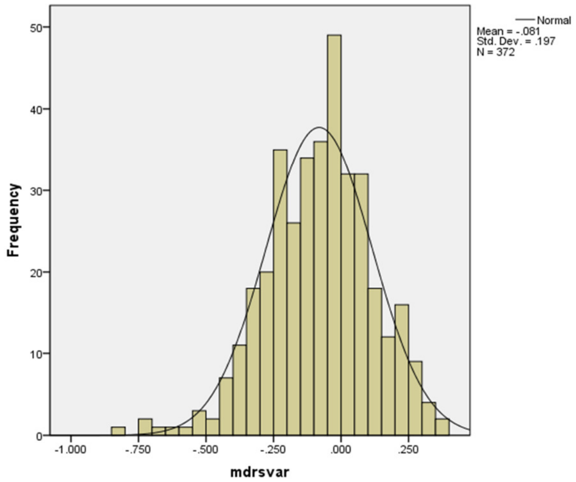


Figure E.9 Histogram of MDRSVAR

E.1.2.3 Multivariate Normality Assumption –Teacher Support

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

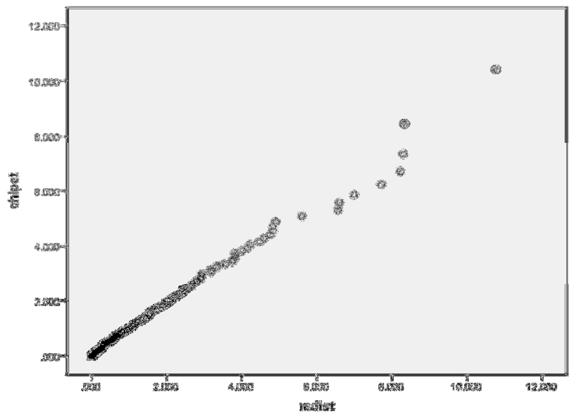


Figure E.10 Pilot of CHIPCT vs MDIST

E.1.2.4 Assumption of Linear Relationship between Level-2 Predictors and Teacher Support

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.11, E.12, E.13, and E.14). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

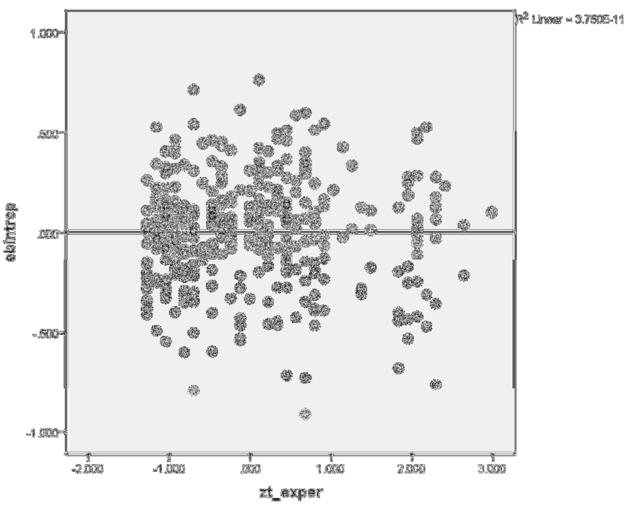


Figure E.11 EB residuals for intercept against teachers' Experience

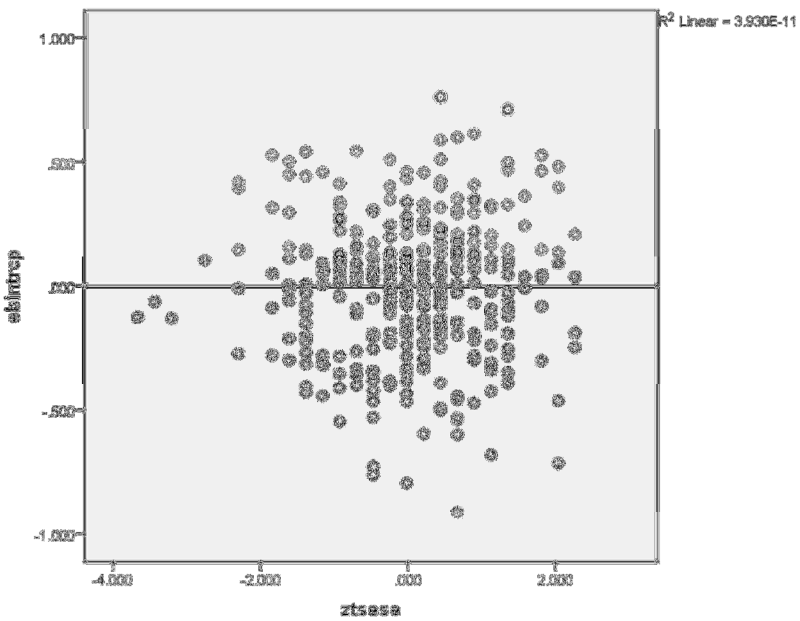


Figure E.12 EB residuals for intercept against teachers' Efficacy for Student Engagement

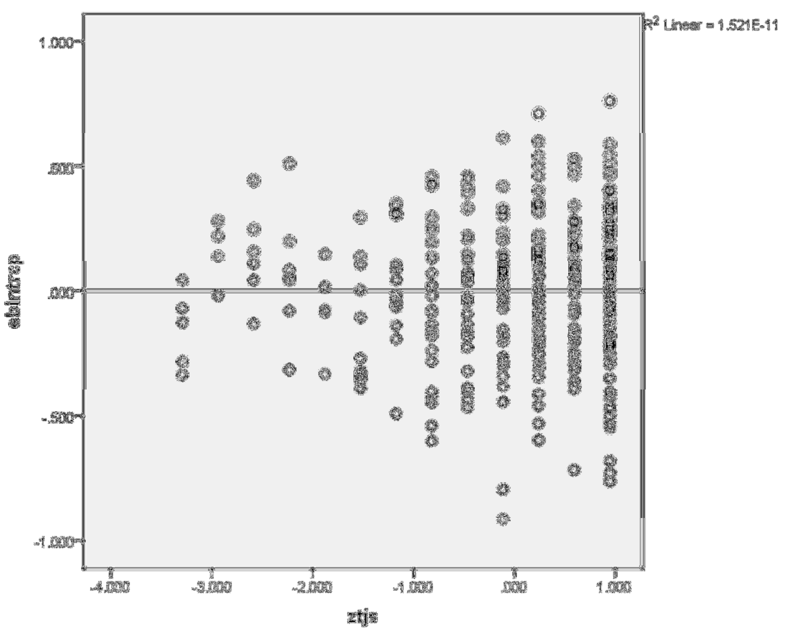


Figure E.13 EB residuals for intercept against teachers' Job Satisfaction

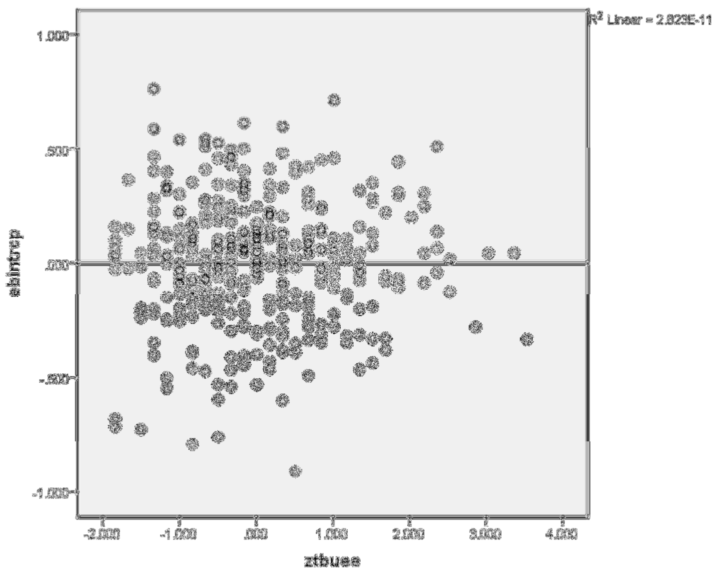


Figure E.14 EB residuals for intercept against teachers' Emotional Exhaustion

E.1.3 Assumption Tests for Involvement

The differences between standard errors in Table E.5 and E.6 are not large, which yielded that there is no serious violation of the assumptions.

Table E.5 Final estimation of fixed effects for Involvement as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	p-value
Overall mean ZSWHINVO, γ_{00}	.009	**.017**	.537	.590
ZTRESE, γ_{01}	.065	**.017**	3.899	.000

Table E.6 Final estimation of fixed effects (with robust standard errors) for Involvement as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSWHINVO, γ_{00}	.009	**.017**	.539	.590
ZTRESE, γ_{01}	.065	**.018**	3.620	.001

E.1.3.1 Assumption of Normal Distribution of Level-1 Residuals – Involvement

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

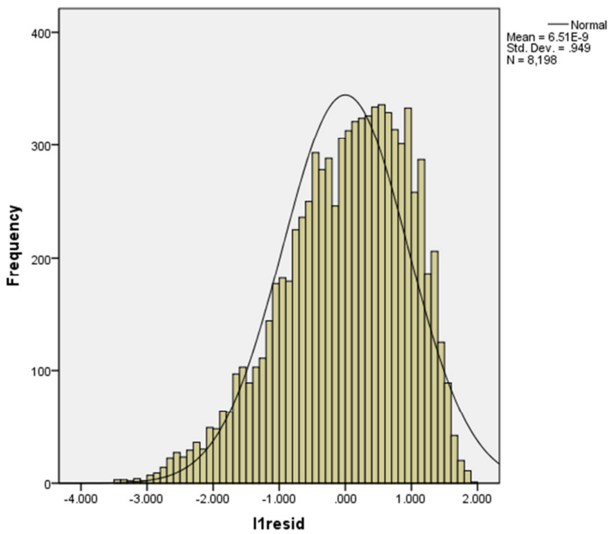


Figure E.15 Histogram of the level-1 residuals

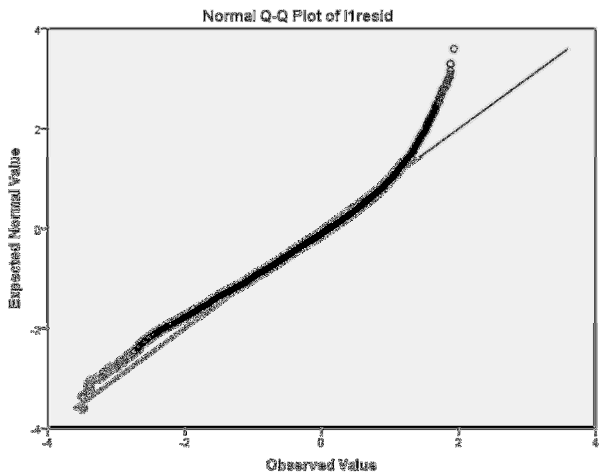


Figure E.16 Q-Q plot of the level-1 residuals

E.1.3.2 Homogeneity of Variance Assumption – Involvement

H statistic was found as 525.53007 with 371 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.17) indicated a few groups which have smaller dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

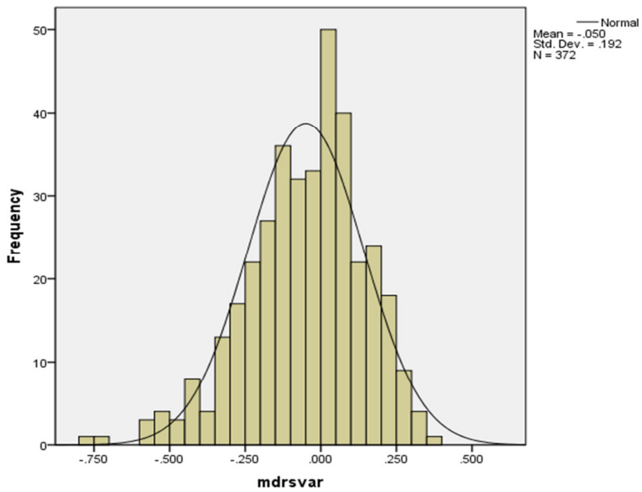


Figure E.17 Histogram of MDRSVAR

E.1.3.3 Multivariate Normality Assumption –Involvement

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

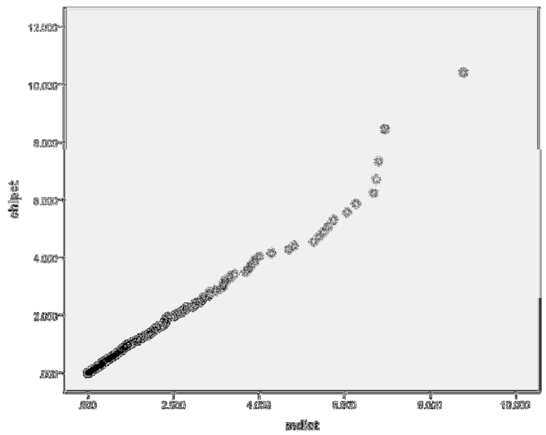


Figure E.18 Pilot of CHIPCT vs MDIST

E.1.3.4 Assumption of Linear Relationship between Level-2 Predictors and Involvement

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.19). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

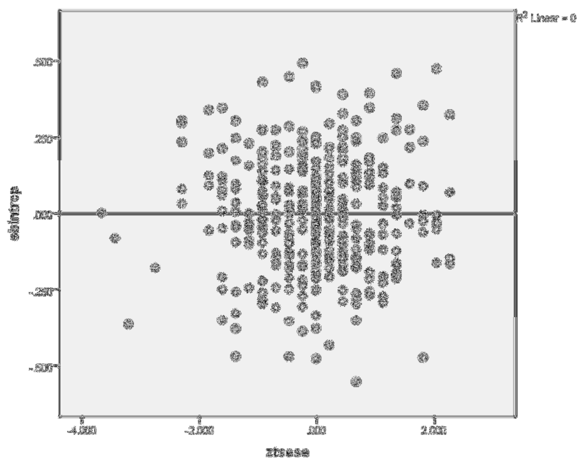


Figure E.19 EB residuals for intercept against teachers' Efficacy for Student Engagement

E.1.4 Assumption Test for Investigation

The differences between standard errors in Table E.7 and E.8 are not large, which yielded that there is no serious violation of the assumptions.

Table E.7 Final estimation of fixed effects for Investigation as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSWHINVE, γ_{00}	.012	**.018**	.657	.511
ZTRESE, γ_{01}	.108	**.023**	4.681	.000
ZTRECM, γ_{02}	-.055	**.023**	-2.365	.019

Table E.8 Final estimation of fixed effects (with robust standard errors) for Investigation as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSWHINVE, γ_{00}	.012	**.018**	.660	.509
ZTRESE, γ_{01}	.108	**.025**	4.234	.000
ZTRECM, γ_{02}	-.055	**.023**	-2.424	.016

E.1.4.1 Assumption of Normal Distribution of Level-1 Residuals – Investigation

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

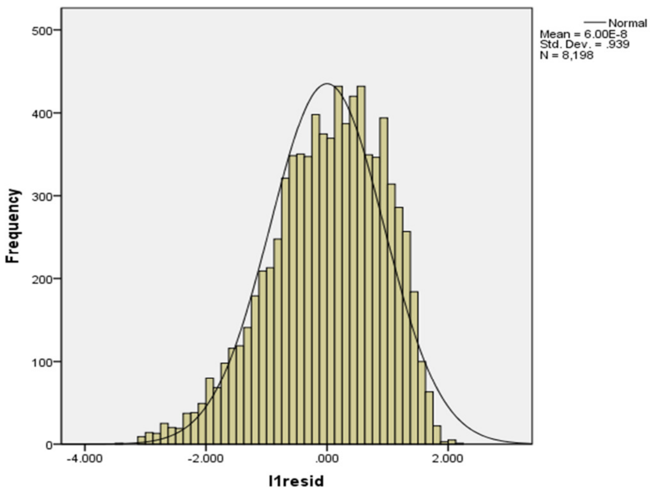


Figure E.20 Histogram of the level-1 residuals

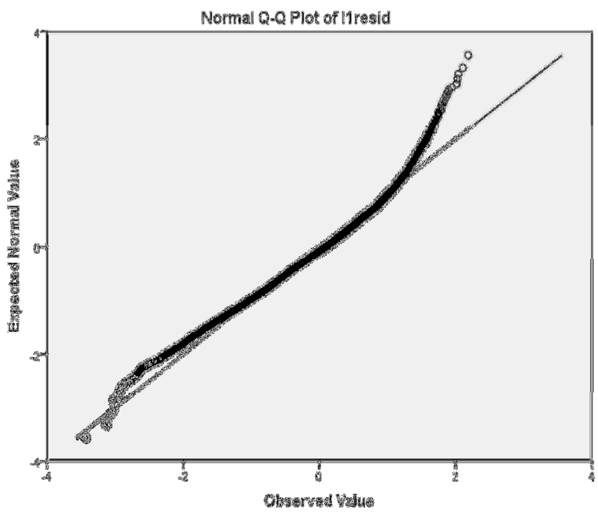


Figure E.21 Q-Q plot of the level-1 residuals

E.1.4.2 Homogeneity of Variance Assumption – Investigation

H statistic was found as 458.38195 with 371 degree of freedom, which was significant beyond the .01 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.22) indicated a few groups which have smaller and higher dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

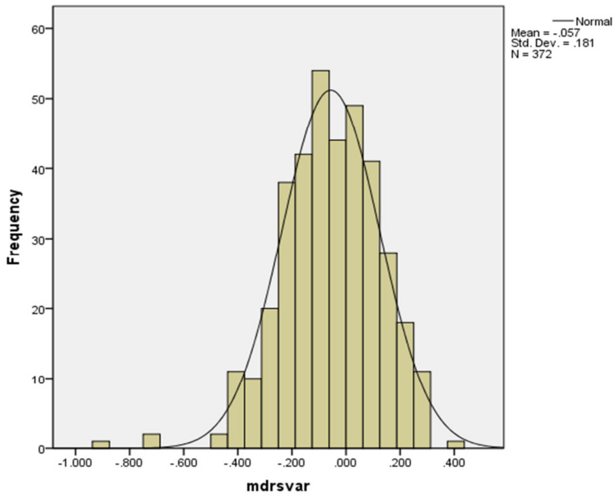


Figure E.22 Histogram of MDRSVAR

E.1.4.3 Multivariate Normality Assumption –Investigation

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

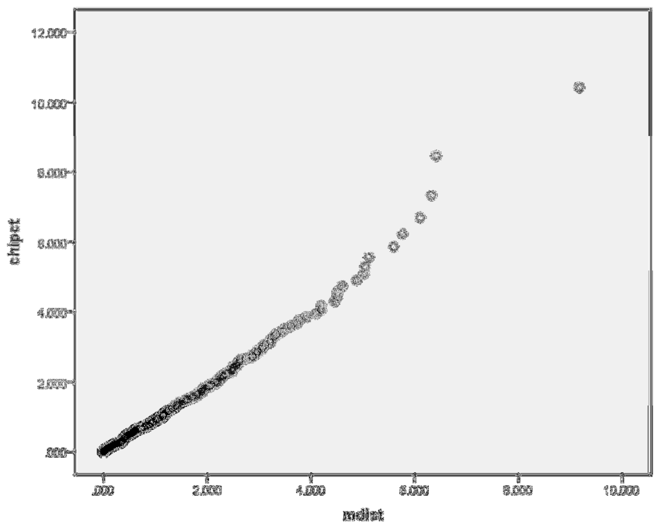


Figure E.23 Pilot of CHIPCT vs MDIST

E.1.4.4 Assumption of Linear Relationship between Level-2 Predictors and Investigation

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.24 and E.25). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

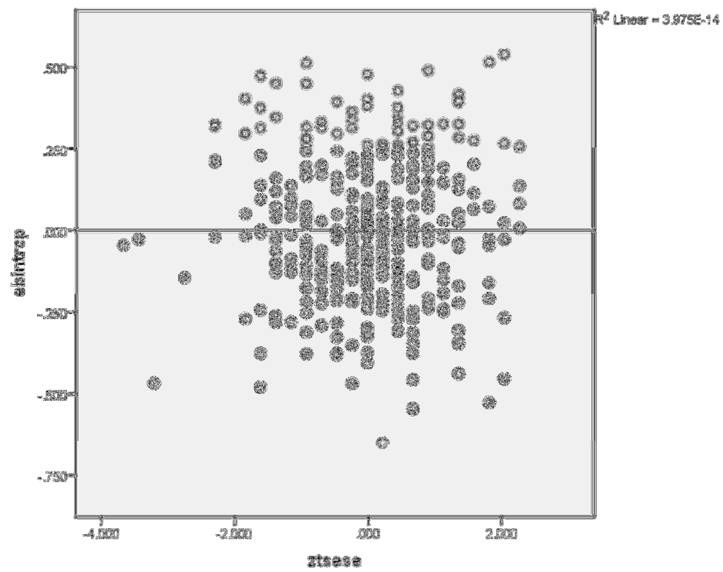


Figure E.24 EB residuals for intercept against teachers’ Efficacy for Student Engagement

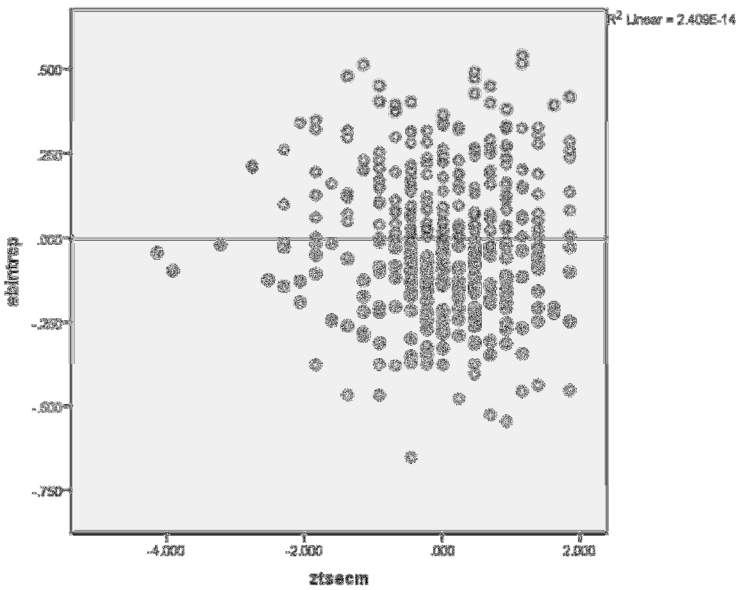


Figure E.25 EB residuals for intercept against teachers’ Efficacy for Classroom Management

E.1.5 Assumption tests for Task Orientation

The differences between standard errors in Table E.9 and E.10 are not large, which yielded that there is no serious violation of the assumptions.

Table E.9 Final estimation of fixed effects for Task Orientation as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSWHTO, γ_{00}	.008	**.017**	.468	.640
ZTRESE, γ_{01}	.093	**.021**	4.338	.000
ZTRECM, γ_{02}	-.055	**.022**	-2.549	.012

Table E.10 Final estimation of fixed effects (with robust standard errors) for Task Orientation as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSWHTO, γ_{00}	.008	**.017**	.468	.640
ZTRESE, γ_{01}	.093	**.020**	4.572	.000
ZTRECM, γ_{02}	-.055	**.021**	-2.598	.010

E.1.5.1 Assumption of Normal Distribution of Level-1 Residuals – Task Orientation

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

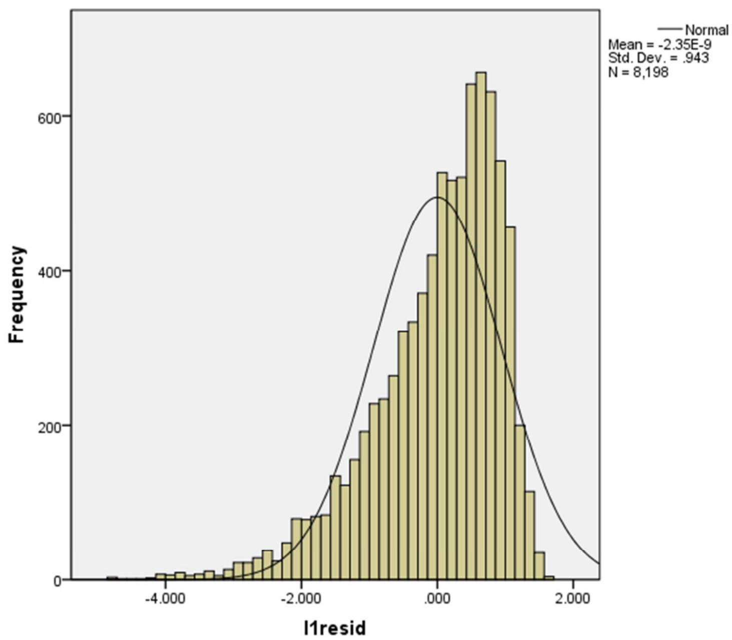


Figure E.26 Histogram of the level-1 residuals

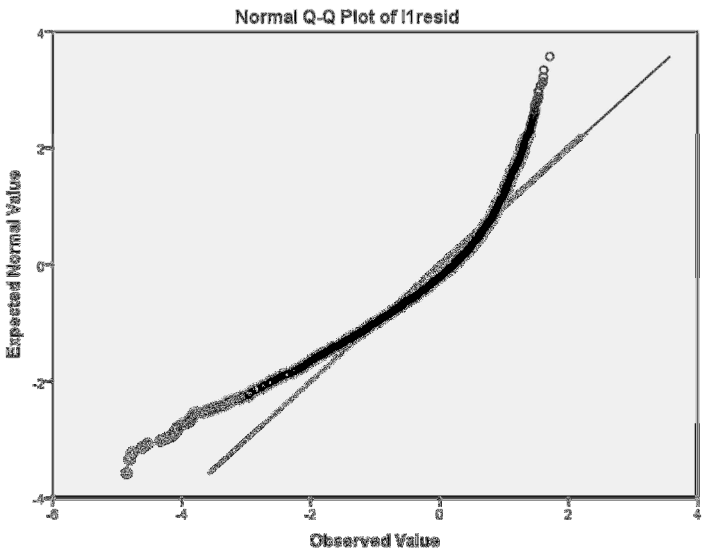


Figure E.27 Q-Q plot of the level-1 residuals

E.1.5.2 Homogeneity of Variance Assumption – Task Orientation

H statistic was found as 816.93819 with 371 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.28) indicated a few groups which have smaller and higher dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

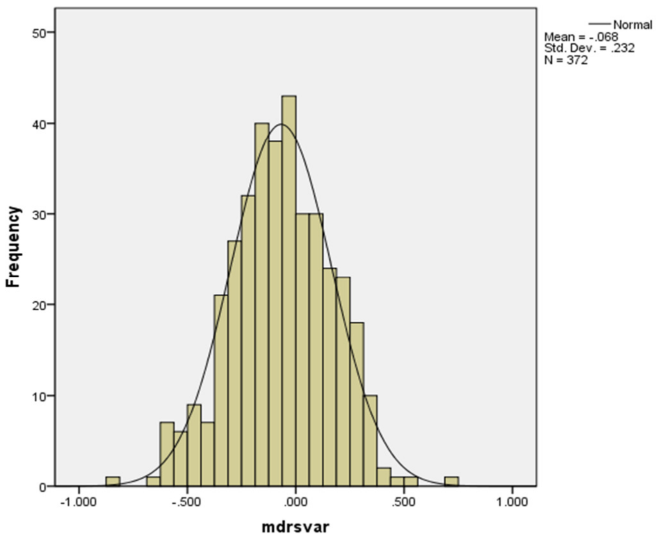


Figure E.28 Histogram of MDRSVAR

E.1.5.3 Multivariate Normality Assumption –Task Orientation

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

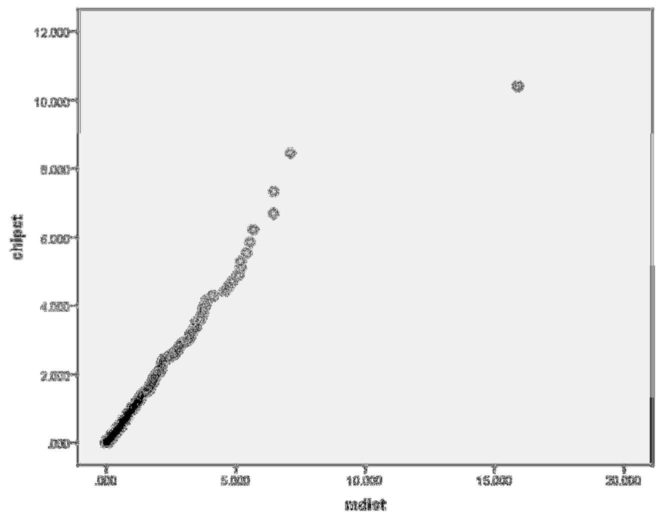


Figure E.29 Pilot of CHIPCT vs MDIST

E.1.5.4 Assumption of Linear Relationship between Level-2 Predictors and Task Orientation

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.30 and E.31). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

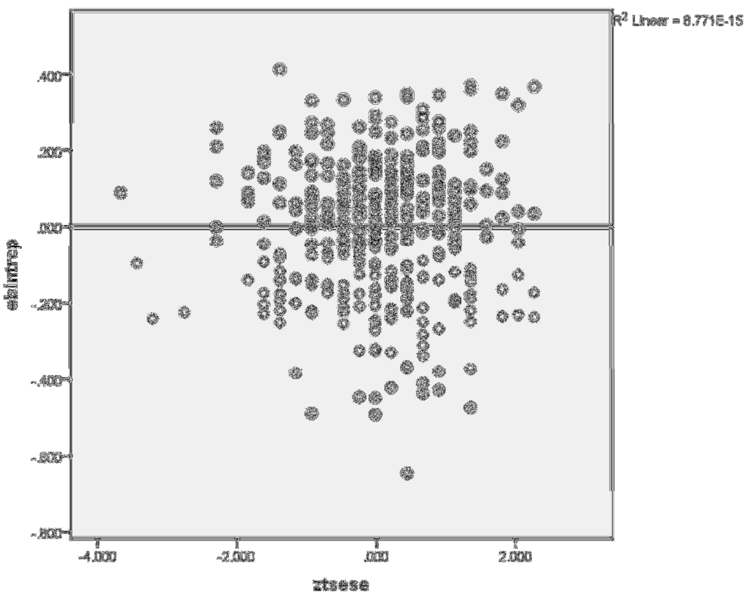


Figure E.30 EB residuals for intercept against teachers' Efficacy for Student Engagement

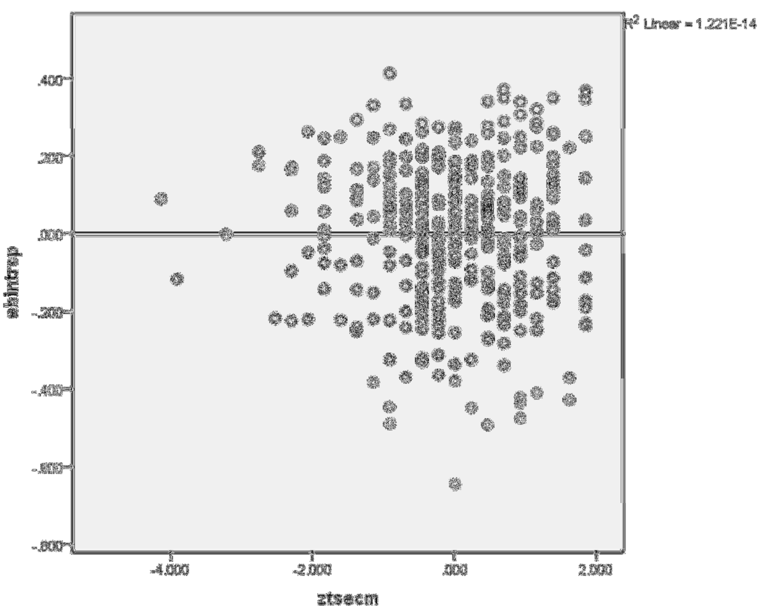


Figure E.31 EB residuals for intercept against teachers' Efficacy for Classroom Management

E.1.6 Assumption Tests for Cooperation

The differences between standard errors in Table E.11 and E.12 are not large, which yielded that there is no serious violation of the assumptions.

Table E.11 Final estimation of fixed effects for Cooperation as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSWHICOOP, γ_{00}	.013	**.018**	.712	.477
ZTRESE, γ_{01}	.064	**.018**	3.456	.001

Table E.12 Final estimation of fixed effects (with robust standard errors) for Cooperation as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSWHICOOP, γ_{00}	.013	**.018**	.714	.476
ZTRESE, γ_{01}	.064	**.019**	3.436	.001

E.1.6.1 Assumption of Normal Distribution of Level-1 Residuals – Cooperation

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

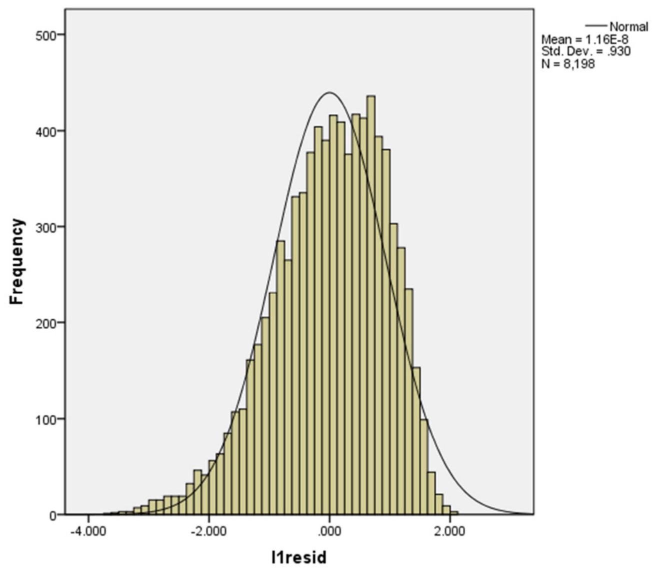


Figure E.32 Histogram of the level-1 residuals

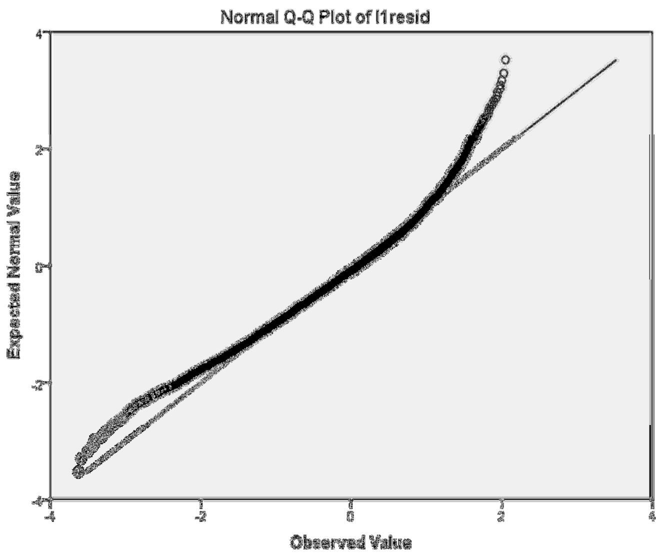


Figure E.33 Q-Q plot of the level-1 residuals

E.1.6.2 Homogeneity of Variance Assumption – Cooperation

H statistic was found as 480.72694 with 371 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.34) indicated a few groups which have smaller dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

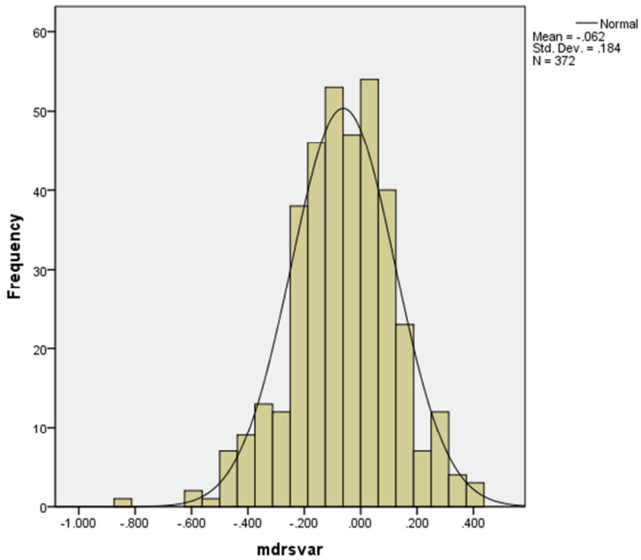


Figure E.34 Histogram of MDRSVAR

E.1.6.3 Multivariate Normality Assumption – Cooperation

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

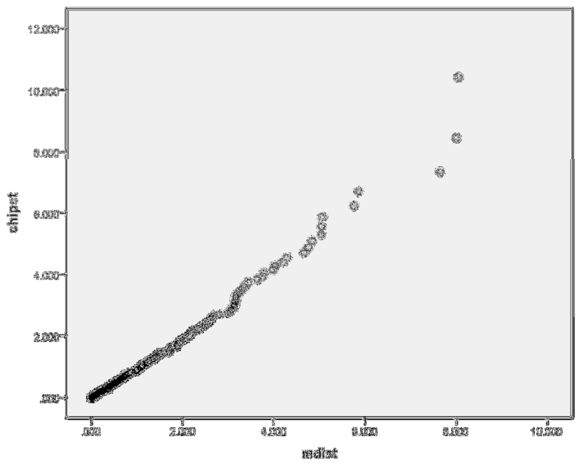


Figure E.35 Pilot of CHIPCT vs MDIST

E.1.6.4 Assumption of Linear Relationship between Level-2 Predictors and Cooperation

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.36). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

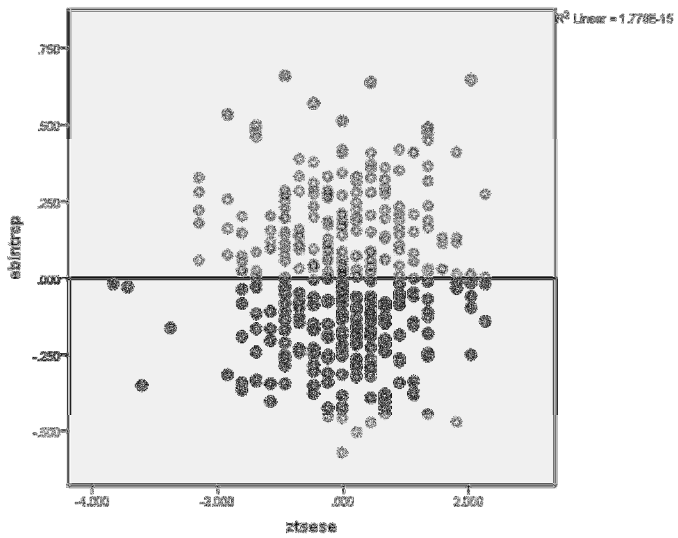


Figure E.36 EB residuals for intercept against teachers' Efficacy for Student Engagement

E.1.7 Assumption tests for Equity

The differences between standard errors in Table E.13 and E.14 are not large, which yielded that there is no serious violation of the assumptions.

Table E.13 Final estimation of fixed effects for Equity as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	p-value
Overall mean ZSWHIEQU, γ_{00}	.011	**.018**	.604	.546
ZTRESE, γ_{01}	.69	**.018**	3.807	.000

Table E.14 Final estimation of fixed effects (with robust standard errors) for Equity as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	p-value
Overall mean ZSWHIEQU, γ_{00}	.011	**.018**	.605	.545
ZTRESE, γ_{01}	.69	**.017**	4.065	.000

E.1.7.1 Assumption of Normal Distribution of Level-1 Residuals –Equity

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

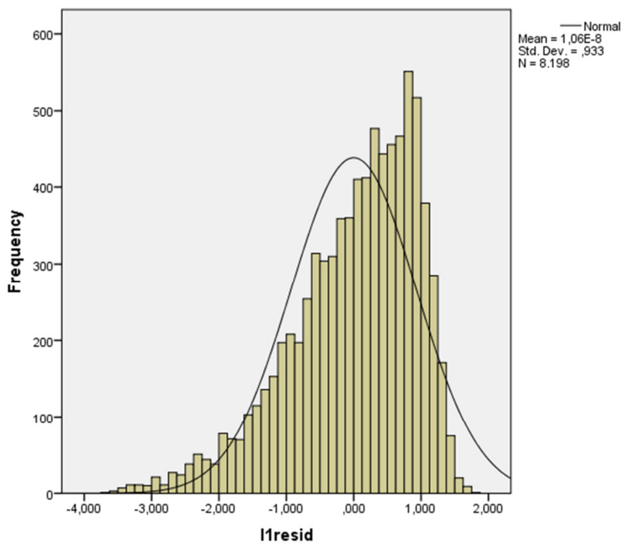


Figure E.37 Histogram of the level-1 residuals

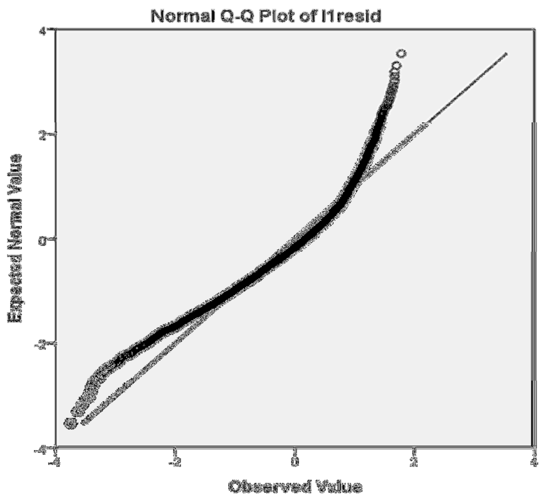


Figure E.38 Q-Q plot of the level-1 residuals

E.1.7.2 Homogeneity of Variance Assumption –Equity

H statistic was found as 714.11481 with 371 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.39) indicated a few groups which have smaller dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

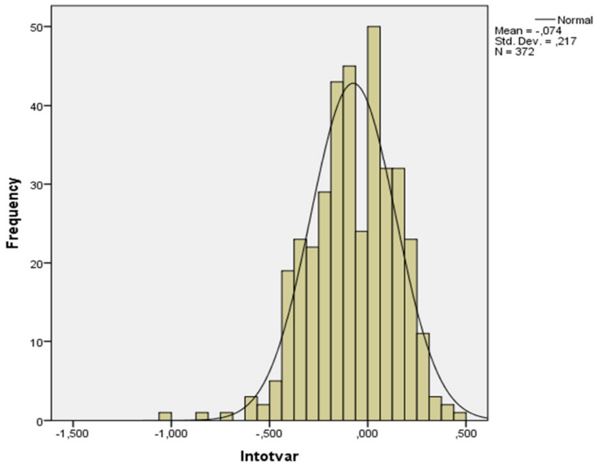


Figure E.39 Histogram of MDRSVAR

E.1.7.3 Multivariate Normality Assumption – Equity

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

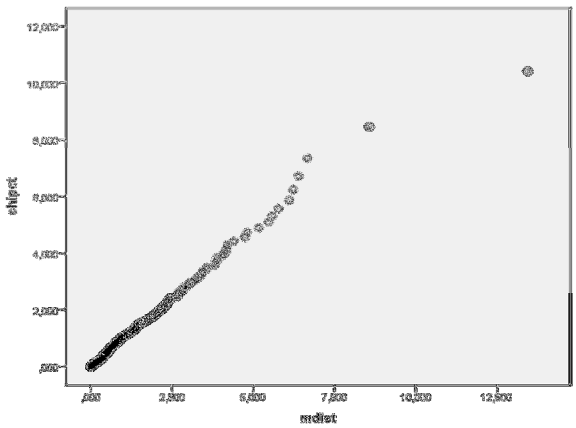


Figure E.40 Pilot of CHIPCT vs MDIST

E.1.7.4 Assumption of Linear Relationship between Level-2 Predictors and Equity

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.41 and E.42). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

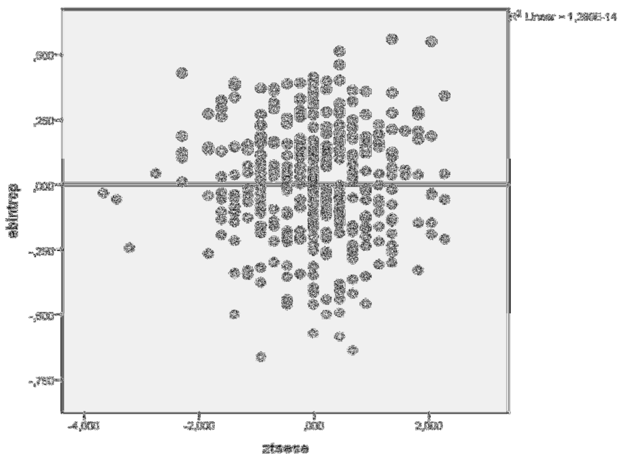


Figure E.41 EB residuals for intercept against teachers' Efficacy for Student Engagement

E.2 Assumption Tests for the Model with Self-Regulation Variables as Outcomes

Below, firstly, multilevel standard errors and robust standard errors are showed for each self-regulation variable as outcomes. The differences between the standard errors between both tables are not large, which yielded that there is no serious violation of the assumptions (Mass & Hox, 2004). Afterwards, normality of level-1 residuals, homogeneity of variances, multivariate normality and linearity assumptions were checked.

E.2.1 Assumption tests for Self-Efficacy

The differences between standard errors in Table E.15 and E.16 are not large, which yielded that there is no serious violation of the assumptions (Mass & Hox, 2004).

Table E.15 Final estimation of fixed effects for Self-Efficacy as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSSE, γ_{00}	-.007	**.014**	-.467	.640
ZTBUEE (Emotional Exhaustion), γ_{01}	.032	**.014**	2.235	.026
ZTBUPA (Personal Accomplishment), γ_{02}	.047	**.015**	3.247	.002
ZSWHSC (Student Cohesiveness), γ_{10}	.028	**.011**	2.534	.012
ZSWHTS (Teacher Support), γ_{20}	.021	**.014**	1.503	.133
ZSWHINVO (Involvement), γ_{30}	.169	**.014**	12.323	.000
ZSWHINVE (Investigation), γ_{40}	.142	**015**	9.573	.000
ZSWHTO (Task Orientation), γ_{50}	.348	**.013**	27.777	.000
ZT_EXPER (Experience), γ_{51}	-.029	**.010**	-2.896	.004
ZTBUPA (Personal Accomplishment), γ_{52}	.026	**.011**	2.407	.017
ZSWHCOOP (Cooperation), γ_{60}	-.116	**.013**	-9.310	.000
ZSWHEQU (Equity), γ_{70}	.119	**.014**	8.834	.000
ZTSEIS (Efficacy for instructional strategies), γ_{71}	-.021	**.010**	-2.119	.035

Table E.16 Final estimation of fixed effects (with robust standard errors) for Self-Efficacy as outcome variable

Fixed Effect	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSSE, γ_{00}	-.007	**.014**	-.467	.640
ZTBUEE (Emotional Exhaustion), γ_{01}	.032	**.015**	2.090	.037
ZTBUPA (Personal Accomplishment), γ_{02}	.047	**.015**	3.099	.003
ZSWHSC (Student Cohesiveness), γ_{10}	.028	**.012**	2.304	.021
ZSWHTS (Teacher Support), γ_{20}	.021	**.014**	1.479	.140
ZSWHINVO (Involvement), γ_{30}	.169	**.014**	11.906	.000
ZSWHINVE (Investigation), γ_{40}	.142	**015**	9.395	.000
ZSWHTO (Task Orientation), γ_{50}	.348	**.012**	28.492	.000
ZT_EXPER (Experience), γ_{51}	-.029	**.010**	-2.855	.005
ZTBUPA (Personal Accomplishment), γ_{52}	.026	**.010**	2.517	.013
ZSWHCOOP (Cooperation), γ_{60}	-.116	**.013**	-9.094	.000
ZSWHEQU (Equity), γ_{70}	.119	**.013**	8.902	.000
ZTSEIS (Efficacy for instructional strategies), γ_{71}	-.021	**.009**	-2.324	.021

E.2.1.1 Assumption of Normal Distribution of Level-1 Residuals – Self-Efficacy

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

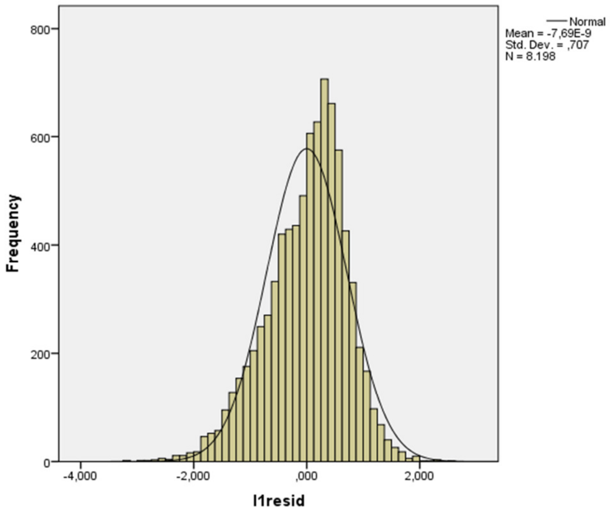


Figure E.42 Histogram of the level-1 residuals

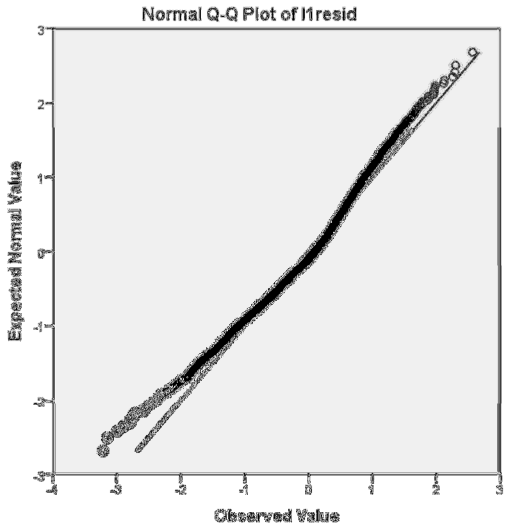


Figure E.43 Q-Q plot of the level-1 residuals

E.2.1.2 Homogeneity of Variance Assumption – Self-Efficacy

H statistic was found as 563.11657 with 371 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.44) indicated a few groups which have smaller dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

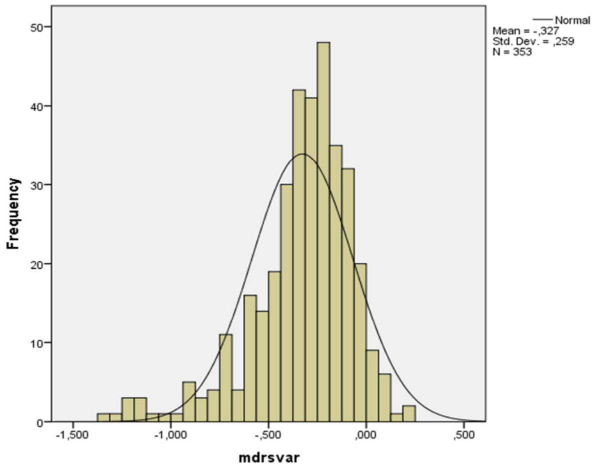


Figure E.44 Histogram of MDRSVAR

E.2.1.3 Multivariate Normality Assumption – Self-Efficacy

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

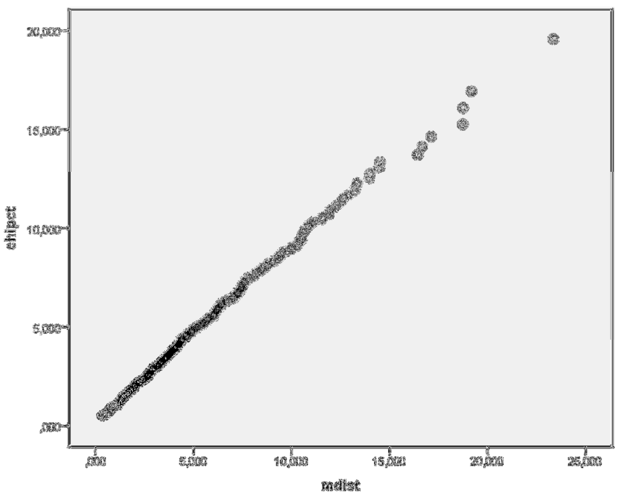


Figure E.45 Pilot of CHIPCT vs MDIST

E.2.1.4 Assumption of Linear Relationship between Level-2 Predictors and Self-Efficacy

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.46, E.47, E.48 and E.49). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

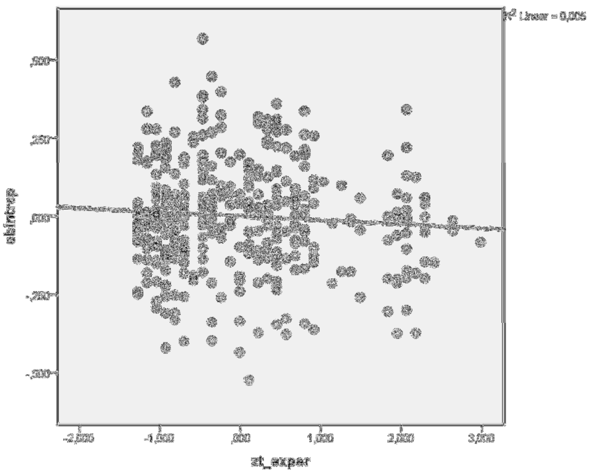


Figure E.46 EB residuals for intercept against teachers' Experience

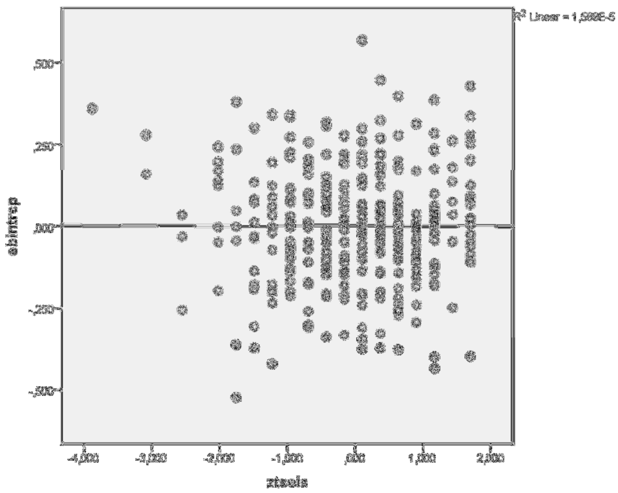


Figure E.47 EB residuals for intercept against teachers' Efficacy for Instructional strategies

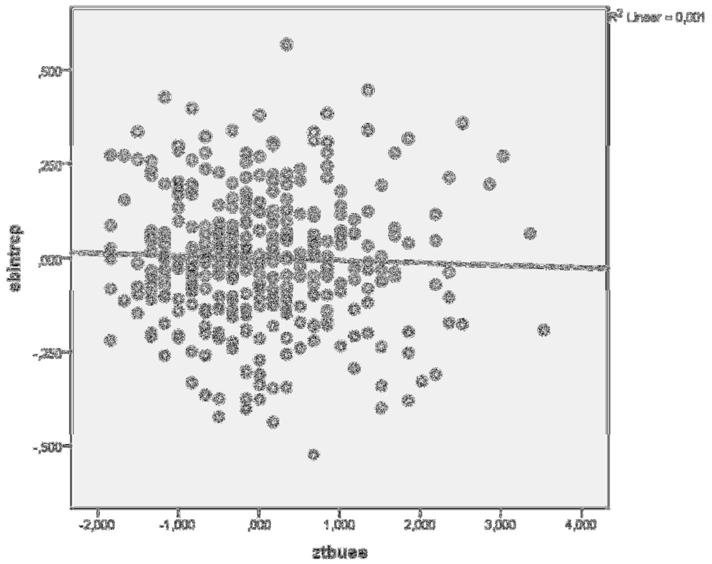


Figure E.48 EB residuals for intercept against teachers' Efficacy for Emotional Exhaustion

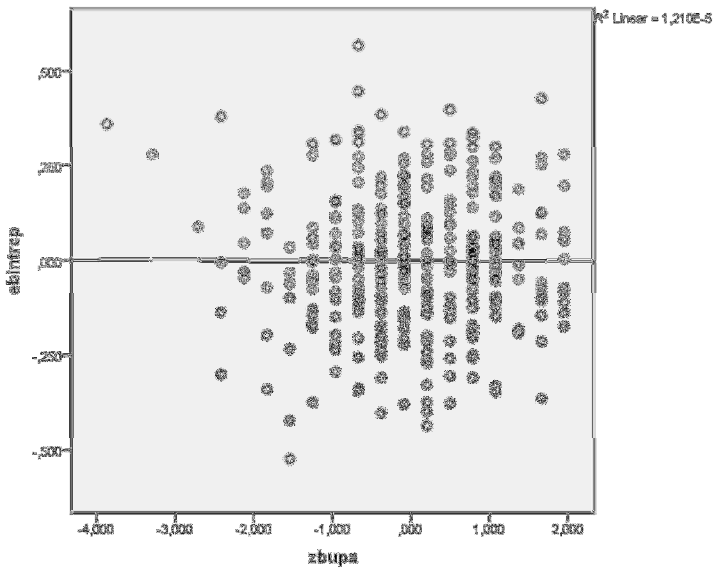


Figure E.49 EB residuals for intercept against teachers' Efficacy for Personal Accomplishment

E.2.2 Assumption Tests for Metacognitive Self-Regulation

The differences between standard errors in Table E.17 and E.18 are not large, which yielded that there is no serious violation of the assumptions.

Table E.17 Final estimation of fixed effects for Metacognitive Self-Regulation as outcome variable

Fixed Effects	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSMC, γ_{00}	-.092	**.016**	-5.715	.000
ZT_EXPER (Experience), γ_{01}	-.034	**.012**	-2.826	.005
ZTBUPA (Personal Accomplishment), γ_{02}	.039	**.013**	3.076	.003
S_FEMALE (Gender), γ_{10}	.166	**.019**	8.655	.000
ZTSEIS (Efficacy for Instructional Strategies), γ_{11}	-.030	**.015**	-2.047	.041
ZSWHSC (Student Cohesiveness), γ_{20}	.043	**.011**	3.936	.000
ZSWHTS (Teacher Support), γ_{30}	.031	**.012**	2.609	.009
ZSWHINVO (Involvement), γ_{40}	.059	**.014**	4.340	.000
ZSWHINVE (Investigation), γ_{50}	.290	**.014**	20.419	.000
ZTSEIS (Efficacy for Instructional Strategies), γ_{51}	-.025	**.010**	-2.409	.017
ZSWHTO (Task Orientation), γ_{60}	.324	**.013**	25.531	.000
ZSWHCOOP (Cooperation), γ_{70}	-.059	**.012**	-4.829	.000
ZSWHEQU (Equity), γ_{80}	.073	**.013**	5.475	.000

Table E.18 Final estimation of fixed effects (with robust standard errors) for Metacognitive Self-Regulation as outcome variable

Fixed Effects	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSMC, γ_{00}	-.092	**.016**	-5.717	.000
ZT_EXPER (Experience), γ_{01}	-.034	**.011**	-3.111	.002
ZTBUPA (Personal Accomplishment), γ_{02}	.039	**.013**	3.141	.002
S_FEMALE (Gender), γ_{10}	.166	**.019**	8.629	.000
ZTSEIS (Efficacy for Instructional Strategies), γ_{11}	-.030	**.016**	-1.922	.055
ZSWHSC (Student Cohesiveness), γ_{20}	.043	**.011**	3.681	.000
ZSWHTS (Teacher Support), γ_{30}	.031	**.012**	2.509	.012
ZSWHINVO (Involvement), γ_{40}	.059	**.014**	4.335	.000
ZSWHINVE (Investigation), γ_{50}	.290	**.014**	20.582	.000
ZTSEIS (Efficacy for Instructional Strategies), γ_{51}	-.025	**.011**	-2.399	.017
ZSWHTO (Task Orientation), γ_{60}	.324	**.013**	25.245	.000
ZSWHCOOP (Cooperation), γ_{70}	-.059	**.013**	-4.687	.000
ZSWHEQU (Equity), γ_{80}	.073	**.013**	5.443	.000

E.2.2.1 Assumption of Normal Distribution of Level-1 Residuals – Metacognitive Self-Regulation

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serius deviation from normal distribution.

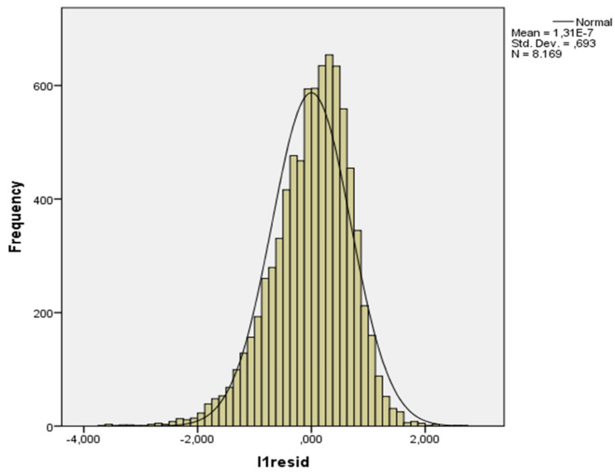


Figure E.50 Histogram of the level-1 residuals

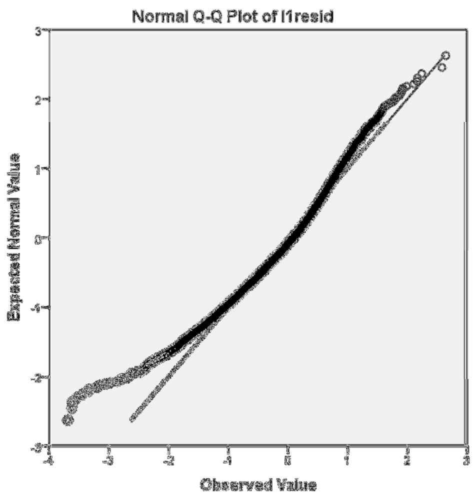


Figure E.51 Q-Q plot of the level-1 residuals

E.2.2.2 Homogeneity of Variance Assumption – Metacognitive Self-Regulation

H statistic was found as 572.41454 with 371 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.52) indicated a few groups which have smaller dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

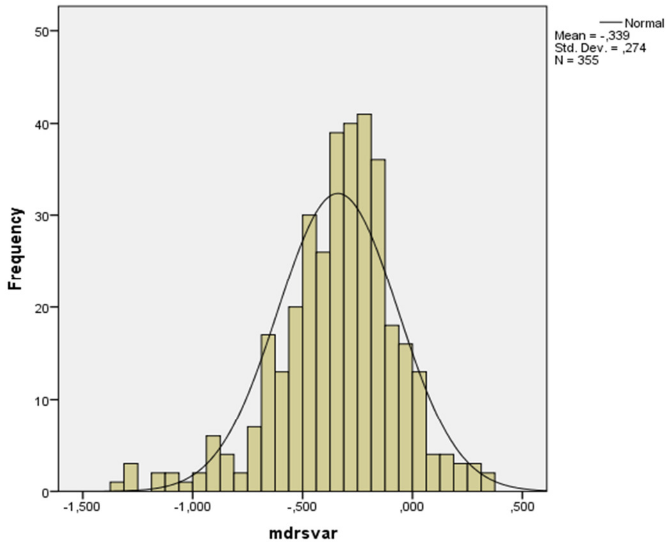


Figure E.52 Histogram of MDRSVAR

E.2.2.3 Multivariate Normality Assumption – Metacognitive Self-Regulation

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

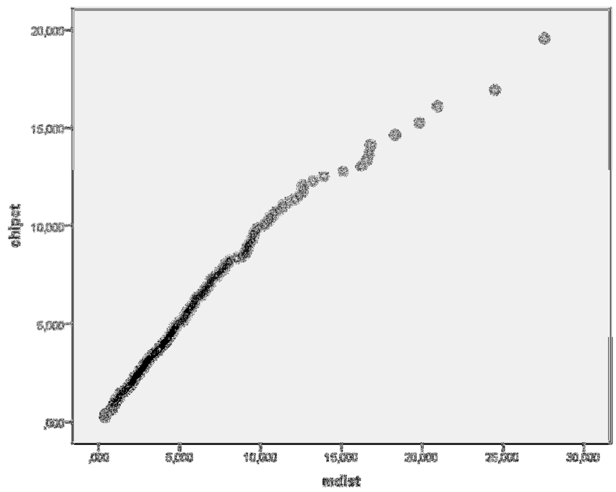


Figure E.53 Pilot of CHIPCT vs MDIST

E.2.2.4 Assumption of Linear Relationship between Level-2 Predictors and Metacognitive Self-Regulation

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.5 and E.6). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

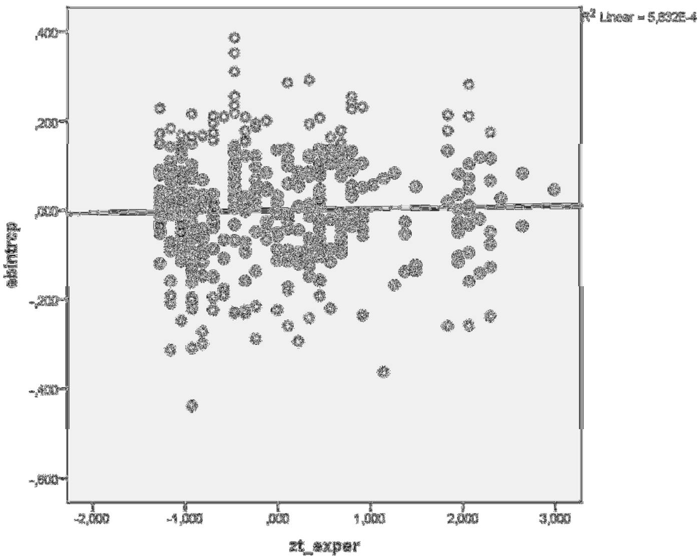


Figure E.54 EB residuals for intercept against teachers' Experience

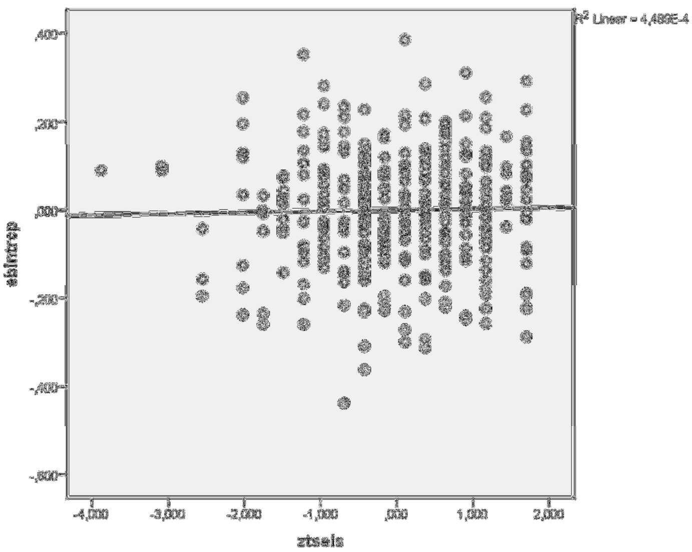


Figure E.55 EB residuals for intercept against teachers' Efficacy for Instructional Strategies

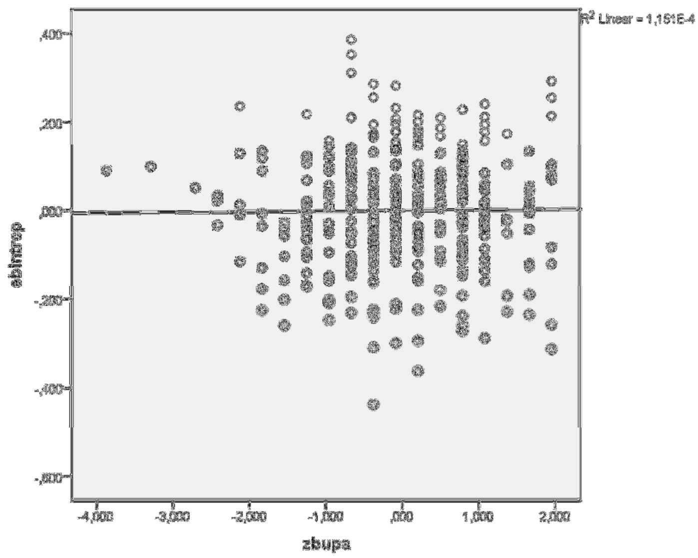


Figure E.56 EB residuals for intercept against teachers' Efficacy for Personal Accomplishment

E.2.3 Assumption Tests for Mastery Approach Goals

The differences between standard errors in Table E.19 and E.20 are not large, which yielded that there is no serious violation of the assumptions.

Table E.19 Final estimation of fixed effects for Mastery Approach Goals as outcome variable

Fixed Effects	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSMAP, γ_{00}	-.062	**.015**	-4.128	.000
S_FEMALE (Gender), γ_{10}	.124	**.018**	6.867	.000
ZT_EXPER (Experience), γ_{11}	-.024	**.012**	-2.055	.040
ZSWHSC (Student Cohesiveness), γ_{20}	.047	**.011**	4.407	.000
ZSWHTS (Teacher Support), γ_{30}	.008	**.013**	.623	.534
ZSWHINVO (Involvement), γ_{40}	.010	**.014**	.657	.492
ZSWHTO (Task Orientation), γ_{50}	.497	**.014**	34.795	.000
ZSWHCOOP (Cooperation), γ_{60}	-.028	**.012**	-2.387	.017
ZSWHEQU (Equity), γ_{70}	.153	**.014**	10.383	.000

Table E.20 Final estimation of fixed effects (with robust standard errors) for Mastery Approach Goals as outcome variable

Fixed Effects	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSMAP, γ_{00}	-.062	**.015**	-4.159	.000
S_FEMALE (Gender), γ_{10}	.124	**.018**	6.943	.000
ZT_EXPER (Experience), γ_{11}	-.024	**.012**	-2.066	.039
ZSWHSC (Student Cohesiveness), γ_{20}	.047	**.012**	4.109	.000
ZSWHTS (Teacher Support), γ_{30}	.008	**.013**	.625	.532
ZSWHINVO (Involvement), γ_{40}	.010	**.014**	.685	.494
ZSWHTO (Task Orientation), γ_{50}	.497	**.014**	35.282	.000
ZSWHCOOP (Cooperation), γ_{60}	-.028	**.011**	-2.466	.014
ZSWHEQU (Equity), γ_{70}	.153	**.014**	11.131	.000

E.2.3.1 Assumption of Normal Distribution of Level-1 Residuals – Mastery Approach Goals

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

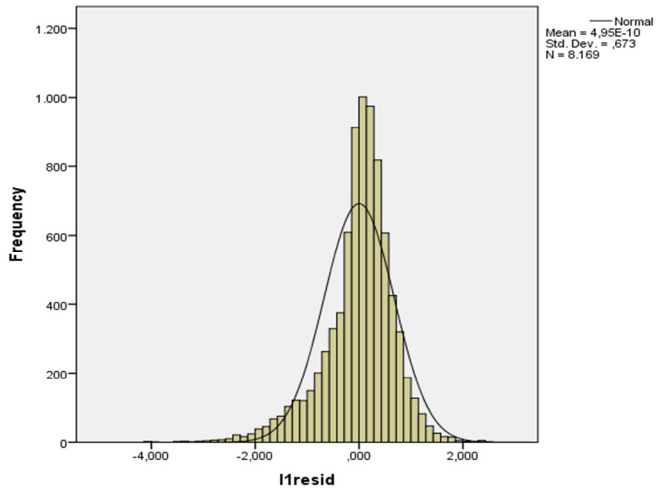


Figure E.57 Histogram of the level-1 residuals

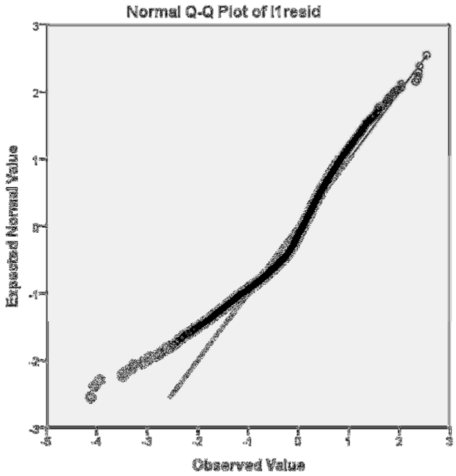


Figure E.58 Q-Q plot of the level-1 residuals

E.2.3.2 Homogeneity of Variance Assumption – Mastery Approach Goals

H statistic was found as 859.19851 with 370 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.59) indicated a few groups which have smaller and higher dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

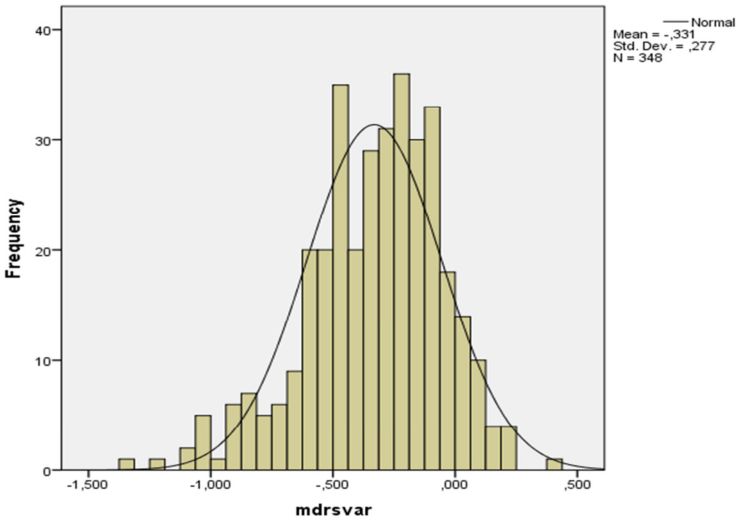


Figure E.59 Histogram of MDRSVAR

E.2.3.3 Multivariate Normality Assumption – Mastery Approach Goals

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Although the shape of the distribution was departed from 45 degree line, the comparison of multilevel standard errors and robust standard errors (see Table E.19 and E.20) indicated no serious violation of multivariate normality assumption.

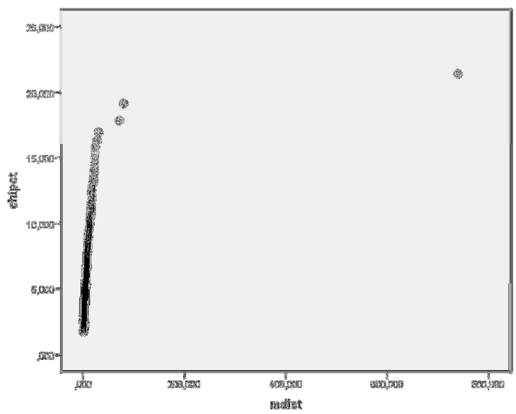


Figure E.60 Pilot of CHIPCT vs MDIST

E.2.3.4 Assumption of Linear Relationship between Level-2 Predictors and Mastery Approach Goals

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.61). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

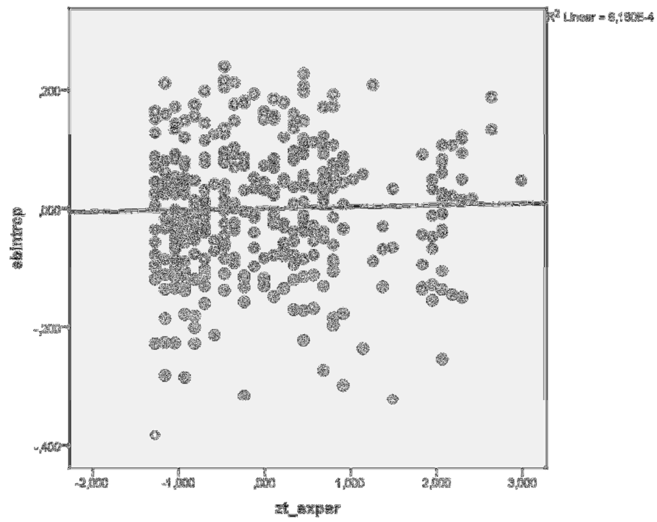


Figure E.61 EB residuals for intercept against teachers' Experience

E.2.4 Assumption Tests for Performance Approach Goals

The differences between standard errors in Table E.21 and E.22 are not large, which yielded that there is no serious violation of the assumptions.

Table E.21 Final estimation of fixed effects for Performance Approach Goals as outcome variable

Fixed Effects	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSPAP, γ_{00}	-.042	**.017**	-2.580	.011
S_FEMALE (Gender), γ_{10}	.086	**.020**	4.345	.000
ZSWHSC (Student Cohesiveness), γ_{20}	.033	**.012**	2.690	.008
ZSWHINVO (Involvement), γ_{30}	.020	**.015**	1.353	.171
ZSWHTO (Task Orientation), γ_{40}	.370	**.014**	25.657	.000
ZTSESE (Efficacy for Student Engagement), γ_{41}	-.044	**.013**	-3.411	.001
ZTJS (Job Satisfaction), γ_{42}	.033	**.013**	2.659	.009
ZSWHEQU (Equity), γ_{50}	.066	**.015**	4.536	.000
ZTSEIS (Efficacy for Instructional Strategies), γ_{51}	.037	**.014**	2.688	.000
ZBUPA (Personal Accomplishment), γ_{52}	-.028	**.014**	-2.040	.042

Table E.22 Final estimation of fixed effects (with robust standard errors) for Performance Approach Goals as outcome variable

Fixed Effects	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSPAP, γ_{00}	-.042	**.016**	-2.595	.010
S_FEMALE (Gender), γ_{10}	.086	**.021**	4.178	.000
ZSWHSC (Student Cohesiveness), γ_{20}	.033	**.013**	2.564	.011
ZSWHINVO (Involvement), γ_{30}	.020	**.016**	1.319	.188
ZSWHTO (Task Orientation), γ_{40}	.370	**.015**	25.537	.000
ZTSESE (Efficacy for Student Engagement), γ_{41}	-.044	**.014**	-3.165	.002
ZTJS (Job Satisfaction), γ_{42}	.033	**.014**	2.375	.018
ZSWHEQU (Equity), γ_{50}	.066	**.014**	4.552	.000
ZTSEIS (Efficacy for Instructional Strategies), γ_{51}	.037	**.012**	2.960	.004
ZBUPA (Personal Accomplishment), γ_{52}	-.028	**.013**	-2.105	.036

E.2.4.1 Assumption of Normal Distribution of Level-1 Residuals – Performance Approach Goals

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

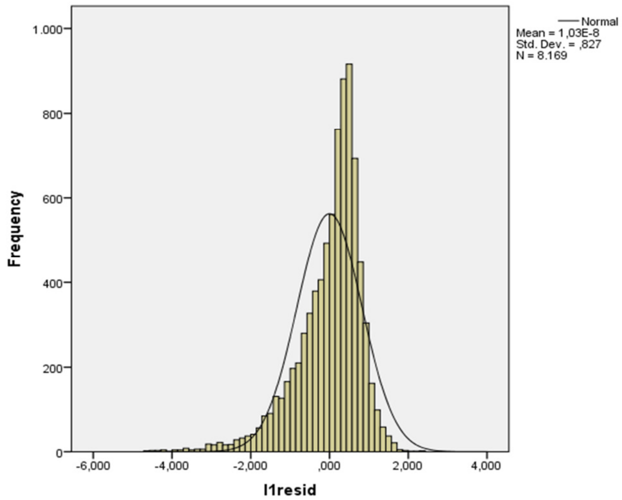


Figure E.62 Histogram of the level-1 residuals

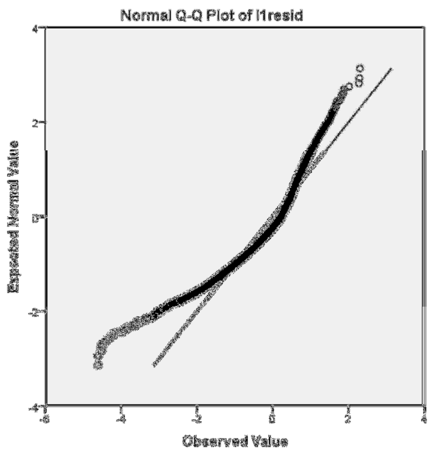


Figure E.63 Q-Q plot of the level-1 residuals

E.2.4.2 Homogeneity of Variance Assumption – Performance Approach Goals

H statistic was found as 790.50986 with 371 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.64) indicated a few groups which have smaller and higher dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

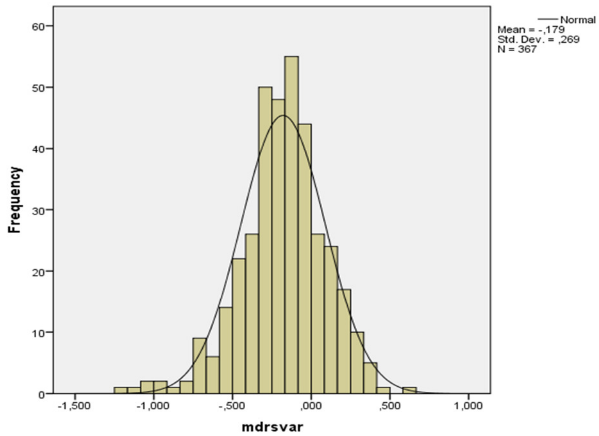


Figure E.64 Histogram of MDRSVAR

E.2.4.3 Multivariate Normality Assumption – Performance Approach Goals

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

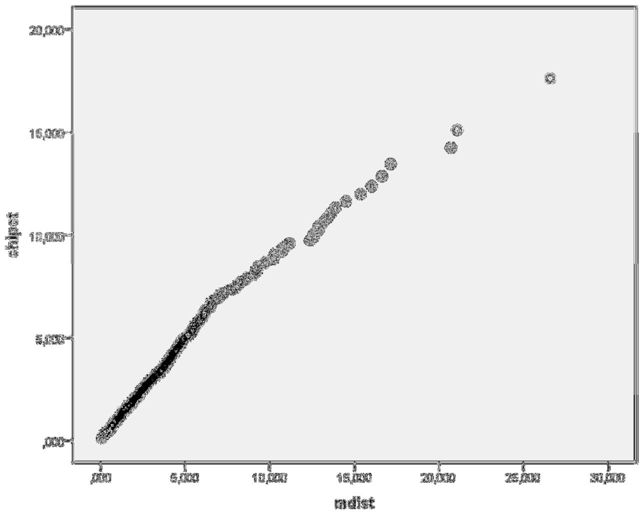


Figure E.65 Pilot of CHIPCT vs MDIST

E.2.5.4 Assumption of Linear Relationship between Level-2 Predictors and Performance Approach Goals

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.66, E.67, E.68, and E.69). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

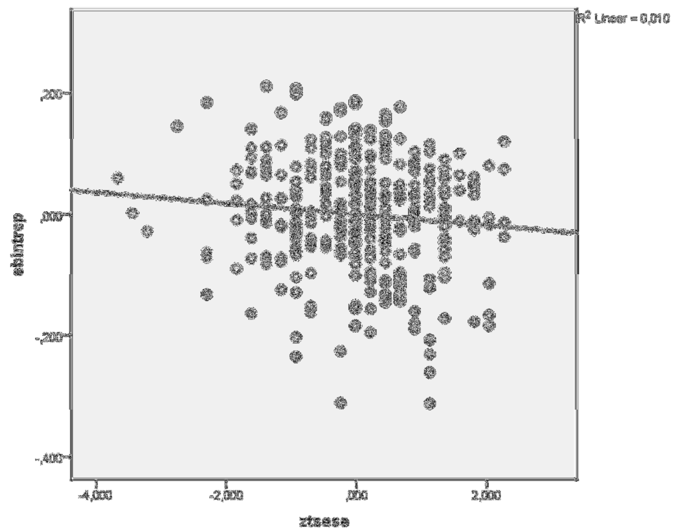


Figure E.66 EB residuals for intercept against teachers' Efficacy for Student Engagement

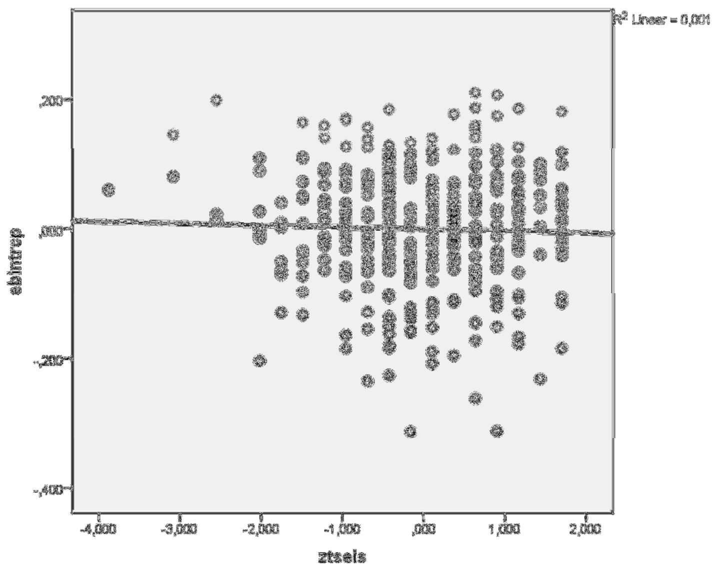


Figure E.67 EB residuals for intercept against teachers' Efficacy for Instructional Strategies

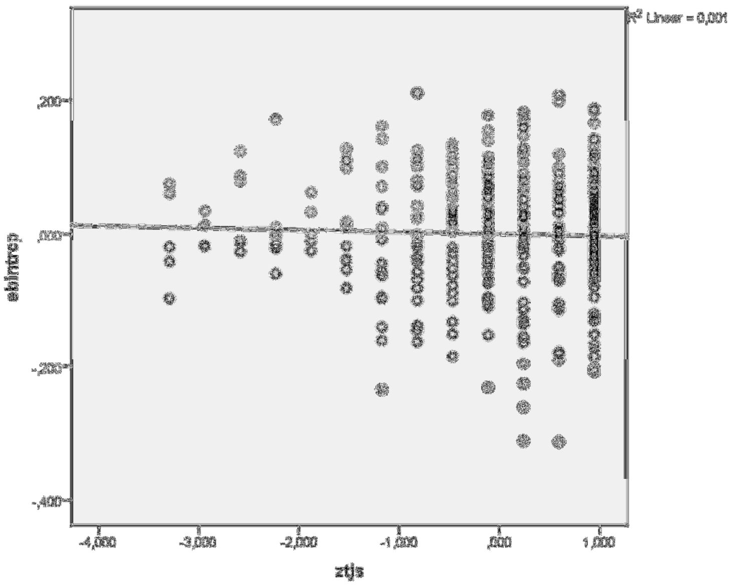


Figure E.68 EB residuals for intercept against teachers' Job Satisfaction

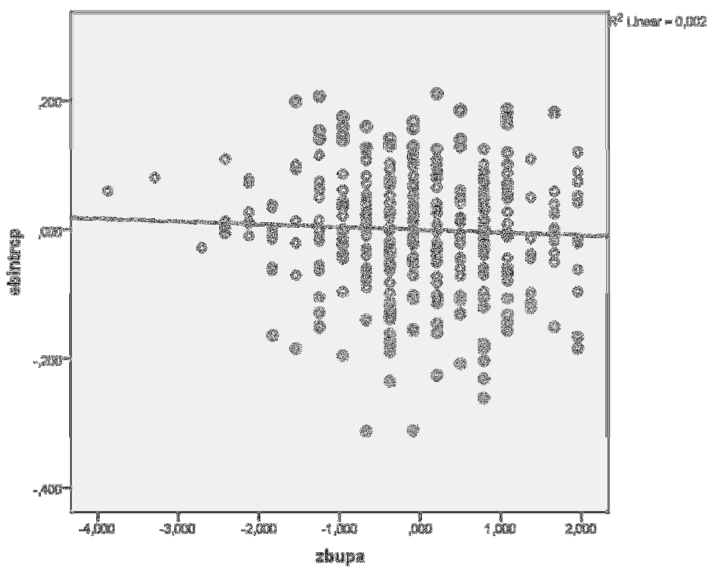


Figure E.69 EB residuals for intercept against teachers' Personal Accomplishment

E.2.5 Assumption Tests for Mastery Avoidance Goals

The differences between standard errors in Table E.23 and E.24 are not large, which yielded that there is no serious violation of the assumptions.

Table E.23 Final estimation of fixed effects for Mastery Avoidance Goals as outcome variable

Fixed Effects	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSMAV, γ_{00}	-.065	**.019**	-3.416	.001
S_FEMALE (Gender), γ_{10}	.117	**.023**	5.076	.000
ZTSESE (Efficacy for Student Engagement), γ_{11}	-.039	**.017**	-2.304	.022
ZSWHINVO (Involvement), γ_{20}	-.047	**.017**	-2.806	.006
ZSWHINVE (Investigation), γ_{30}	.012	**.017**	.667	.505
ZSWHTO (Task Orientation), γ_{40}	.114	**.014**	8.011	.000
ZSWHCOOP (Cooperation), γ_{50}	.178	**.015**	12.173	.000

Table E.24 Final estimation of fixed effects (with robust standard errors) for Mastery Avoidance Goals as outcome variable

Fixed Effects	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSMAV, γ_{00}	-.065	**.019**	-3.357	.001
S_FEMALE (Gender), γ_{10}	.118	**.023**	5.042	.000
ZTSESE (Efficacy for Student Engagement), γ_{11}	-.039	**.016**	-2.413	.016
ZSWHINVO (Involvement), γ_{20}	-.047	**.017**	-2.809	.006
ZSWHINVE (Investigation), γ_{30}	.012	**.017**	.660	.509
ZSWHTO (Task Orientation), γ_{40}	.114	**.014**	7.962	.000
ZSWHCOOP (Cooperation), γ_{50}	.178	**.015**	11.655	.000

E.2.5.1 Assumption of Normal Distribution of Level-1 Residuals – Mastery Avoidance Goals

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

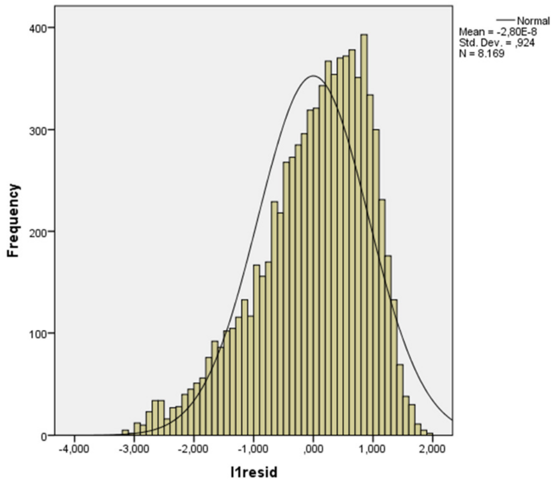


Figure E.70 Histogram of the level-1 residuals

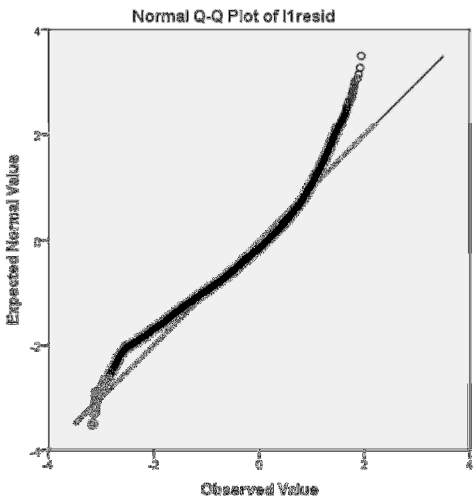


Figure E.71 Q-Q plot of the level-1 residuals

E.2.5.2 Homogeneity of Variance Assumption – Mastery Avoidance Goals

H statistic was found as 485.25064 with 371 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.72) indicated a few groups which have smaller dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

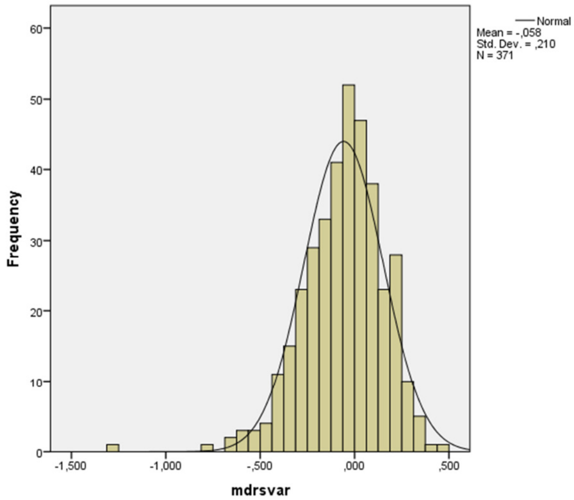


Figure E.72 Histogram of MDRSVAR

E.2.5.3 Multivariate Normality Assumption – Mastery Avoidance Goals

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

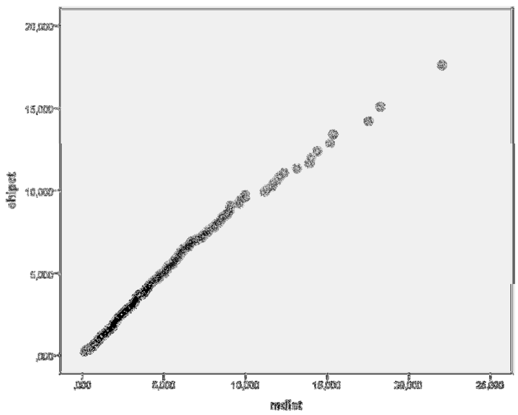


Figure E.73 Pilot of CHIPCT vs MDIST

E.2.5.4 Assumption of Linear Relationship between Level-2 Predictors and Mastery Avoidance Goals

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.74). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

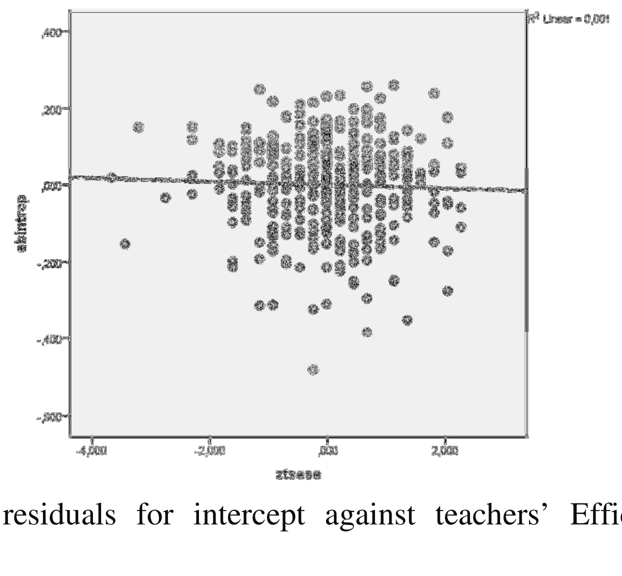


Figure E.74 EB residuals for intercept against teachers' Efficacy for Student Engagement

E.2.6 Assumption Tests for Performance Avoidance Goals

The differences between standard errors in Table E.25 and E.26 are not large, which yielded that there is no serious violation of the assumptions.

Table E.25 Final estimation of fixed effects for Performance Avoidance Goals as outcome variable

Fixed Effects	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSPAV, γ_{00}	-.000	**.019**	-.018	.986
S_FEMALE (Gender), γ_{10}	.013	**.023**	.562	.574
ZSWHSC, (Student Cohesiveness), γ_{20}	.043	**.014**	3.002	.003
ZSWHINVO (Involvement), γ_{30}	-.044	**.015**	-2.984	.003
ZSWHTO (Task Orientation), γ_{40}	.213	**.016**	13.538	.000
ZTSECM (Efficacy for Classroom Management), γ_{41}	-.026	**.013**	-2.011	.045
ZSWHCOOP (Cooperation), γ_{50}	.143	**.015**	9.726	.000
ZSWHEQU (Equity), γ_{60}	.062	**.016**	3.826	.000

Table E.26 Final estimation of fixed effects (with robust standard errors) for Performance Avoidance Goals as outcome variable

Fixed Effects	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSPAV, γ_{00}	-.000	**.018**	-.018	.986
S_FEMALE (Gender), γ_{10}	.013	**.023**	.562	.574
ZSWHSC, (Student Cohesiveness), γ_{20}	.043	**.014**	3.027	.003
ZSWHINVO (Involvement), γ_{30}	-.044	**.016**	-2.751	.006
ZSWHTO (Task Orientation), γ_{40}	.213	**.016**	13.676	.000
ZTSECM (Efficacy for Classroom Management), γ_{41}	-.026	**.013**	-1.938	.053
ZSWHCOOP (Cooperation), γ_{50}	.143	**.016**	8.859	.000
ZSWHEQU (Equity), γ_{60}	.062	**.016**	3.797	.000

E.2.6.1 Assumption of Normal Distribution of Level-1 Residuals – Performance Avoidance Goals

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

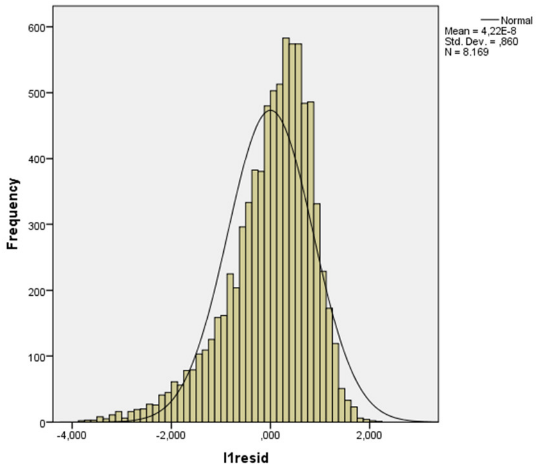


Figure E.75 Histogram of the level-1 residuals

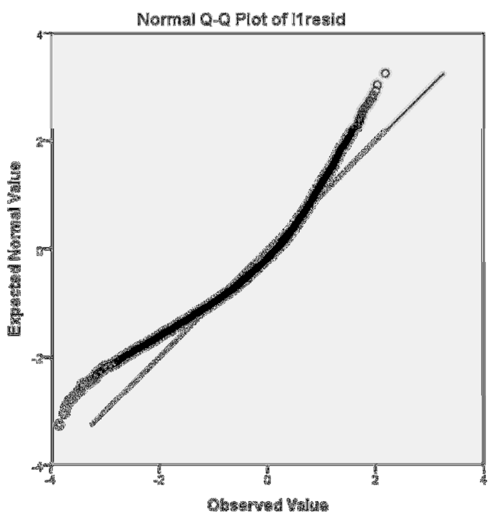


Figure E.76 Q-Q plot of the level-1 residuals

E.2.6.2 Homogeneity of Variance Assumption – Performance Avoidance Goals

H statistic was found as 652.13876 with 371 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.77) indicated a few groups which have smaller dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

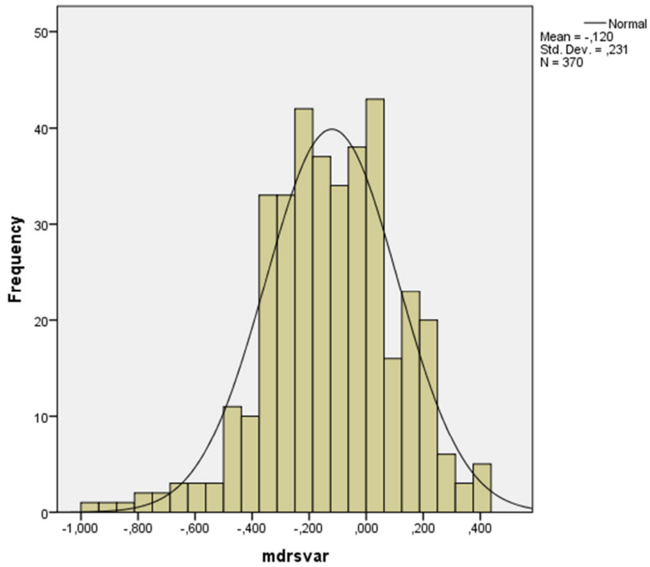


Figure E.77 Histogram of MDRSVAR

E.2.6.3 Multivariate Normality Assumption – Performance Avoidance Goals

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

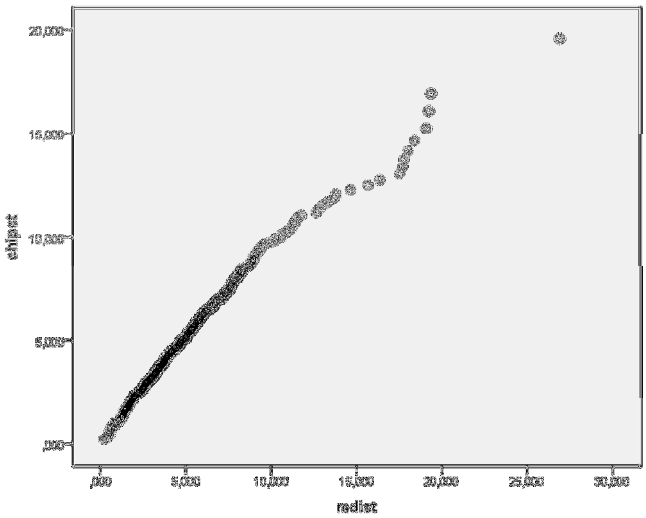


Figure E.78 Pilot of CHIPCT vs MDIST

E.2.6.4 Assumption of Linear Relationship between Level-2 Predictors and Performance Avoidance Goals

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.79). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

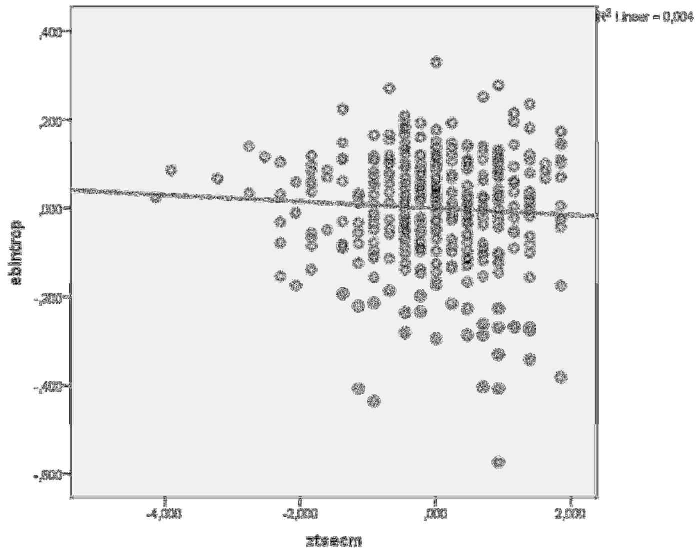


Figure E.79 EB residuals for intercept against teachers' Efficacy for Classroom Management

E.3 Assumption Tests for Predicting Science Achievement with Perceived Classroom Learning Environment (Model 1)

The difference between standard errors in Table E.27 and E.28 are not large, which yielded that there is no serious violation of the assumptions (Mass & Hox, 2004).

Table E.27 Final estimation of fixed effects for Science Achievement as outcome variable (Model 1)

Fixed Effects	*Coefficient* γ	SE	t-ratio	*p-value*
ZSAS (Science Achievement), Model for Class Means[1]				
Intercept, γ_{00}	-.049	**.031**	-1577	.115
ZT_EXPER (Experience), γ_{01}	.069*	**.027**	2.540	.012
ZTSESE (Self-Efficacy), γ_{02}	.095**	**.028**	3.430	.001
ZTITSA (Implicit Theory of Science Ability), γ_{03}	.064*	**.027**	2.353	.019
S_FEMALE (Gender), γ_{10}	.038	**.025**	1.526	.128
ZSWHSC (Student Cohesiveness), γ_{20}	.013	**.013**	.997	.320
ZSWHTS (Teacher Support), γ_{30}	-.011	**.015**	-.744	.458
ZSWHINVO (Involvement), γ_{40}	.135***	**.015**	9.183	.000
ZSWHINVE (Investigation), γ_{50}	-.031*	**.015**	-2.106	.036
ZSWHTO (Task Orientation), γ_{60}	.192***	**.013**	15.063	.000
ZSWHCOOP (Cooperation), γ_{70}	-.065***	**.014**	-4.839	.000
ZSWHEQU (Equity), γ_{80}	.032	**.018**	1.872	.061
T_FEMALE (Gender), γ_{81}	.060**	**.021**	2.853	.005

Table E.28 Final estimation of fixed effects (with robust standard errors) for Science Achievement (Model 1) as outcome variable

Fixed Effects	*Coefficient* γ	SE	t-ratio	*p-value*
ZSAS (Science Achievement), Model for Class Means[1]				
Intercept, γ_{00}	-.049	**.031**	-1589	.113
ZT_EXPER (Experience), γ_{01}	.069*	**.028**	2.404	.017
ZTSESE (Self-Efficacy), γ_{02}	.095**	**.029**	3.225	.002
ZTITSA (Implicit Theory of Science Ability), γ_{03}	.064*	**.029**	2.187	.029
S_FEMALE (Gender), γ_{10}	.038	**.025**	1.542	.124
ZSWHSC (Student Cohesiveness), γ_{20}	.013	**.014**	.957	.340
ZSWHTS (Teacher Support), γ_{30}	-.011	**.015**	-.737	.462
ZSWHINVO (Involvement), γ_{40}	.135***	**.015**	8.820	.000
ZSWHINVE (Investigation), γ_{50}	-.031*	**.015**	-2.095	.037
ZSWHTO (Task Orientation), γ_{60}	.192***	**.013**	14.736	.000
ZSWHCOOP (Cooperation), γ_{70}	-.065***	**.014**	-4.586	.000
ZSWHEQU (Equity), γ_{80}	.032	**.019**	1.737	.083
T_FEMALE (Gender), γ_{81}	.060**	**.021**	2.844	.005

E.3.1 **Assumption of Normal Distribution of Level-1 Residuals – Science Achievement (Model 1)**

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

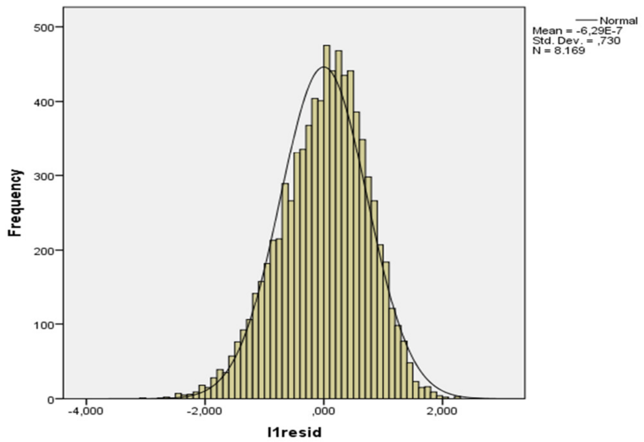


Figure E.80 Histogram of the level-1 residuals

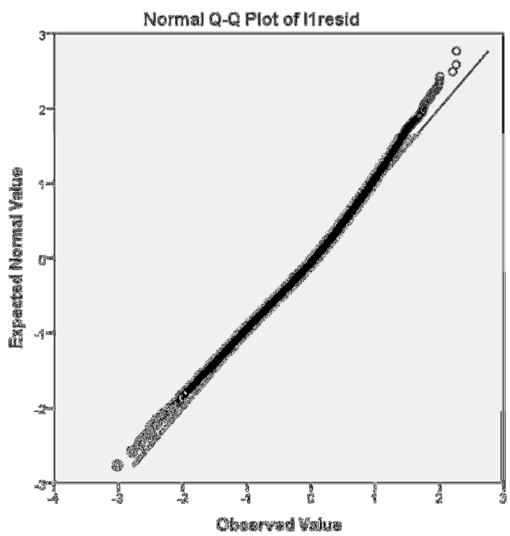


Figure E.81 Q-Q plot of the level-1 residuals

E.3.2 Homogeneity of Variance Assumption – Science Achievement (Model 1)

H statistic was found as 709.10994 with 370 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.82) indicated a few groups which have smaller dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

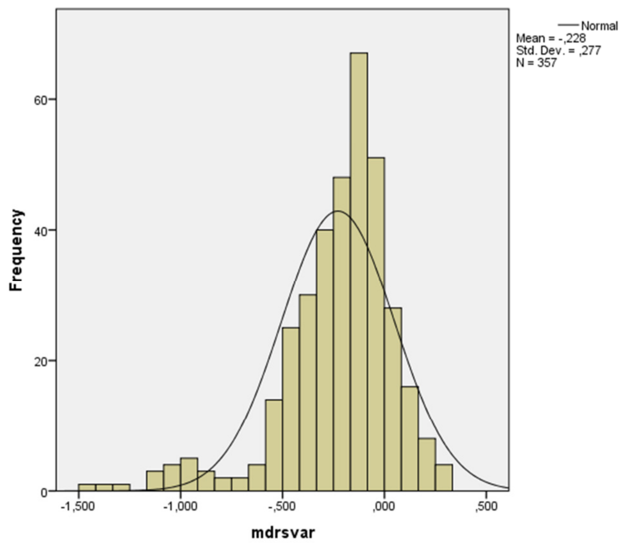


Figure E.82 Histogram of MDRSVAR

E.3.3 Multivariate Normality Assumption – Science Achievement (Model 1)

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

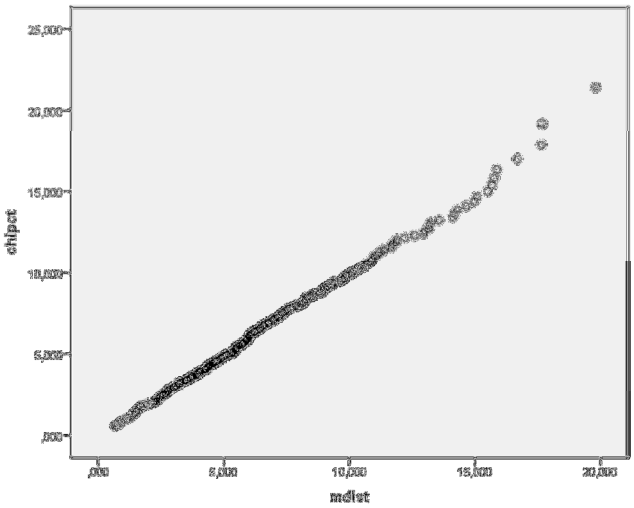


Figure E.83 Pilot of CHIPCT vs MDIST

E.3.4 Assumption of Linear Relationship between Level-2 Predictors and Science Achievement (Model 1)

Scatterplot of EB residuals for intercept and level-2 suggested that residuals are randomly distributed around zero line (see Figure E.84, E.85, and E.86). Therefore there was no serious violation for linear relationship between level-2 predictors and residual for the intercept.

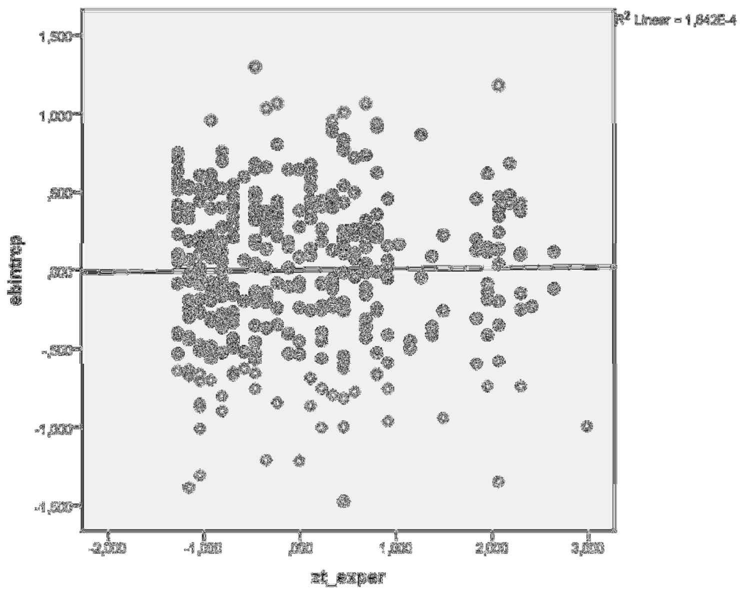


Figure E.84 EB residuals for intercept against teachers' Experience

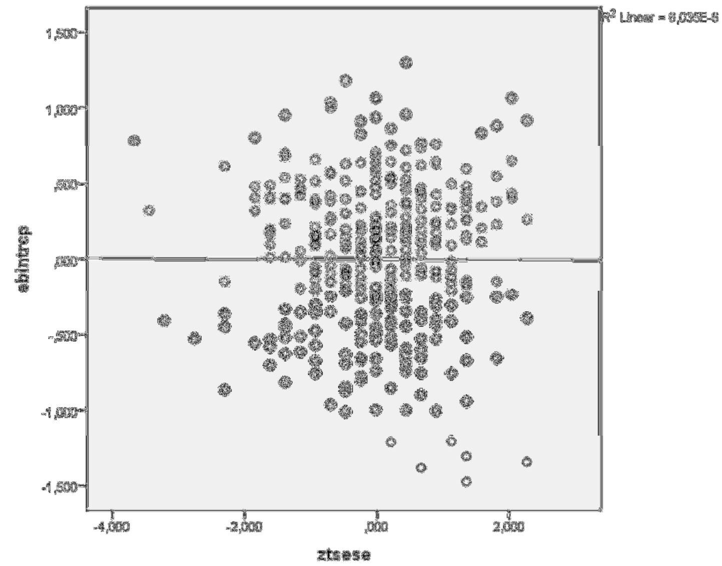


Figure E.85 EB residuals for intercept against teachers' Efficacy for Student Engagement

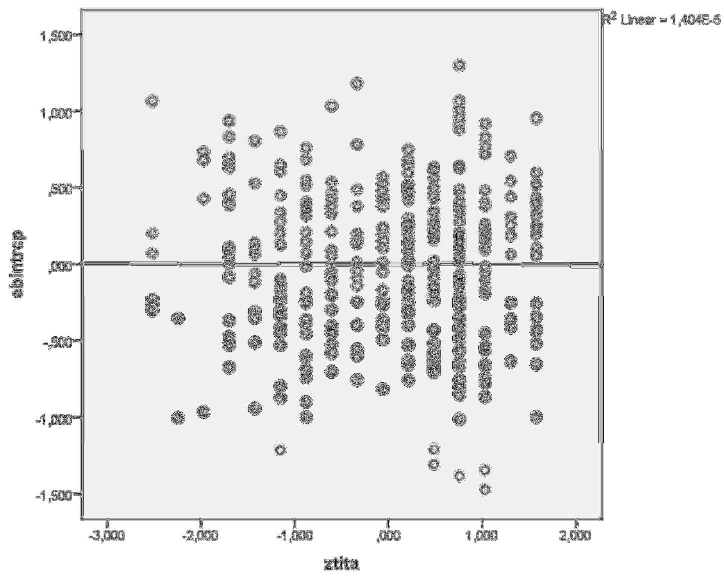


Figure E.86 EB residuals for intercept against teachers' Implicit Theories about Science Ability

E.4 Assumption Tests for Predicting Science Achievement with Perceived Classroom Learning Environment and Self-Regulation (Model 2)

Below, multilevel standard errors and robust standard errors are showed for Science Achievement variable as outcome. The difference between the standard errors of both Table E.29 and Table E.30 are not large, which yielded that there is no serious violation of the assumptions (Mass & Hox, 2004).

Table E.29 Final estimation of fixed effects for Science Achievement as outcome variable

Fixed Effects	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSAS γ_{00}	-.045	**.030**	-1.527	.128
S_FEMALE (Gender), γ_{10}	.036	**.023**	1.557	.120
ZSWHSC (Student Cohesiveness), γ_{20}	-.002	**.012**	-.159	.874
ZSWHTS (Teacher Support), γ_{30}	-.022	**.012**	-1.813	.069
ZSWHINVO (Involvement), γ_{40}	.076	**.014**	5.422	.000
ZSWHINVE (Investigation), γ_{50}	-.074	**.013**	-5.574	.000
ZSWHTO (Task Orientation), γ_{60}	.045	**.014**	3.319	.001
ZSWHCOOP (Cooperation), γ_{70}	-.016	**.013**	-1.257	.209
ZSWHEQU (Equity), γ_{80}	.017	**.013**	1.288	.199
ZSSE (Self-Efficacy), γ_{90}	.340	**.015**	22.836	.000
ZSMC (Metacognitive Self-Regulation), γ_{100}	-.009	**.013**	-.668	.504
ZSGOMAP (Mastery Approach Goals), γ_{110}	.085	**.014**	6.145	.000
ZSGOPAV (Performance Avoidance Goals), γ_{120}	-.063	**.012**	-5.418	.000
ZSGOPAP (Performance Approach goals) , γ_{130}	.020	**.012**	1.581	.114
ZSGOMAV (Mastery Avoidance Goals), γ_{140}	.005	**.010**	.436	.662

Table E.30 Final estimation of fixed effects (with robust standard errors) for Science Achievement as outcome variable

Fixed Effects	Coefficient	SE	t-ratio	*p-value*
Overall mean ZSAS γ_{00}	-.045	**.030**	-1.532	.126
S_FEMALE (Gender), γ_{10}	.036	**.023**	1.571	.117
ZSWHSC (Student Cohesiveness), γ_{20}	-.002	**.013**	-.150	.881
ZSWHTS (Teacher Support), γ_{30}	-.022	**.013**	-1.677	.093
ZSWHINVO (Involvement), γ_{40}	.076	**.015**	5.082	.000
ZSWHINVE (Investigation), γ_{50}	-.074	**.013**	-5.615	.000
ZSWHTO (Task Orientation), γ_{60}	.045	**.014**	3.300	.001
ZSWHCOOP (Cooperation), γ_{70}	-.016	**.014**	-1.171	.242
ZSWHEQU (Equity), γ_{80}	.017	**.013**	1.281	.201
ZSSE (Self-Efficacy), γ_{90}	.340	**.015**	22.184	.000
ZSMC (Metacognitive Self-Regulation), γ_{100}	-.009	**.015**	-.613	.540
ZSGOMAP (Mastery Approach Goals), γ_{110}	.085	**.014**	6.059	.000
ZSGOPAV (Performance Avoidance Goals), γ_{120}	-.063	**.012**	-5.402	.000
ZSGOPAP (Performance Approach goals) , γ_{130}	.020	**.012**	1.648	.100
ZSGOMAV (Mastery Avoidance Goals), γ_{140}	.005	**.010**	.452	.651

E.4.1 Assumption of Normal Distribution of Level-1 Errors - Science Achievement (Model 2)

Normality of level-1 residuals obtained from final model was checked by histogram and normal Q-Q plot. The both distribution seems approximately normal and indicated no serious deviation from normal distribution.

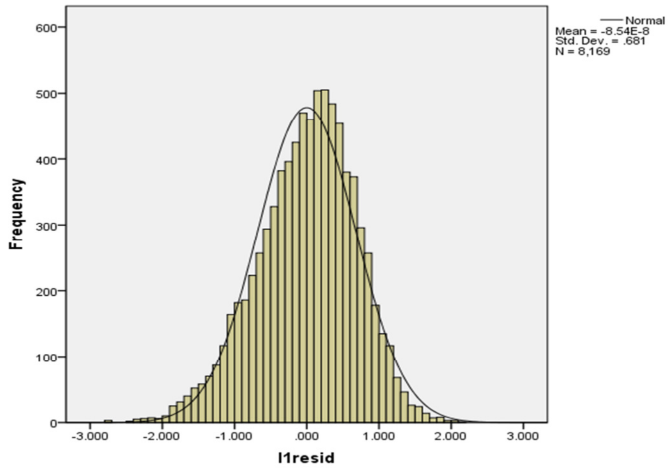


Figure E.87 Histogram of the level-1 residuals

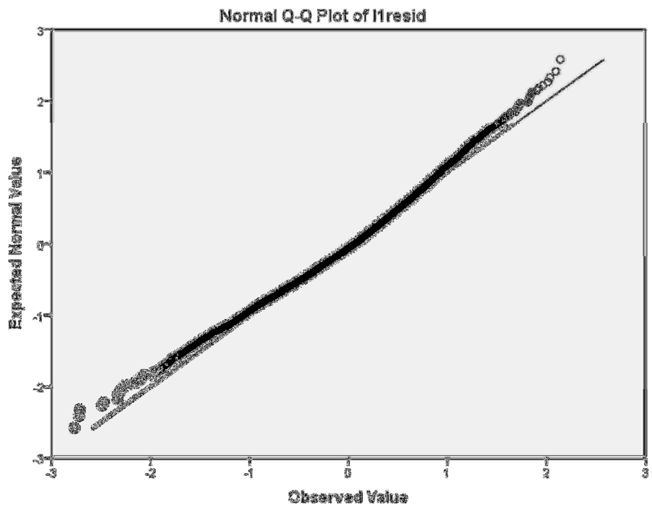


Figure E.88 Q-Q plot of the level-1 residuals

E.4.2 Homogeneity of Variance Assumption - Science Achievement (Model 2)

H statistic was found as 645.99842 with 369 degree of freedom, which was significant beyond the .001 level. The histogram of natural logarithm of the final model residual standard deviation (see Figure E.89) indicated a few groups which have smaller dispersions than expected. However, a violation of homogeneity of variance assumption is not serious problem for estimating level-2 coefficients and their standard errors (Raudenbush & Bryk, 2002, p.264).

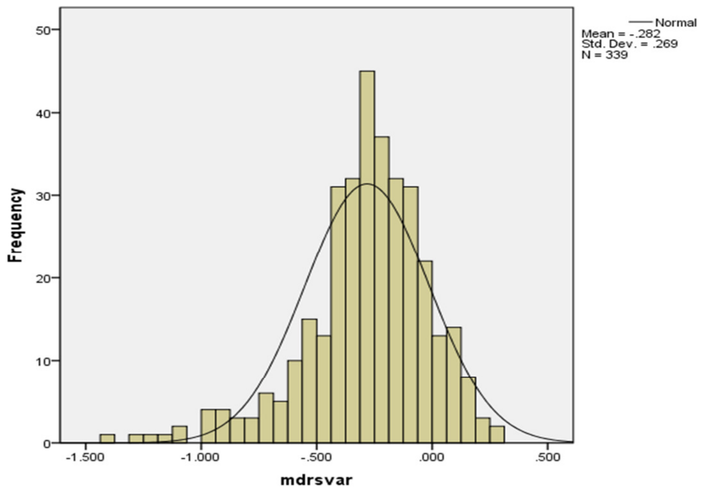


Figure E. 89 Histogram of MDRSVAR

E.4.3 Multivariate Normality Assumption - Science Achievement (Model 2)

Multivariate assumption of the final model was checked by the scatterplot of CHIPCT versus MDIST. Since the shape of the distribution was approximately 45 degree line, it indicated no serious violation of multivariate normality assumption.

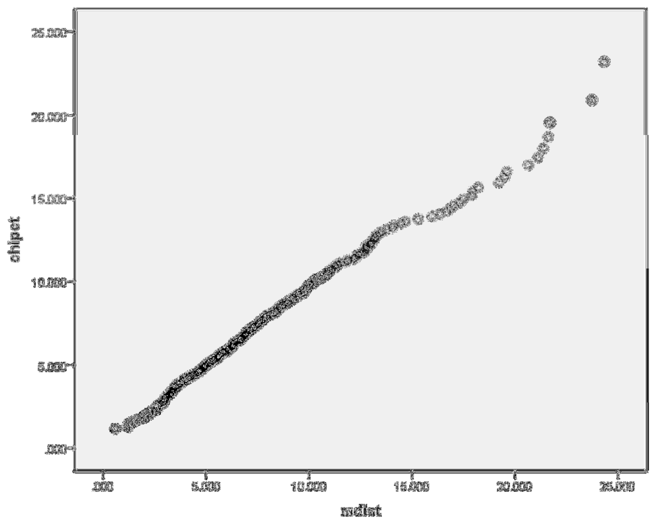


Figure E.90 Pilot of CHIPCT vs MDIST

E.4.4 Assumption of Linear Relationship between Level-2 Predictors and Science Achievement (Model 1)

Since no level-2 variable was included in the model-2, there was no need to check this assumption.

Appendix F

TURKISH SUMMARY

ÖĞRENCİLERİN BİLİŞSEL VE DUYUŞSAL ÖĞRENME ÇIKTILARI VE BUNLARIN SINIFTAKİ ÖĞRENME ORTAMI ALGISI VE ÖĞRETMEN VERİMLİLİĞİ İLE İLİŞKİSİNİN ÇOK DÜZEYLİ İNCELENMESİ

Giriş

Öğrenmenin nasıl gerçekleştiğini anlamak için birçok faktör göz önüne alınmalıdır. Öğrenme çok boyutlu bir süreçtir ve yalnızca kişisel özelliklere değil, sosyal ve fiziksel çevre, bireyin davranışları ve bu faktörlerin karşılıklı etkileşimine de bağlıdır (Bandura, 1986). Son zamanlarda birçok çalışma öğrencilerin öğrenmesini etkileyen faktörler üzerine odaklanmıştır. Bu çalışmalar yaklaşımlarına göre çeşitli şekillerde gruplanabilmesine rağmen, bunlar arasında üç temel araştırma alanı ön plana çıkmaktadır: (1) öğrencinin kişisel özelliklerini konu alan araştırmalar, (2) sınıftaki öğrenme ortamını konu alan araştırmalar ve (3) öğretmen verimliliğini konu alan araştırmalar. Bu üç araştırma alanına göre, öğrencilerin öğrenmesini etkileyen başlıca etkenler geçmiş deneyimler, inançlar ve öz-düzenleme becerileri gibi kişisel özellikler (Bandura, 1986; Pintrich, 2000; Zimmerman, 2000); öğretmen desteği sağlama, akran desteği sağlama ve görev odaklı olma gibi öğrenme ortamının nitelikleri (Fraser, 1990; Trickett ve Moss, 1973; Walberg ve Anderson, 1968; Walberg ve diğerleri, 1986); ve tükenmişlik belirtisi göstermeme, yüksek öz-yeterlik inancı ve iş tatmini gibi öğretmen verimliliğini ifade eden faktörlerdir (Kyriciou, 2001; Maslach ve Leither, 1999; Tschannen-Moran ve Woolfolk Hoy, 2001). Bu çalışmada, üç araştırma alanı birlikte ele alınarak öğrencilerin başarılarını etkileyen faktörlerin daha geniş çapta incelenmesi hedeflenmiştir.

Öz-düzenleme becerileri, öğrencilerin öğrenme sürecinin temelinde yatan önemli bir özelliktir. Öz-düzenleme becerileri gelişmiş olan öğrenciler, öğrenmeye yönelik hedeflediklerine ulaşmak için bireysel olarak biliş, duyuş ve davranışlarını aktive edebilen ve onları sürdürebilen kişilerdir (Zimmerman, 2000). Öğrenme sürecini öz-düzenleme becerilerinin akademik başarı üzerinde önemli bir etkisi bulunmaktadır (Ee, Moore, ve Atputhasamy, 2003; Pintrich, Simith, Garcia, ve McCeachie, 1993; Sungur ve Gungoren, 2009; Yerdelen, Sungur ve Klassen, 2012; Zimmerman ve Martinez-Pons 1986). Öz-düzenleme bilişsel ve Üst Bilişsel, duyuşsal, ve davranışsal süreçleri kapsamaktadır. Öz-düzenlemeye yönelik araştırmalarda duyuşsal süreçlerden Öz-Yeterlik be başarı hedefleri, bilişsel süreçlerden ise Üst Bilişsel öz-düzenleme öğrenmeyi etkileyen faktörler olarak sıklıkla çalışılmaktadır. Birçok araştırma öz-yeterliğin başarı üzerinde önemli bir etkisi olduğunu göstermiştir (Bandura, 1986; Bandura, Barbaranelli, Caprara ve Pastorelli, 1996; Britner ve Pajares, 2006; Greene, Miller, Crowson, Duke ve Akey, 2004; Klassen ve Kuzucu, 2009; Linnenbrink ve Pintrich, 2002; Schunk ve Pajares, 2005; Yildirim, 2012; Zhang ve Zhang, 2003). Diğer yandan Üst Bilişsel öz düzenlemenin başarı üzerindeki etkisi üzerine yapılan çalışmaların sonuçları tutarsızdır (Sperling, Howard, Miller ve Cherly, 2002). Diğer bir öz-düzenleme becerisi bileşeni olan başarı hedefleri ise 4 farklı şekilde öngörülmektedir: Öğrenme Yaklaşma Hedefleri, Öğrenme Kaçınma Hedefleri, Performans Yaklaşma Hedefleri ve Performans Kaçınma Hedefleri (Elliot ve McGregor, 2001; Pintrich, 2000). Öğrenme Yaklaşma Hedeflerine sahip öğrenciler öğrenmeye ve görevleri başarmaya odaklanırken, Öğrenme Kaçınma Hedeflerine sahip öğrenciler anlamamaktan, yanlış anlamaktan ve görevleri başaramamaktan kaçınmaya odaklanmaktadır. Ayrıca, Performans Yaklaşma Hedeflerine sahip öğrenciler kendi performanslarını diğer öğrencilerinkiyle kıyaslamayı, diğerlerinden daha iyi puanlar almayı ve onları geçmeyi amaçlarken, Performans Kaçınma Hedeflerine sahip öğrenciler başkalarından düşük not almaktan ve onlara yeteneksiz görünmekten kaçınmaktadır

(Pntrich, 2000). Önceki araştırmalar, başarı hedefleri ile akademik başarı arasında tutarsız sonuçlar bulsa da (Limenbrink-Garcia, Tyson ve Patall, 2008), bazı araştırmacılar öğrenme odaklı hedeflere sahip öğrencilerin performans odaklı hedeflere sahip öğrencilere kıyasla daha zorlayıcı görevleri tercih ettiğini, daha etkili öğrenme stratejileri kullandığını ve daha yüksek öz-yeterliğe sahip olduğunu belirtmişlerdir (Ames, 1992; Ames ve Archer, 1988; Pntrich, 2000; Wolters, 2004). Bu nedenle, akademik başarı ile öğrencilerin öz-yeterliği, Üst Bilişsel öz-düzenleme becerileri ve akademik hedef yönelimleri arasındaki ilişkilerin incelenmesi öğrencilerin etkili öğrenme süreçlerini anlamak için gereklidir.

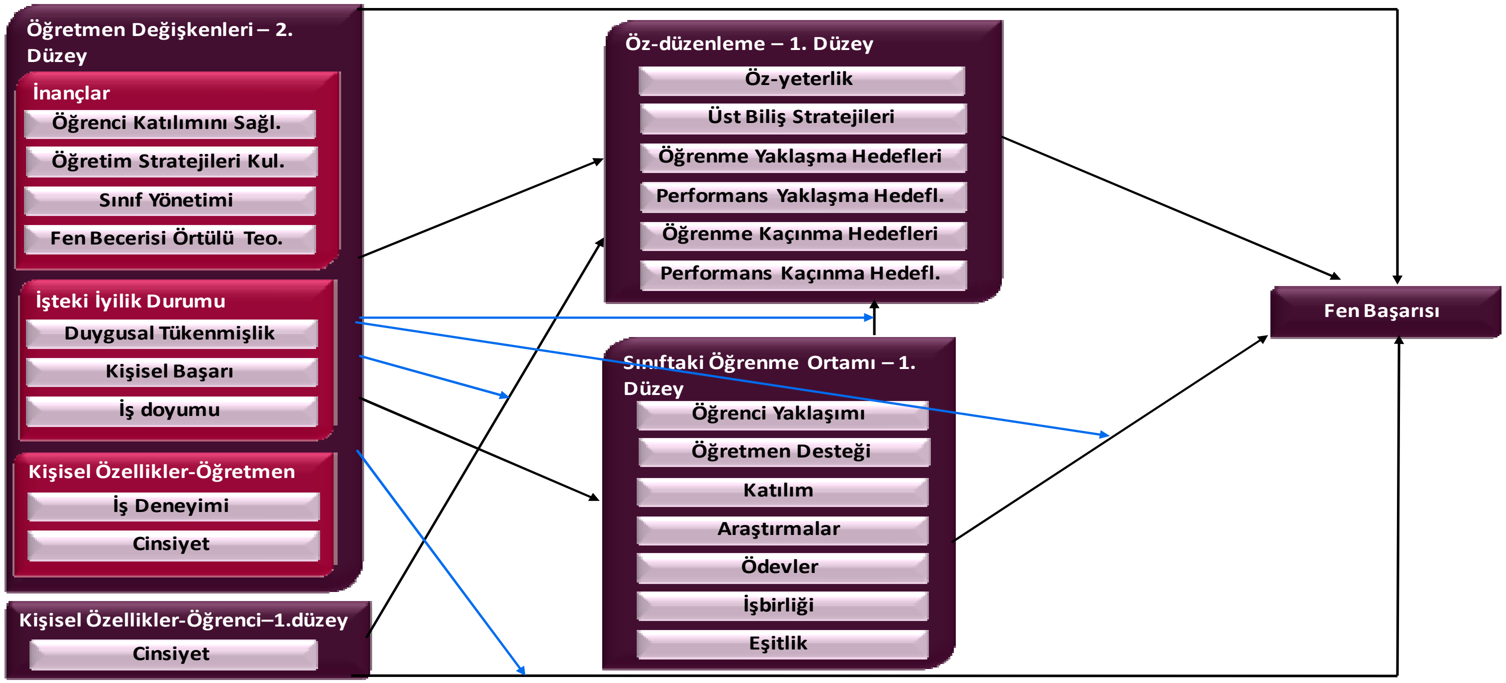
Sınıf ortamı, öğrencilerin öğrenme çıktılarını etkileyen en önemli faktörlerden biridir (Fraser ve Walberg, 1991; Walberg ve diğerleri, 1986). Araştırmacıların sınıf ortamının pisikososyal yönlerini incelemeye yönelik ilgileri, bazı ölçeklerin geliştirilmesiyle artış göstermiştir. Daha önceki ölçekler öğretmen merkezli sınıf ortamına yönelik hazırlanmışken, son zamanlarda geliştirilen ölçekler, öğretmen ve öğrenci algısına dayanan öğrenci merkezli sınıf ortamına odaklanmaktadır (Fraser, 2012). Bu ölçekler arasında Bu Sınıfta Neler Oluyor (BSNO; Fraser, McRobbie ve Fisher, 1996) ölçeği öğrencilerin ve öğretmenin sınıftaki pisikososyal ortamına yönelik algılarını ölçen ölçekler arasında en yaygın kullanılanlardan biridir. BSNO, daha önceki araştırmalarda öğrenme çıktıları ile ilişkili bulunan en önemli boyutları içermektedir. Ayrıca, eşitlik ve yapılandırmacılık gibi eğitim alanındaki son yaklaşımları ve yenilikleri dikkate alarak BSNO'ya yeni boyutlar da eklenmiştir (Fraser, 1998; Fraser et al. 1996). BSNO aynı zamanda fen öğrenimine yönelik en son bilişsel yaklaşımları da yansıtmaktadır (Kim, Fisher ve Fraser, 2000). BSNO ölçeğinde vurgulanan öğrenme ortamı boyutları, öğrenci merkezli eğitime dayanan Türkiye'deki ilköğretim fen eğiitimi öğretim programıyla da uyumlu olduğu için Türkiye'de fen sınıflarındaki öğrenme ortamının psikososyal boyutlarını incelemek için en uygun ölçek olarak düşünülebilir. BSNO ölçeği 7 alt boyut içermektedir: Öğrenci Yaklaşımı, Öğretmen Desteği, Katılım, Araştırmalar, Ödevler, İşbirliği ve Eşitlik (Waldrip, Fisher ve Dorman, 2009). Waldrip ve diğerleri öğrenme ortamını incelerken, öğretmen verimliliğini tanımlarken ve öğrenci çıktılarını araştırırken

BSNO ölçeğini kullanmanın faydalı olacağını önermişlerdir. Önceki araştırmalar (BSNO kullanılarak yapılan) göstermiştir ki sınıftaki öğrenme ortamı akademik başarının güçlü bir yordayıcısıdır. (den Brok, Telli, Cakiroglu, Taconis ve Tekkaya, 2010; Chionh ve Fraser, 1998; Snyder, 2005; Wolf ve Fraser, 2008). Ayrıca, öğrencilerin otonomi, karmaşık düşünme becerileri ve çeşitli stratejiler kullanmasının desteklendiği ve işbirliği içerisinde çalıştığı sınıflarda öğrencilerin öz-düzenleme becerilerinin gelişmesi beklenmektedir (bkz. Haertel, Walberg ve Haertel, 1981; Sungur ve Gungoren, 2009; Paris ve Paris, 2001; Ross, Salisbury-Glennon, Guarino, Reed ve Marshall, 2003). Fakat, fen eğitimi alanında sınıftaki öğrenme ortamının öz-düzenleme becerilerinin boyutlarıyla olan ilişkisi üzerine yapılmış ampirik çalışmalar oldukça azdır. Öyle ki, sınıftaki öğrenme ortamının Öz-Yeterlik (örn. Arisoy, 2007; Dorman, 2001; Dorman, Adams ve Ferguson, 2003; Dorman, Fisher ve Waldrip, 2006; Sungur ve Gungorem, 2009), başarı hedef yönelimi (örn. Arisoy, 2007; Allen ve Fraser, 2007; Church, Elliot ve Gabl, 2001; Gherasim, Butnaru ve Mairean, 2012; Sungur ve Gungoren, 2009) ve Üst Biliş (örn. Ozkal, Tekkaya, Cakiroglu ve Sungur, 2009; Schraw, Crippen ve Hartley, 2006; Yilmaz-Tuzun ve Topcu, 2010) ile ilişkisini inceleyen yalnızca birkaç çalışma bulunmaktadır. Ayrıca, bu çalışmaların hepsinde BSNO ölçeği kullanılmamıştır. Wolters, Pintrich ve Karabenick'e (2003) göre çoğu öz-düzenleme modeli kişisel ve ortama özgü özellikler ile gerçek başarı veya performans arasındaki ilişki bireylerin öz-düzenleme becerilerinden etkilendiğini varsaymaktadır. Bazı ampirik çalışmaların sonuçları sınıftaki öğrenme ortamı algısı ile başarı arasındki ilişkinin öğrencilerin öz-düzenleme becerilerinden etkilendiğini göstermiştir. (örn. Church ve diğerleri, 2001; Fast ve diğerleri, 2010; Patrick, Ryan ve Kaplan, 2007; Peters, 2013; Sungur ve Gungoren, 2009; Yildirim, 2012). Bu nedenle, sınıftaki öğrenme ortamının öğrencilerin bilişsel ve duyuşsal öğrenme çıktılarını olumlu etkileyen boyutlarını incelemek, öğretimin niteliğini artırmak ve eğitimin amaçlarına ulaşmak açısından oldukça önemlidir.

Öğretmen verimliliği üzerine yapılan araştırmalar, öğrencilerin öğrenme çıktılarını etkileme potansiyeli olan öğretmen özelliklerine odaklanmaktadır (örn. Bolyard ve

Moyer-Packenham, 2008; Patrick ve Smart, 1998). Öğretmen verimliliği konusunda yapılmış çalışmalar çoğunlukla öğretmenlerin kişisel özellikleri, öğrenme ortamındaki uygulama ve davranışlarına (Patrick ve Smart, 1998) ve işteki iyilik durumlarına (Klusmann et al. 2008; Kyriacou, 1987; Lee ve Ashforth, 1996; Maslach ve Jackson, 1881) odaklanmıştır. Fakat öğretmen inançları da öğrenci çıktılarını etkileme potansiyeli olan önemli bir faktördür (Deemer, 2004; Lee, 1996; Lynott ve Woolfolk, 1994; Tschannen-Moran, Woolfolk Hoy ve Hoy, 1998) ve öğretmen verimliliği araştırmalarına dâhil edilmelidir. Öğretmenlerin inançlarına istinaden, Tschannen-Moran ve Woolfolk Hoy'a (2001) göre, öğretmenlerin performansı, hedef yönelimi ve dirençliliği, Öz-Yeterlik inancından etkilenmektedir. Ayrıca, Öz-Yeterlik inancı öğretmenlerin sınıf içindeki davranışlarını da etkilemektedir (Ashton ve Webb, 1986). Birçok araştırmacının, öğretmenlerin Öz-Yeterlik inancı ve öğrenci çıktıları arasında pozitif ilişki öngörmesine rağmen (örn. Ashton ve Webb, 1986; Tschannen-Moran ve diğerleri, 1998) bu ilişkileri inceleyen ampirik çalışmalar oldukça azdır (bkz. Klassen, Tze, Betts, ve Gordon, 2011; Vasquez; 2008) ve bu çalışmalarda ya pozitif ilişki bulunmuş ya da anlamlı bir ilişki bulunamamıştır. Ayrıca, bazı çalışmalarda öğretmenlerin Öz-Yeterlik inançlarının sınıftaki öğrenme ortamı ile öğrencilerin akademik kazanımları arasındaki ilişkiyi etkilediği bulunmuştur (örn. Guo, McDonald Connor, Yang, Roehring ve Morrison, 2012; Guo, Piasta, Justice, ve Kaderavek, 2010; Woolfolk Hoy ve Davis, 2005). Diğer bir öğretmen inancı değişkeni ise öğretmenlerin örtülü zekâ teorileridir ve bu teoriler onların sınıftaki tutum ve davranışlarını etkiler (Deemer, 2004; Lee, 1996; Lynott ve Woolfolk, 1994; Shim, Cho ve Cassady, 2013). Dweck ve Leggett'e(1988) göre bireyler zekanın yanı sıra kişilik, yetenek, motivasyon ve ahlaka yönelik örtülü teorilere sahip olabilirler. Dweck, Chiu ve Hong, (1995) Varolan (entity) ve Artan (incremental) olmak üzere iki farklı örtülü teoriyi açıklayan bir model öne sürmüşlerdir. Bu modele göre, Varolan Teorisine inanan insanlar kişisel özelliklerin sabit olduğuna inanırlar ve performansa dayalı hedefler belirlerler. Diğer yandan, Artan Teorisine inanan insanlar kişisel özelliklerin biçimlendirilebilir olduğuna inanırlar ve öğrenmeye dayalı hedefler belirlerler (Hong, Chiu, Dweck, Lin ve Wan, 1999). Ayrıca, Varolan Teoriye inanan öğretmenler başarısızlık durumunu sarf edilen çabanın yetersizliği yerine, yetenek eksikliği olarak nitelendirirler. Oysa Artan Teoriye inanan öğretmenler genellikle öğrencilerin gösterdikleri çabaya odaklanırlar (bkz. Dweck, 1996; Dweck ve diğerleri, 1995; Dweck ve Leggett, 1988). Bu nedenle, artan teoriye inanan öğretmenlerin sınıfta daha nitelikli öğrenme ortamı yaratma ve öğrencilerin öğrenmelerine olumlu katkıda bulunma ihtimali daha yüksektir. Öğretmen verimliliğinin diğer bir boyutu olarak ele alınan işteki iyilik durumu öğretmenlerin düşük tükenmişlik ve yüksek İş Tatmini olarak tanımlanmaktadır (Kyriacou, 2001; Maslach ve Leiter, 1999). Öğretmenlerin derslerdeki performansları ve öğrencilerin öğrenme çıktıları öğretmenlerin tükenmişliklerinden olumsuz yönde etkilenirler (Klusmann ve diğerleri, 2008). Ayrıca, İş Tatmini yüksek öğretmenlerin olduğu okulların daha nitelikli eğitim vermesi ve öğrencilerin kazanımlarını artırması beklenmektedir (Demirtas, 2010). Geçmişteki araştırmalarda öğretmenlerin İş Tatmini ile işteki performansları (örn. Ololube, 2006) ve öğrenci başarısı (Klusman ve diğerleri, 2008; Michaelowa ve Wittmann, 2007) arasında pozitif ilişki bulunmuştur. Fakat öğretmenlerin tükenmişlik düzeyi ve İş Tatmini öğrencilerin sınıftaki öğrenme ortamı algısı ve öğrenme çıktıları üzerine etkisi hakkında çok az bilgi mevcuttur. Diğer yandan öğretmenin Cinsiyeti ve İş Deneyimi de öğrencilerin öğrenme sürecini ve sınıftaki öğrenme ortamını etkileyen önemli değişkenler olarak dünya çapında çeşitli alanlarda sıklıkla incelenmektedir. Fen eğitiminde yapılan araştırmalarda çoğunlukla öğrenci başarısının öğretmenin Cinsiyeti (örn. Ehrenberg, Goldhaber ve Brewer, 1995; Forslund ve Hull, 1988; Harp, 2010) ve İş Deneyimi (örn. Goldhaber ve Brewer, 2000; Harp, 2010; Monk, 1994; Zhang, 2008; Zuelke, 2008) ile ilişkisi istatistiksel olarak anlamlı bulunmamıştır. Fakat bayan öğretmenlerin sağladığı sınıftaki öğrenme ortamı genellikle daha olumlu algılanmaktadır (örn. den Brok, Fisher, Rickards ve Bull, 2006; Levy, den Brok, Wubbels ve Brekelmans, 2003). Ayrıca öğretmenin İş Deneyimi ile fen sınıflarındaki öğrenme ortamı arasındaki ilişki üzerine yapılan çalışmaların sonuçları tutarlı değildir (örn. Brekelmans, Wubbels ve den Brok, 2002; Flinn, 2004; Levy ve diğerleri, 2003). Ayrıca, öğretmenlerin Cinsiyeti ve iş deneyimleri öğrencilerin öz-düzenleme stratejileriyle nadir olarak çalışılmıştır. Bu nedenle, fen eğitimi alanında bu değişkenlerin öğrencilerin başarısı, öz-düzenleme becerileri ve sınıftaki öğrenme ortamı algıları üzerindeki etkisini araştırmaya ihtiyaç duyulmaktadır.

Bu çalışmanın amacı öğretmen düzeyindeki faktörlerin öğrenci düzeyindeki faktörleri nasıl etkilediği ve sonuçta Türkiye'deki 7. sınıf öğrencilerinin Fen Başarısını nasıl etkilediğini incelemektir. Öğrenci düzeyindeki değişkenler, öz-düzenleme becerilerini (Öz-Yeterlik, Üst Biliş Stratejileri, Öğrenme Yaklaşma Hedefleri, Öğrenme Kaçınma Hedefleri, Performans Yaklaşma Hedefleri ve Performans Kaçınma Hedefleri), sınıftaki öğrenme ortamı boyutlarını (Öğrenci Yaklaşımı, Öğretmen Desteği, Katılım, Araştırmalar, Ödevler, İşbirliği ve Eşitlik), Cinsiyeti ve Fen Başarısını içermektedir. Öğretmen düzeyindeki değişkenler ise inançları (Öğrenci Katılımını Sağlama Öz-Yeterliği, Öğretim Stratejileri Kullanma Öz-Yeterliği, Sınıf Yönetimi Öz-Yeterliği ve Örtülü Teorileri), işteki iyilik durumunu (Duygusal Tükenmişlik, Kişisel Başarı ve İş Tatmini), İş Deneyimini ve Cinsiyeti içermektedir. Dolayısıyla bu çalışma, 7. sınıf öğrencilerinin fen dersine yönelik öz-düzenleme becerileri, sınıftaki öğrenme oortamı algısı, fen başarısı ve fen öğretmenlerinin inançları ve işteki iyilik durumu arasındaki ilişkileri 2 düzeyde (öğrenci ve öğretmen düzeyi) araştırmayı amaçlamaktadır. Verilerin analizi için hiyerarşik lineer model (HLM) analizi kullanılarak birçok model test edilmiştir. Tasarlanan genel model Şekil 1'de gösterilmiştir.



Şekil 1 Fen Başarısı ile öğrenci düzeyindeki (1. düzey) ve öğretmen düzeyindeki (2. düzey) değişkenler arasındaki ilişkiler hakkında tasarlanan model.

Not. Oklar sebep-sonuç ilişkisini temsil etmemektedir. Okların yönü yordayıcı değişkenlerden yordanan değişkenlere doğrudur. Mavi oklar 1. düzey ve 2. düzey değişkenler arasındaki etkileşimi temsil etmektedir.

Bu çalışma öğrenci değişkenlerini konu alan araştırmaları, öğrenme ortamı araştırmalarını ve öğretmen verimliliği çalışmalarını birlikte ele alarak, ilköğretim öğrencilerinin fen başarılarını etkileyen faktörleri bulmak için çok geniş kapsamlı bir yaklaşşım sergilemektedir. Daha önce tek bir çalışma içerisinde bütün bu değişkenlerin birlikte incelendiği ve analizlere katıldığı bir çalışmaya rastlanmamıştır.

Bu çalışma spesifik olarak fen dersine yöneliktir. Çünkü PISA (PISA 2003, PISA 2006, PISA 2009) ve TIMSS (TIMMS 1999, TIMSS 2007) gibi birçok uluslararası sınav Türkiye'deki Öğrencilerin fen testlerindeki başarısının, diğer ülkelerin ortalamasının çok altında olduğunu göstermektedir. Yani Türkiye'deki öğrencilerin fen dersindeki başarısı birçok ülkeninkinden çok daha düşüktür. Fen Başarısı artırmak amacıyla 2005 yılında ilköğretim fen öğretim programı yeniden düzenlenmiştir. Yeni programla, daha önce öğretmen merkezli olan fen eğitiminden, öğrencilerin öğrenmede aktif rol aldıkları öğrenci merkezli eğitime geçiş olmuştur. Dolayısıyla yeni program, öz-düzenleme becerilerini de kapsayan birçok stratejiyi ön plana çıkarmıştır. Wolters ve Pintrich'e (1998) gore öz-düzenleme stratejilerinin kullanım düzeyleri alanlara gore farklılık göstermektedir. Bu nedenle, fen dersinde, öğrencilerin öz-düzenleme becerileri, başarısı ve öğretmen değişkenleri arasındaki ilişkilerin matematik ve dil gibi derslerdekinden farklı olabileceği düşünülmektedir. Dolayısıyla, öğrencilerin öz-düzenleme stratejilerini kullanmalarına yardımcı olacak faktörlerin ve bu stratejilerin kullanımının öğrencilerin fen dersindeki başarısını artırmadaki rolünün araştırılmasının Türkiye'deki öğrencilerin fen konularını nasıl öğrendiklerinin anlaşılmasına katkı sağlayacağı beklenmektedir.

Bu çalışmanın digger bir önemi ise Türkiye'deki fen dersine yönelik sınıftaki öğrenme ortamı üzerine yapılan sınırlı çalışmaları daha da genişletmek, daha ayrıntılı bilgi sağlamayı amaçlamasıdır. Ayrıca, Türkiye'de öğretmen inançları ve işteki iyilik durumunun öğrencilerin sınıftaki öğrenme ortamı algısına etkisi üzerine yapılmış çalışmaya henüz rastlanmamıştır. Ayrıca öğrencilerden elde edilen verilerin aynı sınıf içerisinde birbirinden etkilendiğini de göz önüne alarak, daha doğru sonuçlar elde etmek için çok düzeyli analiz yapılması uygun görülmüştür. Çok düzeyli analiz aynı zamanda araştırmacıya farklı düzeylerdeki değişkenler arasındaki etkileşimleri de bulma şansı tanır. Oysaki geçmişteki birçok çalışmada, gözlemlerin bağımsızlığı varsayımı göz arrdı edilerek yanlı sonuçlara ulaşılmıştır. Dolayısıyla bu çalışmada çok daha kapsamlı bir yaklaşımla ve daha güçlü analiz yöntemleriyle, Türkiye'deki fen eğitinininin niteliğini artırmak hedeflenmektedir.

Bu çalışmanın 4 temel araştırma sorusu vardır:

1. Öğretmen düzeyindeki değişkenler (Öğrenci Katılımını Sağlama Öz-Yeterliği, Öğretim Stratejileri Kullanma Öz-Yeterliği, Sınıf Yönetimi Öz-Yeterliği, Fen Yeteneğine Yönelik İnançlar, Duygusal Tükenmişlik, Kişisel Başarı, İş Tatmini, İş Deneyimini ve Cinsiyet), öğrencilerin sınıftaki öğrenme ortamı (Öğrenci Yaklaşımı, Öğretmen Desteği, Katılım, Araştırmalar, Ödevler, İşbirliği ve Eşitlik) algısını ne derece yordamaktadır?

2. Öğrencilerin Cinsiyeti ve sınıftaki öğrenme oortamı (Öğrenci Yaklaşımı, Öğretmen Desteği, Katılım, Araştırmalar, Ödevler, İşbirliği ve Eşitlik) algısı ve öğretmen düzeyindeki değişkenler (Öğrenci Katılımını Sağlama Öz-Yeterliği, Öğretim Stratejileri Kullanma Öz-Yeterliği, Sınıf Yönetimi Öz-Yeterliği, Fen Yeteneğine Yönelik İnançlar, Duygusal Tükenmişlik, Kişisel Başarı, İş Tatmini, İş Deneyimini ve Cinsiyet), öğrencilerin öz-düzenleme becerilerini (Öz-Yeterlik, Üst Biliş stratejileri, Öğrenme Yaklaşma Hedefleri, Öğrenme Kaçınma Hedefleri, Performans Yaklaşma Hedefleri ve Performans Kaçınma Hedefleri) ne derece yordamaktadır?

3. Öğrencilerin Cinsiyeti ve sınıftaki öğrenme oortamı (Öğrenci Yaklaşımı, Öğretmen Desteği, Katılım, Araştırmalar, Ödevler, İşbirliği ve Eşitlik) algısı ve öğretmen düzeyindeki değişkenler (Öğrenci Katılımını Sağlama Öz-Yeterliği, Öğretim Stratejileri Kullanma Öz-Yeterliği, Sınıf Yönetimi Öz-Yeterliği, Fen

Yeteneğine Yönelik İnançlar, Duygusal Tükenmişlik, Kişisel Başarı, İş Tatmini, İş Deneyimini ve Cinsiyet), öğrencilerin Fen Başarısını ne derece yordamaktadır?

4. Öğrencilerin öz-düzenleme becerileri (Öz-Yeterlik, Üst Biliş stratejileri, Öğrenme Yaklaşma Hedefleri, Öğrenme Kaçınma Hedefleri, Performans Yaklaşma Hedefleri ve Performans Kaçınma Hedefleri), Fen Başarısı ile sınıftaki öğrenme ortamı (Öğrenci Yaklaşımı, Öğretmen Desteği, Katılım, Araştırmalar, Ödevler, İşbirliği ve Eşitlik) algısı ve Cinsiyet arasındaki ilişkide aracı rol oynuyor mu?

Yöntem

Bu çalışma Türkiye sınırlarında ve tarama modeli kullanılarak gerçekleştirilecektir. Türkiye'deki il ve ilçe merkezlerinde bulunan ilköğretim okullarında öğrenim gören 7. sınıf öğrencilerine ve Fen ve Teknoloji öğretmenlerine çeşitli anketler ve testler uygulanıp belirli değişkenler arasındaki ilişkiler çok düzeyli analiz yöntemi (HLM) kullanılarak incelenmiştir.

Evren ve Örneklem

Bu çalışmanın evrenini Türkiye'deki il ve ilçe merkezlerinde bulunan devlet okullarındaki 7. Sınıf öğrencileri ve onların fen öğretmenleri oluşturmaktadır. Toplam 10137 ilköğretim okulundan 400 tanesi SPSS programı kullanılarak seçkisiz olarak belirlenmiştir. Örneklem seçilirken, Türkiye İstatistik Kurumu'nun (TÜİK) 2005 yılına ait İstatistikî Bölge Birimleri Sınıflandırmasına dikkate alınmıştır. Bu sınıflamaya göre Türkiye, sosyoekonomik, kültürel ve coğrafik durumlara göre 12 bölgeden oluşmaktadır. Toplamda 81 ilden 72'si örnekleme dâhil edilmiştir. Evren büyüklüğünün örneklem büyüklüğüne oranı her bölge için yaklaşık olarak %4 civarındadır. Veri toplama araçları Eğitimi Araştırma ve Geliştirme Dairesi Başkanlığı (EARGED) tarafından okullara bir uygulama yönergesi ile birlikte gönderilmiştir. Her okuldan yalnız bir adet 7. Sınıf (ve bu sınıfın dersine giren fen öğretmeni) idare tarafından rastgele seçilmiştir. Sonuç olarak geri dönüş oranı yaklaşık %94 olmuştur ve 400 okuldan 376'ünden veri elde edilmiştir. Bunlar arasından 372 fen öğretmeni ve onların 8189 öğrencisine ait veri HLM analizlerine dâhil edilmeye uygun bulunmuştur.

Veri toplama araçları

Veri toplama araçları öğretmen ve öğrenciler için ayrı ayrı 2 form şeklinde düzenlenmiştir.

Öğretmen Veri Toplama Aracı

Öğretmenler için düzenlenen veri toplama aracı 2 bölümden oluşmaktadır: (a) Demogrfik bilgiler bölümü ve (b) öz-değerlendirme blümü. Bu bölümlerde bulunan ölçeklerin alt boyutları, güvenirlik katsayıları ve doğrulayıcı faktör analizi sonuçları Tablo 1'de gösterilmiştir. Veri toplama aracındaki bütün alt ölçeklerin geçerlik katsayısı yeterince yüksek bulunmuştur ve beklenen faktör yapıları doğrulanmıştır.

Tablo 1 Öğretmenlere uygulanan veri toplama araçları

Veri Toplama Aracı	Değişkenler	Cronbach's Alpha	Doğrulayıcı Faktör Analizi Uyum Katsayıları
Demografik Bilgi Ölçeği	Cinsiyet Yaş Mezun Olduğu Fakülte Mezun Olduğu Bölüm Mezuniyet Derecesi İş Deneyimi Hftalık Ders Saati Sınıflardaki Öğrenci Sayısı Medeni Durum Çocuk Sayısı		
Öğretmenler için Öz-Yeterlik Ölçeği (Tschannen-moran ve Hoy, 2001)	Öğrenci Katılımını Sağlama Öğretim stratejilerini Kullanma Sınıf Yönetimi	.76 .80 .83	($\chi^2_{(51)}$ = 160.91, p < .05; CFI = .98, GFI = .93, NFI = .96, NNFI = .97; SRMR = .05; RMSEA = .08; 90% CI = .07, .09)
Fen Yeteneğine İlişkin İnançlar (IT IS'den uyarlanmıştır (Dweck ve Henderson, 1988)	Varolan Teori	.84	($\chi^2_{(0)}$ = 0, p > .05).
Maslach Tükenmişlik Envanteri (Maslach ve Jackson, 1981)	Duygusal Tükenmişlik Kişisel Başarı	.87 .77	($\chi^2_{(118)}$ = 278.57, p < .05; CFI = .97, GFI = .92, NFI = .94, NNFI = .96; SRMR = .07; RMSEA = .06; 90% CI = .05, .07)
İş Tatmini Ölçeği (Skaalvik ve Skaalvik, 2009)	İş Tatmini	.87	($\chi^2_{(0)}$ = 0, p > .05).

Öğrenci Veri Toplama Aracı

Öğrenciler için düzenlenen veri toplama aracı 3 bölümden oluşmaktadır: (a) demogrfik bilgiler bölümü ve (b) öz-değerlendirme blümü ve (3) Fen Başarı Testi. Bu bölümlerde bulunan ölçeklerin alt boyutları, güvenirlik katsayıları ve doğrulayıcı faktör analizi sonuçları Tablo 2'de gösterilmiştir. Veri toplama aracındaki bütün alt ölçeklerin geçerlik katsayısı yeterince yüksek bulunmuştur ve beklenen faktör yapıları doğrulanmıştır.

Tablo 2 Öğrencilere uygulanan veri toplama araçları

Veri Toplama Aracı	Değişkenler	Cronbach's Alpha	Doğrulayıcı Faktör Analizi Uyum Katsayıları
Demografik Bilgi Ölçeği	Cinsiyet Yaş Önceki Yarıyıl Not Ortalaması Sosyoekonomik Durum		
Öğrenmede Güdüsel Stratejiler Ölçeği (MSLQ; Pintrich, Simith, Garcia, ve Mckeachie, 1991)	Öz-Yeterlik	.93	($\chi^2_{(20)}$ = 1311.98, $p < .05$; CFI = .99, GFI = .96, NFI = .99, NNFI = .98; SRMR = .03; RMSEA = .09; 90% CI = .087, .095)
	Üst Biliş Stratejileri	.89	($\chi^2_{(35)}$ = 593.13, $p < .05$; CFI = .99, GFI = .98, NFI = .99, NNFI = .99; SRMR = .02; RMSEA = .05; 90% CI = .042, .048)
WIHIC (Fraser, Fisher ve Mcrobbie, 1996)	Öğrenci Yaklaşımı Öğretmen Desteği Katılım Araştırmalar Ödevler İşbirliği Eşitlik	.78 .88 .86 .88 .81 .84 .88	($\chi^2_{(1463)}$ = 20259.31, $p < .05$; CFI = .98, GFI = .90, NFI = .98, NNFI = .98; SRMR = .04; RMSEA = .05; 90% CI = .045, .045)
AGQ (Elliot ve Mcgregor, 2001)	Öğrenme Yaklaşma Performans Yaklaşma Öğrenme Kaçınma Performans Kaçınma	.76 .73 .73 .77	($\chi^2_{(84)}$ = 9848.47, $p < .05$; CFI = .95, GFI = .94, NFI = .95, NNFI = .94; SRMR = .07; RMSEA = .08; 90% CI = .075, .079)
Fen Başarı Testi	14 Fen Sorusu	KR20=.78	

Çalışmanın Sayıltıları

Bu çalışmanın sayıtlıları:

1. Katılımcılar anketlerdeki maddeleri ciddiyetle cevaplandırmıştır.
2. Anketler standart koşullarda uygulanmıştır
3. Uygulama esnasında katılımcı öğrencilerin birbirleriyle ve öğretmenle etkileşimi olmamıştır.
4. Örneklem evreni temsil etmektedir.

Bulgular ve Tartışma

Bu çalışmada öğretmen ve öğrencilerden elde edilen veriler bir çeşit regresyon analizi olan Hiyerarşik Lineer Modelleme (HLM) yöntemi kullanılarak analiz edilmiştir. HLM analizi çok düzeyli örneklemlerden elde edilen verilerde değişkenler arasındaki ilişkileri hesaplamak için kullanılan güçlü bir yöntemdir. Çok düzeyli (multilevel) örnekleme sınıflar içerisinde gruplanmış öğrenciler veya okullar içinde gruplanmış sınıflar gibi örnekler verilebilir. Bu çalışmada da öğrenciler sınıflar içerisinde gruplandığı için HLM analizini kullanmak uygun görülmüştür. Böylece aynı sınıftaki öğrencilerin sorulara verdiği yanıtlar arasındaki benzerlik göz ardı edilmemiş ve daha doğru sonuçlar elde edilmiş olacaktır. HLM analizi ayrıca öğrenci ve sınıf düzeyindeki değişkenlerin ilişkilerini inceleme ve hatta bunlar arasındaki etkileşimleri inceleme şansıda tanımaktadır. Bu çalılşmada öğrenci değişkenleri 1. düzey değişkenlerini, öğretmen değişkenleri ise 2. düzey (sınıf düzeyi) değişkenlerini oluşturmaktadır.

Bu çalışmanın 4 temel araştırma sorusu vardır ve sonuçlar sırasıyla bu sorulara odaklanarak aşağıda tartışılmıştır. Araştırmanın 4 ana araştırma sorusunu ve onların alt sorularını test etmek amacıyla birçok HLM analizi yapılmıştır. Regresyon katsayılarının yorumlanmasını kolaylaştırmak ve değişkenlerin yordayıcılık güçlerinin karşılaştırılabilmesi için bütün sürekli değişkenler analizlerden önce ortalaması 0 ve standart sapması 1 olacak şekilde standartlaştırılmıştır.

Araştırma sorusu 1: Sınıftaki Öğrenme Ortamı Algılarını Yordama

İlk araştırma sorusu öncelikle sınıftaki öğrenme ortamı algılarına göre sınıfların farklılık gösterip göstermediğine odaklanmıştır. Daha sonra her bir sınıftaki öğrenme ortamı boyutu değişkeni bağımlı değişken olarak atanarak bütün öğretmen değişkenleriyle yordanmaya çalışılmıştır.

HLM analizlerinin sonuçları Tablo 3 ve Tablo 4’te gösterilmiştir. Elde edilen sonuçlara göre sınıflar arasında sınıftaki öğrenme ortamının bütün boyutları açısından anlamlı farklılıklar bulunmuştur. Bu da öğretmen değişkenlerinin bu sınıf farklılıklarının varyansını açıklamakta rolü olabileceğini belirtmektedir. Dolayısıyla, sonraki analizlere her bir bağımlı değişkeni yordamak için bütün öğretmen değişkenleri analizlere katılmıştır ve bu analizlerin sonuçları ayrı ayrı incelenmiştir. Öğrenci Yaklaşımını yordayan modele göre deneyimli öğretmenlerin ve öğrenci katılımı konusunda Öz-Yeterlik inancı yüksek olan öğretmenlerin, öğrenciler arasında daha arkadaşçıl ve samimi bir ortaam sağladıkları düşünülmektedir. Öğretmen Desteğini yordayan modelde ise Öğretmen Desteğinin öğretmen değişkenlerinden en çok etkilenen boyut olduğu görülmüştür. Bu modele göre öğrenciler bayan öğretmenleri, İş Tatmini yüksek, öğrenci katılımını sağlama konusundaki Öz-Yeterlik inancı yüksek ve yüksek Duygusal Tükenmişlik yaşayan öğretmenleri daha fazla destek sağlayan ve öğrencilerin problemlerini önemseyen öğretmenler olarak algılanmışlardır. Diğer yandan, deneyimli öğretmenler daha az destek sağlayan öğretmenler olarak algılandıkları bulunmuştur. Öğrencilerin algıladıkları sınıftaki öğrenme otamının Katılım, İşbirliği ve Eşitlik boyutları yalnızca öğretmenin öğrencilerin katılımını sağlamaya yönelik Öz-Yeterlik inancıyla anlamlı olarak yordanmaktadır. Yani, bütün öğrencilerin derse katılımını sağlamak konusunda kendine güvenen öğretmenlerin sınıfında öğrenciler sınıf tartışmalarına katılmaya, dersten zevk almaya, derse ilgi göstermeye, fikirlerini paylaşmaya, grup çalışmalarında rol almaya, diğer öğrencilerle iş birliği yapmaya ve öğrenme materyallerini diğerleriyle paylaşmaya daha yatkındır. Ayrıca bu öğretmenler öğrencilerine eşit muamele göstermeye daha eğilimlidir. Araştırma ve Ödevler boyutlarına ait modellerin sonuçları Öğrenci Katılımını Sağlama Öz-Yeterliği yüksek ve Sınıf Yönetimi Öz-Yeterliği düşük öğretmenlerin sınıfındaki öğrenciler araştırma ve sorgulama becerilerini geliştirme ve bu becerileri problem çözmede kullanma konusunda daha iyidirler ve verilen görevlerin tamamlanmasına daha çok önem verirler.

Sonuçlar genel olarak, ele alındığında öğretmenlerin öğrenci katılımına yönelik Öz-Yeterlik inançları sınıftaki öğrenme ortamının bütün boyutları ile ilişkili ve bütün boyutların en iyi yordayıcısı olarak bulunmuştur.

Tablo 3 Sınıftaki öğrenme ortamı boyutları için final modellerden elde edilen sabit etkiler

Sabit Etkiler	Öğrenci Yakla.		Öğretmen De.		Katılım		Araştırmalar		Ödevler		İşbirliği		Eşitlik	
	γ	SH	γ	SH	γ	SH	γ	SH	γ	SH	γ	SH	γ	SH
Sınıf Ortalamaları için Model														
Kesme noktası	.009	.017	-.038	.029	.009	.017	.012	.018	.008	.017	.013	.018	.011	.018
T_FEMALE (Cinsiyet)			.088*	.041										
ZT_EXPER (İş Deneyimi)	.042*	.017	-.056**	.020										
ZTSESE (Öğrenci Katılımı Öz-Yeterliği)	.047**	.017	.065**	.021	.065***	.017	.108***	.023	.093***	.021	.064**	.018	.069***	.018
ZTSEIS (Öğretim Stratejileri Öz-Yeterl.)														
ZTSECM (Sınıf Yönetimi Öz-Yeterl.)							-.055*	.023	-.055*	.022				
ZTJS (İş Tatmini)			.093**	.028										
ZTBUEE (Duygusal Tükenmişlik)			.060*	.028										
ZBUPA (Kişisel Başarı)														
ZTITSA (Fen Yeteneğine İlişkin Örtülü Teoriler)														

Not. Sadece final modeldeki yordayıcılar tabloya dâhil ediğilmiştir. Katsayısı olmayan yordayıcılar, bağımlı değişkenle anlamlı ilişki bulunmadığı için ilgili modelden çıkarılan değişkenlerdir. SH: Standart Hata.

*p< .05, **p<.01, ***p<.001

Tablo 4 Sınıftaki öğrenme ortamı boyutları için final modellerden elde edilen varyans bileşenleri

Random Etki	Varyans bileşeni	df	χ^2	R^2
ZSWHSC (Öğrenci Yaklaşımı)				
Sınıf ortalaması, u_{0j}	.064	369	936.94***	.059
1. düzey etkisi, r_{ij}	.920			
ZSWHTS (Öğretmen Desteği)				
Sınıf ortalaması, u_{0j}	.103	366	1333.38***	.135
1. düzey etkisi, r_{ij}	.867			
ZSWHINVO (Katılım)				
Sınıf ortalaması, u_{0j}	.059	370	894.31***	.078
1. düzey etkisi, r_{ij}	.924			
ZSWHINVE (Araştırmalar)				
Sınıf ortalaması, u_{0j}	.074	369	1027.64***	.086
1. düzey etkisi, r_{ij}	.908			
ZSWHTO (Ödevler)				
Sınıf ortalaması, u_{0j}	.058	369	890.21***	.079
1. düzey etkisi, r_{ij}	.914			
ZSWHCOOP (İşbirliiği)				
Sınıf ortalaması, u_{0j}	.082	370	1110.27***	.038
1. düzey etkisi, r_{ij}	.891			
ZSWHEQU (Eşitlik)				
Sınıf ortalaması, u_{0j}	.076	370	1056.73***	.050
1. düzey etkisi, r_{ij}	.897			

*** p <.001

Araştırma Sorusu 2: Öğrencilerin Fen Dersindeki Öz-Düzenleme Becerilerini Yordama

İkinci araştırma sorusu ve alt soruları sınıflar arasında öğrencilerin öz-düzenleme becerilerinin bileşenleri açısından farklılık olup olmadığı, varsa bu farklılıkların öğretmen ve öğrenci değişkenleriyle ne derece açıklanabildiği ve öz-düzenleme becerilerini yordarken öğrenci ve öğretmen değişkenleri arasında etkileşim olup olmadığını incelemeye odaklanmıştır. Bu çalışmaya konu edilen öz-düzenleme becerileri Öz-Yeterlik, Üst Biliş stratejileri, Öğrenme Yaklaşma Hedefleri, Performans Yaklaşma Hedefleri, Öğrenme Kaçınma Hedefleri ve Performans Kaçınma Hedeflerini içermektedir. Araştırma sorularını test etmek amacıyla her bir öz-düzenleme becerisi bileşeni ayrı ayrı bağımlı değişken olarak atanarak, öğrenci ve öğretmen değişkenleri ile ilişkileri birçok modelde HLM analizi kullanılarak incelenmiştir. Bu modelllerin sonuçları öncelikle göstermiştir ki bütün öz-düzenleme bileşenleri için sınıflar arasında anlamlı farklılıklar vardır ve bu farklılıklar sınıf veya öğretmen değişkenleri ile yordanabilir. Her bir öz-düzenleme bileşenine ilişkin final modellerden elde edilen sonuçlar aşağıda ayrı ayrı tartışılmaktadır.

Fen dersine yönelik Öz-Yeterlik için kurulan final modelin sonuçlarına göre (bkz. Tablo 5 ve Tablo 6), sınıftaki öğrenme ortamı boyutlarının çoğu (Öğrenci Yaklaşımı, Katılım, Araştırmalar, Ödevler, İşbirliği ve Eşitlik) Öz-Yeterlik algısının anlamlı yordayıcıları olarak bulunmuştur. Yani, 7. sınıf öğrencilerinin fen dersini öğrenmeye yönelik Öz-Yeterlik algıları öğrencilerin arkadaşça geçindiği, sınıf tartışmalarına katıldığı, merak ettikleri soruların cevaplarını bulmak için araştırmalar yaptığı, dersin amaçlarını bilmeye ve verilen görevleri tamamlamaya önem verdiği ve fen öğretmeni tarafından eşit fırsatlar tanındığı sınıflarda daha yüksek olma eğilimindedir. Sınıftaki İşbirliği algısı yüksek olan öğrencilerin ise Öz-Yeterlik algısı düşük bulunmuştur. Öğretmen değişkenlerinden ise Duygusal Tükenmişlik ile Kişisel Başarı, öğrencilerin Öz-Yeterlik algısı ile pozitif ilişkikli bulunmuştur. Diğer yandan, öğrencilerin Öz-Yeterliği ile verilen görevleri tamamlamaya verdikleri önem arasındaki ilişki deneyimli öğretmenlerin sınıfında daha az fakat Kişisel Başarı algısı yüksek öğretmenlerin sınıfında daha yüksektir. Öğretim stratejilerini kullanma konusunda kendine güvenen öğretmanlerin, sınıflarda öğrencilerin Öz-Yeterliği ile Eşitlikçi öğrenme ortamı algısı arasındaki ilişki diğer öğretmenlerin sınıflarındakine göre daha düşüktür.

Tablo 5 Fen dersine yönelik Öz-Yeterlik algısı için final modelden elde edilen sabit etkiler

Sabit Etkiler	Katsayı	SH
ZSSE (Öz-Yeterlik), Sınıf ortalamaları için model		
Kesme noktası, γ_{00}	-.007	.014
ZTBUEE (Dugusal Tükenmişlik), γ_{01}	.032*	.014
ZTBUPA (Kişisel Başarı), γ_{02}	.047**	.015
ZSWHSC (Öğrenci Yaklaşımı), γ_{10}	.028*	.011
ZSWHTS (Öğretmen Desteği), γ_{20}	.021	.014
ZSWHINVO (Involvement), γ_{30}	.169***	.014
ZSWHINVE (Katılım), γ_{40}	.142***	015
ZSWHTO (Ödevler), γ_{50}	.348***	.013
ZT_EXPER (İş deneyimi), γ_{51}	-.029**	.010
ZTBUPA (Kişisel Başarı), γ_{52}	.026*	.011
ZSWHCOOP (İşbirliği), γ_{60}	-.116***	.013
ZSWHEQU (Eşitlik), γ_{70}	.119***	.014
ZTSEIS (Öğretme Stratejileri Öz-Yeterliği), γ_{71}	-.021*	.010

Not: Sadece final modeldeki yordayıcılar tabloya dâhil edilmiştir. SH: Standart Hata.

*p< .05, **p<.01, ***p<.001

Tablo 6 Fen dersine yönelik Öz-Yeterlik algısı için final modelden elde edilen varyans bileşenleri

Random Etkiler	Varyans Bileşeni	df	χ^2	R^2	Güvenirlik
ZSSE (Öz-Yeterlik)					
Sınıf Ortalaması, u_{0j}	.047	369	885.19***	.041	.532
ZSWHTS (Öğretmen Desteği), u_{2j}	.019	371	516.97***		.231
ZSWHINVE (Araştırmalar), u_{4j}	.019	371	514.53***		.230
ZSWHTO (Ödevler), u_{5j}	.007	369	439.77**	.125	.117
ZSWHEQU (Eşitlik), u_{7j}	.010	370	468.42**	.091	.141
1. düzey etkisi, r_{ij}	.533			.401	

Not: Sadece final modeldeki yordayıcılar tabloya dâhil edilmiştir

*p< .05, **p<.01, ***p<.001

Fen dersinde kullanılan Üst Biliş stratejileri için kurulan final modelin sonuçlarına göre (bkz. Tablo 7 ve Tablo 8), Cinsiyet ve sınıftaki öğrenme ortamının bütün boyutlarının Üst Biliş Stratejilerini anlamlı olarak yordadığı bulunmuştur. Diğer bir değişle, öğrencilerin samimi ilişkiler kurduğu, sınıf tartışmalarına katıldığı, fikirlerini paylaştığı, araştırmalar yaptığı, problem çözme becerileri kazandığı, görevleri önemsediği ve fen öğretmeni tarafından eşit davranıldığı ve desteklendiği sınıflarda, öğrenciler daha çok Üst Biliş stratejisi kullanma eğilimi göstermektedir. İşbirliğinin yüksek olduğu sınıflarda ise öğrenciler daha az üst biliş stratejisi kullandıklarını belirtmişlerdir. Ayrıca, kız öğrencilerin erkek öğrencilere göre daha çok Üst Biliş stratejisi kullandıkları bulunmuştur. Öğretmen değişkenleri de dikkate elındığında, daha deneyimli öğretmenlerin ve Kişisel Başarı algısı düşük olan öğretmenlerin sınıfındaki öğrencilerin fen derslerinde Üst Biliş stratejilerini daha az kullandığı görülmüştür. Ayrıca öğretmenlerin Öğretim Stratejileri Kullanma Öz-Yeterliğinin artması Cinsiyet ile Üst Biliş arasındaki ilişkinin ve Araştırmalar ile Üst Biliş arasındaki ilişkinin büyüklüğünü azaltmaktadır.

Table 7 Fen dersinde Üst Biliş stratejilerinin kullanımı için final modelden elde edilen sabit etkiler

Sabit Etkiler	Katsayı	SH
ZSMC (Üst Biliş Stratejileri), Sınıf ortalamaları için model		
Kesme noktası, γ_{00}	-.092***	.016
ZT_EXPER (İş Deneyimi), γ_{01}	-.034**	.013
ZTBUPA (Kişisel Başarı), γ_{02}	.039**	.013
S_FEMALE (Cinsiyet), γ_{10}	.166***	.019
ZTSEIS (Öğretim Stratejileri Öz-Yeterliği), γ_{11}	-.030*	.015
ZSWHSC (Öğrenci Yaklaşımı), γ_{20}	.043***	.011
ZSWHTS (Öğretmen Desteği), γ_{30}	.031**	.012
ZSWHINVO (Katılım), γ_{40}	.059***	.014
ZSWHINVE (Araştırmalar), γ_{50}	.290***	.014
ZTSEIS (Öğretim Stratejileri Öz-Yeterliği), γ_{51}	-.025*	.010
ZSWHTO (Ödevler), γ_{60}	.324***	.013
ZSWHCOOP (İşbirliği), γ_{70}	-.059***	.012
ZSWHEQU (Eşitlik), γ_{80}	.073***	.013

Not: Sadece final modeldeki yordayıcılar tabloya dâhil edilmiştir. SH: Standart Hata. *p< .05, **p<.01, ***p<.001

Table 8 Fen dersnde Üst Biliş stratejilerinin kullanımı için final modelden elde edilen varyans bileşenleri

Random Etkiler	Veryans Bileşenleri	df	χ^2	R^2	Güvenirlik
ZSMC (Üst Biliş Stratejileri)					
Sınıf ortalaması, u_{0j}	.038	369	593.96***	.073	.339
S_FEMALE (Cinsiyet), u_{1j}	.031	370	485.36***	.061	.197
ZSWHINVE (Araştırmalar), u_{5j}	.015	370	482.60***	.063	.220
ZSWHTO (Ödevler), u_{6j}	.008	371	421.40*		.119
ZSWHEQU (Eşitlik), u_{8j}	.010	371	448.27**		.159
1. düzey etkisi, r_{ij}	.512			.441	

Not: Sadece final modeldeki yordayıcılar tabloya dâhil edilmiştir

*p< .05, **p<.01, ***p<.001

Fen dersindeki Öğrenme Yaklaşma Hedeflerini yordayan modelin sonuçlarına göre (bkz. Tablo 9 ve Tablo 10), öğrencilerin arkadaşçıl ilişkiler kurduğu, sınıftaki görevlerin tamamlanmasına önem verildiği, fen öğretmeni tarafından eşit davranıldığı ve işbirliğinin az olduğu sınıflarda öğrenciler daha çok Öğrenme Yaklaşma Hedeflerine sahip olma eğilimindedirler. Ayrıca, kız öğrenciler erkek öğrencilere gore daha çok Öğrenme Yaklaşma hedefine sahiptir. Fakat Cinsiyet ile Öğrenme Yaklaşma Hedefleri arasındaki ilişkinin büyüklüğünün öğretmenin deneyimi arttıkça düştüğü bulunmuştur.

Tablo 9 Fen dersinde Öğrenme Yaklaşma Hedefleri için final modelden elde edilen sabit etkiler

Sabit Etkiler	Katsayı	SH
ZSGOMAP (Öğrenme Yaklaşma Hedefleri), Sınıf ortalamaları için model		
Kesme noktası, γ_{00}	-.062***	.015
S_FEMALE (Cinsiyet), γ_{10}	.124***	.018
ZT_EXPER (İş Deneyimi), γ_{11}	-.024*	.012
ZSWHSC (Öğrenci Yaklaşma), γ_{20}	.047***	.011
ZSWHTS (Öğretmen Desteği), γ_{30}	.008	.013
ZSWHINVO (Katılım), γ_{40}	.010	.014
ZSWHTO (Ödevler), γ_{50}	.497***	.014
ZSWHCOOP (İşbirliği), γ_{60}	-.028*	.012
ZSWHEQU (Eşitlik), γ_{70}	.153***	.014

Not: Sadece final modeldeki yordayıcılar tabloya dâhil edilmiştir. SH: Standart Hata.
*p< .05, **p<.01, ***p<.001

Tablo 10 Fen dersinde Öğrenme Yaklaşma Hedefleri için final modelden elde edilen varyans bileşenleri

Random Etkiler	Varyans bileşenleri	df	χ^2	R^2	Güvenirlik
ZSGOMAP (Öğrenme Yaklaşma Hedefleri)					
Sınıf ortalaması, u_{0j}	.026	371	538.68***		.260
S_FEMALE (Cinsiyet), u_{1j}	.021	370	439.79**	.033	.140
ZSWHTS, (Öğretmen Desteği), u_{3j}	.016	371	455.03**		.198
ZSWHINVO (Katılımt), u_{4j}	.013	371	448.79**		.157
ZSWHTO (Ödevler), u_{5j}	.027	371	584.96***		.305
ZSWHEQU (Eşitlik), u_{7j}	.020	371	509.30***		.229
1. düzey etkisi, r_{ij}	.484			.461	

Not: Sadece final modeldeki yordayıcılar tabloya dâhil edilmiştir.
*p< .05, **p<.01, ***p<.001

Fen dersindeki Performans Yaklaşma Hedeflerini yordamak için kurulan modelin sonuçlarına göre (bkz. Tablo 11 ve Tablo 12), sınıftaki öğrenme ortamını arkadaşçıl bulan, verilen görevleri tamamlamaya önem veren ve dersin amaçlarını bilen ve öğretmen tarafından eşit fırsatlar tanınan öğrenciler daha çok Performans Yaklaşma Hedefine sahip olma eğilimindedirler. Yani bu öğrenciler, sınıfta en iyi notu alma, diğerlerinden daha iyi performans sergileme ve başkalarından övgüler duymak gibi performansa dayalı hedeflere odaklandıklarını ifade etmişlerdir. Bu modele göre öğretmen değişkenleri olarak, Öğrenci Katılımını Sağlama Öz-Yeterliği ve İş Tatmini değişkenleri, Ödevler ile Performans Yaklaşma Hedefleri arasındaki ilişkide düzenleyici değişken olarak rol alırken, Öğretim Stratejilerini Kullanma Öz-Yeterliği ve Kişisel Başarı algısı da Eşitlik ile Performans Yaklaşma Hedefleri arasındaki ilişkide düzenleyici değişken olarak rol almaktadır.

Tablo 11 Fen dersinde Performans Yaklaşma Hedefleri için final modelden elde edilen sabit etkiler

Sabit Etkiler	Katsayı	SH
ZSGOPAP (Performans Yaklaşma Hedefleri), Sınıf ortalamaları için model		
Kesme noktası, γ_{00}	-.042*	.017
S_FEMALE (Cinsiyet), γ_{10}	.086***	.020
ZSWHSC (Öğrenci Yaklaşımı), γ_{20}	.033**	.012
ZSWHINVO (Katılımt), γ_{30}	.020	.015
ZSWHTO (Ödevler), γ_{40}	.370***	.014
ZTSESE (Öğrenci Katılımını Sağlama Öz-Yeterliği), γ_{41}	-.044**	.013
ZTJS (İş Tatmini), γ_{42}	.033**	.013
ZSWHEQU (Eşitlik), γ_{50}	.066***	.015
ZTSEIS (Öğretim Stratejilerini Kullanma Öz-Yeterliği), γ_{51}	.037**	.014
ZBUPA (Kişisel Başarı), γ_{52}	-.028*	.014

Not: Sadece final modeldeki yordayıcılar tabloya dâhil edilmiştir. SH: Standart Hata. *p< .05, **p<.01, ***p<.001

Tablo 12 Fen dersinde Performans Yaklaşma Hedefleri için final modelden elde edilen varyans bileşenleri

Random Etkiler	Varyans Bileşenleri	df	χ^2	R^2	Güvenirlik
ZSGOPAP (Performans Yaklaşma Hedefleri)					
Sınıf Ortalaması, u_{0j}	.021	371	628.13***		.316
ZSWHINVO (Katılım), u_{3j}	.013	371	451.14**		.153
ZSWHTO (Ödevler), u_{4j}	.013	369	452.78**	.133	.149
ZSWHEQU (Eşitlik), u_{5j}	.012	369	478.29***	.077	.131
1. düzey etkisi, r_{ij}	.714			.233	

Not: Sadece final modeldeki yordayıcılar tabloya dâhil edilmiştir.

*p< .05, **p<.01, ***p<.001

Fen dersindeki Öğrenme Kaçınma Hedeflerini yordayan modelin sonuçlarına göre (bkz. Tablo 13 ve Tablo 14), kız öğrenciler erkek öğrencilere göre daha çok Performans Kaçınma Hedeflerine sahiptir. Ayrıca, öğrenme ortamını daha fazla işbirlikçi, daha çok görev odaklı ve daha az katılımcı olarak algılayan öğrenciler dersi gerektiği gibi öğrenememekten veya yanlış öğreneceklerinden daha çok endişelenmektedirler. Ayrıca öğrenci katılımını sağlamaya yönelik Öz-Yeterlik algısı yüksek olan fen öğretmenlerinin sınıfında, öğrenememekten kaçınmaya odaklı hedefler açısından kız ve erkek öğrenciler arasındaki farklar daha azdır.

Tablo 13 Fen dersinde Öğrenme Kaçınma Hedefleri için final modelden elde edilen sabit etkiler

Sabit Etkiler	Katsayı	SH
ZSGOMAV (Öğrenme Kaçınma Hedefleri), Sınıf ortalamaları için model		
Kesme noktası, γ_{00}	-.065***	.019
S_FEMALE (Cinsiyet), γ_{10}	.117***	.023
ZTSESE (Öğrenci Katılımını Sağlama Öz-Yeterliği), γ_{11}	-.039*	.017
ZSWHINVO (Katılım), γ_{20}	-.047**	.017
ZSWHINVE Araştırmalar), γ_{30}	.012	.017
ZSWHTO (Ödevler), γ_{40}	.114***	.014
ZSWHCOOP (İşbirliği), γ_{50}	.178***	.015

Not: Sadece final modeldeki yordayıcılar tabloya dâhil edilmiştir. SH: Standart Hata. *p< .05, **p<.01, ***p<.001

Tablo 14 Fen dersinde Öğrenme Kaçınma Hedefleri için final modelden elde edilen varyans bileşenleri

Random Etkiler	Varyans Bileşenleri	df	χ^2	R^2	Güvenirlik
ZSGOMAV (Öğrenme Kaçınma Hedefleri)					
Class mean, u_{0j}	.035	371	480.76***		.236
S_FEMALE (Cinsiyet), u_{1j}	.023	370	426.70*	.042	.105
ZSWHINVO (Katılım), u_{2j}	.013	371	423.38*		.122
ZSWHINVE (Araştırmalar), u_{3j}	.015	371	429.06*		.133
1. düzey etkisi, r_{ij}	.884			.079	

Not: Sadece final modeldeki yordayıcılar tabloya dâhil edilmiştir

*p< .05, **p<.01, ***p<.001

Fen dersindeki Performans Kaçınma Hedeflerini yordayan modelin sonuçlarına göre (bkz. Tablo 15 ve Tablo 16), kız öğrenciler erkek öğrencilere göre daha çok Öğrenme Kaçınma Hedeflerine sahiptir. Ayrıca, öğrenme ortamını daha fazla işbirlikçi, görev odaklı, eşitlikçi ve arkadaşçıl veya daha az katılımcı olarak algılayan öğrenciler fen dersinde sınıftaki diğer öğrencilerden daha kötü not alacaklarından veya başarısız görüneceklerinden endişelenmektedirler. Ayrıca sınıf yönetimini sağlamak konusunda kendine daha çok güvenen fen öğretmenlerinin sınıfında öğrencilerin verilen görevleri tamamlamaya verdikleri önem ile Performans Kaçınma Hedefleri arasındaki ilişki daha zayıf bulunmuştur.

Tablo 15 Fen dersinde Performans Kaçınma Hedefleri için final modelden elde edilen sabit etkiler

Sabit Etkiler	Katsayı	SH
ZSGOPAV (Performans Kaçınma Hedefleri), Sınıf ortalamaları için model		
Kesme noktası, γ_{00}	-.000	.019
S_FEMALE (Cinsiyet), γ_{10}	.013	.023
ZSWHSC, (Öğrenci Yaklaşımı), γ_{20}	.043**	.014
ZSWHINVO (Katılım), γ_{30}	-.044**	.015
ZSWHTO (Ödevler), γ_{40}	.213***	.016
ZTSECM (Sınıf Yönetimi Öz-Yeterliği), γ_{41}	-.026*	.013
ZSWHCOOP (İşbirliği), γ_{50}	.143***	.015
ZSWHEQU (Eşitlik), γ_{60}	.062***	.016

Not. Sadece final modeldeki yordayıcılar tabloya dâhil edilmiştir. SH: Standart Hata.

*p< .05, **p<.01, ***p<.001

Tablo 16 Fen dersinde Performans Kaçınma Hedefleri için final modelden elde edilen varyans bileşenleri

Random Etkiler	Varyans bileşenleri	df	χ^2	R^2	Güvenirlik
ZSGOPAV (Performans Kaçınma Hedefleri)					
Sınıf ortalaması, u_{0j}	.039	371	502.19***		.259
S_FEMALE (Cinsiyet), u_{1j}	.039	371	434.63*		.167
ZSWHSC (Öğrenci Yaklaşımı), u_{2j}	.009	371	423.53*		.116
ZSWHTO (Ödevler), u_{4j}	.020	370	453.37**	.025	.184
ZSWHEQU (Eşitlik), u_{6j}	.021	371	439.64**		.197
1. düzey etkisi, r_{ij}	.783			.165	

Not. Sadece final modeldeki yordayıcılar tabloya dâhil edilmiştir.

*p< .05, **p<.01, ***p<.001

Araştırma Sorusu 3: Öğrencilerin Fen Başarısını Sınıftaki Öğrenme Ortamı Algılarıyla Yordama

Üçüncü araştırma sorusu öğrencilerin Fen Başarısı sınıf ortalamaları arasında fakr olup olmadığı, varsa bu farklılıkları açıklayan öğretmen değişkenlerini, Fen Başarısını açıklayan öğrenci değişkenlerini (Cinsiyet ve sınıftaki öğrenme ortamı algısı boyutları) ve Fen Başarısını yordarken öğretmen değişkenleri ile sınıftaki öğrenme ortamı boyutları arasında etkileşim olup olmadığını araştırmaya yöneliktir. 7. Sınıf öğrencilerinin Fen Başarısını etkileyen faktörleri bulmak için Fen Başarısı bağımlı değişken olarak modelde tanımlanmıştır. HLM analizlerinin sonuçları göstermiştir ki sınıfların Fen Başarısı ortalamaları arasında anlamlı farklılıklar vardır ve sınıf veya öğretmen değişkenleri bu farklılıkları açıklamak için araştırılabilir. Sonraki modelde ise Cinsiyet ve sınıftaki öğrenme ortamı boyutları bağımsız değişkenler olarak modele dâhil edilmiştir. Analiz sonuçlarına göre (bkz. Tablo 17 ve Tablo 18) Katılım, Araştırmalar, Ödevler ve İşbirliği, Fen Başarısını anlamlı olarak yordayan değişkenler olarak bulunmuştur. Bu değişkenler arasında İşbirliği ve Araştırmalar beklenenin aksine Fen Başarısı ile negatif ilişkili çıkmıştır. Bunun nedenlerinden biri bu değişkenlerin modelde baskılayıcı değişken olarak rol alması olabilir. Bu ilişkilerin esasen nasıl olduğunu anlamak için farklı yöntemlerle yeniden araştırma yapılabilir. Öğretmen değişkenlerinden İş Deneyimi, Öğrenci Katılımını Sağlama Öz-Yeterliği ve Fen Yeteneğine İlişkin Örtülü Teoriler öğrencilerin Fen Başarısındaki sınıf ortalamalarındaki farklılıkları açıklayan değişkenler olarak bulunmuştur.

Tablo 17 Fen Başarısı için final modelden elde edilen sabit etkiler

Sabit Etkiler	Katsayı	SH
ZSAS (Fen Başarısı), Sınıf ortalamaları için model		
Kesme noktası, γ_{00}	-.049	.031
ZT_EXPER (İş Deneyimi), γ_{01}	.069*	.027
ZTSESE (Öğrenci Katılımını Sağlama Öz-Yeterliği), γ_{02}	.095**	.028
ZTITSA (Fen Yeteneğine İlişkin Örtülü Teoriler), γ_{03}	.064*	.027
S_FEMALE (Cinsiyet), γ_{10}	.038	.025
ZSWHSC (Öğrenci Yaklaşımı), γ_{20}	.013	.013
ZSWHTS (Öğretmen Desteği), γ_{30}	-.011	.015
ZSWHINVO (Katılım), γ_{40}	.135***	.015
ZSWHINVE (Araştırmalar), γ_{50}	-.031*	.015
ZSWHTO (Ödevler), γ_{60}	.192***	.013
ZSWHCOOP (İş Birliği), γ_{70}	-.065***	.014
ZSWHEQU (Eşitlik), γ_{80}	.032	.018
T_FEMALE (Cinsiyet), γ_{81}	.060**	.021

Not. Sadece final modeldeki yordayıcılar tabloya dâhil edilmiştir. SH: Standart Hata.

*p< .05, **p<.01, ***p<.001

Tablo 18 Fen Başarısı için final modelden elde edilen varyans bileşenleri

Random Etkiler	Varyans Bileşenleri	df	χ^2	R^2	Güvenirlik
ZSAS (Fen Başarısı),					
Sınıf ortalaması, u_{0j}	.284	368	1612.79***	.078	.73
S_FEMALE (Cinsiyet), u_{1j}	.106	371	633.45***		.41
ZSWHSC (Öğrenci Yaklaşımı), u_{2j}	.012	371	460.42**		.17
ZSWHTS (Öğretmen Desteği) u_{3j}	.018	371	448.50**		.19
ZSWHINVE (Araştırmalar), u_{5j}	.007	371	417.60*		.09
ZSWHEQU (Eşitlik), u_{8j}	.006	370	424.04*	.041	.08
1. düzey etkisi, r_{ij}	.587			.173	

*p< .05, **p<.01, ***p<.001

Araştırma Sorusu 4: Öğrencilerin Fen Başarısını Sınıftaki Öğrenme Ortamı Algılarıyla ve Öz-Düzenleme Becerileriyle Yordama

Son araştırma sorusu üçüncü araştırma sorusunun genişletilmiş versiyonudur. Yani bağımsız değişken olarak Cinsiyet ve sınıftaki öğrenme ortamı algısı boyutlarının yanı sıra modele, öz-düzenleme becerileri boyutları da eklenmiştir ve bunların modeldeki düzenleyici rolü araştırılmıştır. HLM analizinin sonuçları üçüncü araştırma sorusunun sonuçlarıyla birlikte Tablo 19 ve Tablo 20'de karşılaştırmalı olarak verilmiştir. Bu sonuçlara göre Öz-Yeterlik boyutlarından Öz-Yeterlik, Öğrenme Yaklaşma Hedefleri ve Prformans Kaçınma Hedefleri Fen Başarısını anlamlı olarak yordayan değişkenler olarak bulunmuştur. Öz-Yeterlik değişkenleri modele dâhil edildiğinde sınıftaki öğrenme ortamı değişkenlerinden İşbirliği ve Eşitlik artık Fen Başarısının anlamlı yordayıcıları olmaktan çıkmıştır. Bu da gösteriyor ki öğrencilerin öz-düzenleme becerileri, Fen Başarısı ile sınıftaki öğrenme ortamı değişkenleri arasında aracı değişkenler olarak rol almıştır. Ayrıca bütün değişkenler göz önünde bulundurulduğunda Fen Başarısını en iyi yordayan değişken öğrencilerin fen öğrenmeye yönelik Öz-Yeterlik algılarıdır.

Tablo 19 Fen Başarısını sınıftaki öğrenme ortamı, Cinsiyet ve öz-düzenleme becerileriyle yordamak için final modelden elde edilen sabit etkiler

	Model 1		Model 2	
Sabit Etkiler	Katsayı	SH	Katsayı	SH
ZSAS (Fen Başarısı), Sınıf ortalamaları için model				
Kesme noktası, γ_{00}	-.049	.031	-.045	.030
S_FEMALE (Cinsiyet), γ_{10}	.039	.025	.036	.023
ZSWHSC (Öğrenci Yaklaşımı), γ_{20}	.014	.013	-.002	.012
ZSWHTS (Öğretmen Desteği), γ_{30}	-.011	.015	-.022	.012
ZSWHINVO (Katılım) γ_{40}	.135***	.015	.075***	.014
ZSWHINVE (Araştırmalar), γ_{50}	-.029*	015	-.074***	.013
ZSWHTO (Ödevler), γ_{60}	.191***	.013	.045**	.014
ZSWHCOOP (İşbirliği), γ_{70}	-.064***	.014	-.016	.013
ZSWHEQU (Eşitlik), γ_{80}	.065***	.014	.017	.013
ZSSE (Öz-Yeterlik), γ_{90}			.340***	.015
ZSMC (Üst Biliş Stratejileri), γ_{100}			-.009	.013
ZSGOMAP (Öğrenme Yaklaşma Hedefleri), γ_{110}			.085***	.014
ZSGOPAV (Performans Yaklaşma Hedefleri), γ_{120}			-.063***	.012
ZSGOPAP (Performans Kaçınma Hedefleri) , γ_{130}			.020	.012
ZSGOMAV (Öğrenme Kaçınma), γ_{140}			.005	.010

Not. Anlamlı ilişkisi olmayan değişkenler modelden çıkarılmamıştır. SH: Standart Hata.

*p< .05, **p<.01, ***p<.001

Tablo 20 Fen Başarısını sınıftaki öğrenme ortamı, Cinsiyet ve öz-düzenleme becerileriyle yordamak için final modelden elde edilen varyans bileşenleri

	Model 1					Model 2				
Random Etkiler	Varyans Bileşenleri	df	χ^2	Güvenirlik	R^2	Varyans Bileşenleri	df	χ^2	Güvenirlik	R^2
ZSAS (Fen Başarısı),										
Sınıf ortalaması, u_{0j}	.308	371	1730.44***	.745		.261	369	1501.15***	.723	
S_FEMALE (Cinsiyet), u_{1j}	.106	371	633.46***	.406		.085	369	599.02***	.363	
ZSWHSC (Öğrenci Yaklaşımı), u_{2j}	.012	371	460.50**	.165		.009	369	463.72**	.147	
ZSWHTS (Öğretmen Desteği), u_{3j}	.019	371	448.57**	.192						
ZSWHINVE (Araştırmalar), u_{5j}	.007	371	417.71*	.091						
ZSWHEQU (Eşitlik), u_{8j}	.007	371	429.20**	.085		.006	369	438.07**	.088	
ZSSE (Öz-Yeterlik), u_{9j}						.015	369	47..77***	.193	
ZSGOMAP (Öğrenme Yaklaşma Hedefleri), u_{11j}						.010	369	426.86*	.113	
ZSGOPAP (Performans Yaklaşma Hedefleri), u_{13j}						.007	369	457.23**	.120	
1. düzey etkisi, r_{ij}	.587				.173	.513				.277

Note: *p< .05, **p<.01, ***p<.001

Sonuç

Birçok HLM modelinden elde edilen sonuçlar göstermiştir ki öğrencilerin sınıftaki öğrenme ortamı algısı öğrencilerin Fen Başarısının yanı sıra öz-düzenleme becerilerini de iyi bir şekilde yordamaktadır. Sınıftaki öğrenme ortamının 7 boyutu arasında Ödevler en iyi yordayıcı olarak bulunurken, İşbirliği ve Katılım değişkenleri bazı modellerde baskıcı değişken olarak gözlenmiştir. Ayrıca, Fen Başarısını açıklayan değişkenleri araştırırken öğrencilerin öz-düzenleme becerilerinin, Fen Başarısı ile sınıftaki öğrenme ortamı değişkenleri arasında aracı değişkenler olduğu görülmüştür. Türkiyedeki 7. Sınıf öğrencilerinin Fen Başarısını ise Fen dersini öğrenmeye yönelik Öz-Yeterlik algısı en iyi şekilde yordamıştır. Bunu ise Öğrenme Yaklaşma Hedefleri takip etmiştir. Bu nedenle öğrencilere sınıfta nitelikli bir öğrenme ortamı hazırlamak onların öz-düzenleme becerilerini ve dolayısıyla da Fen Başarısını artırmaya yardımcı olacaktır.

Sınıf düzeyinde ise, öğretmen değişkenlerinin öz-düzenleme değişkenlerine kıyasla, sınıftaki öğrenme ortamı değişkenleriyle daha çok ilişkili olduğu bulunmuştur. Özellikle de fen öğretmenlerinin Öğrenci Katılımını Sağlama Öz-Yeterliği sınıftaki öğrenme ortamının bütün boyutlarıyla ve Fen Başarısıyla anlamlı ilişkili bulunmuştur. Öğretmen değişkenlerinin genellikle öz-düzenleme becerilerinin ve Fen Başarısının önemli yordayıcıları olan sınıftaki öğrenme ortamı değişkenleriyle ilişkili bulundukları söylenebilir. Ancak, öğretmen değişkenlerinin açıkladıkları varyanslar dikkate alındığında, bu değişkenlerin etkilerinin birçok teorik araştırmacı tarafından öngörüldüğü kadar büyük olmadığı anlaşılmaktadır.

Doğurgalar

Bu çalışma Türkiye'deki ilköğretim okullarındaki fen dersi öğretiminin kapsamlı bir şekilde araştırmıştır. Bu çalışma öğrretmen özelliklerini, sınıf ortamını ve öğrencilerin öğrenme çıktıları ve bunlar arasındaki ilişkileri dikkate alan bir araştırmadır. Ayrıca, bu çalışma sınıftaki öğrenme ve öğretme süreçlerini geniş bir şekilde ve çok büyük bir örneklemle incelendiği, Türkiye'de fen eğitimi alanında yapılan ilk çalışmadır. Dolayısıyla bu çalışmanın bulguları, öğretmenler, öğretmen yetiştirenler, eğitim politikacıları ve eğitim araştırmacıları için önemlidir.

Bu çalışmanın bulguları, sınıftaki öğrenme ortamının niteliğinin 7. Sınıf öğrencilerinin fen derslerindeki öz-düzenleme becerileri ve Fen Başarısı üzerinde önemli etkileri olduğunu göstermiştir. Dolayısıyla nitelikli bir sınıf ortamı hazırlamak için fen öğretmneleri sınıfta öğrencileri iyi ilişkiler kurmaya, diğerlerine yardım etmeye teşvik etmeli, onlara öğrenme sürecinde destek olmalı, problemleriyle ilgilenmeli, dostça yaklaşmalı. Ayrıca, öğrencilere fikirlerini rahatça paylaşabileceği, tartışmalara katılabileceği, öğretmen tarafından eşit fırsatlar tanındığı, dersin amaçlarınn ve gmrevlerin tamamlanmasının önemsendiği bir sınıf ortamı sağlamalıdır. Sınıftaki öğrenme ortamının bütün boyutları öğrencilerin öğrenme çıktıları ile ilişkili bulunduğu için fen öğretmenleri bu bilgiyi sınıftaki öğrenme ve öğretme süreçlerinin niteliğini artırmak ve öğrencilere daha iyi eğitim sunmak için kullanabilir.

Bu çalışmanın bulguları öğretmen eğitimcileri açısından da önemlidir. Çünkü öğretmen adayları nitelikli öğrenme ortamını nasıl sağlayacakları konusunda iyi eğitim almış olmalıdırlar. Örneğin bir grup çalışması yapılacağı zaman, öğretmenin grup çalışmasının gereksinimlerini iyi biliyor olması ve öğrencileri yanlış yönlendirmemesi gerekir. Dolayısıyla, öğretmen eğitiminde bazı dersler bu stratejiler üzerine odaklanmalı veya method dersi gibi derslerde nitelikli sınıf ortamının özellikleri vurgulanmalıdır.

Nitelikli sınıf ortamı aynı zamanda öğrencilerin öz-düzenleme becerilerini geliştirmede de önemli rol oynamaktadır ve bu öz-düzenleme becerileri Fen Başarısı ile sınıftaki öğrenme arasındaki ilişkide aracı değişkenler olarak rol oynamaktadır. Bu nedenle, öğretmenler öğrencileri fen öğrenmeye motive etmelidirler. Bunun için öğrencilerin fen öğrenmeye yönelik Öz-Yeterlik algıları, Üst Biliş stratejilerini kullanmaları ve Öğrenme Yaklaşma Hedeflerini artırmak faydalı olacaktır. Bu öz-düzenleme becerileri nitelikli sınıf ortamı ile artırılabilmesinin yanı sıra farklı stratejilerle de artırılabilir. Örneğin, öğretmenler sınıfta öz-yeterliğin Bandura (1986) tarafından önerilen 4 temel kaynağına odaklanarak öğrencilerin öz-yeterliğini artırabilir.

Sınıf düzeyinde ise öğretmenlerin Öğrenci Katılımını Sağlama Öz-Yeterliği sınıftaki öğrenme ortamı algısının ve öğrenme çıktılarının öğretmen düzeyindeki en iyi yordayıcısı olarak bulunmuştur. Bandura'ya (1998) göre öğretmen öz-yeterliği öğretmen adayı eğitimi sürecinde daha değişkendir ve bir kere oluştupunda değiştirmek çok zordur (Tschannen-Moran, Hoy ve Hoy, 1998). Bu nedenle, öğretmen adaylarının eğitim süre öz-yeterliğin 4 kaynağı göz önünde bulundurarak (Bandura, 1986) düzenlenmelidir.

Öğretmen değişkenlerinin öğrencilerin bilişsel ve duyuşsal çıktıları üzerine etkisini ampirik olarak inceleyen çalışmalar çok az olduğu için bu çalışmanın bulguları eğitim araştırmacıları için de önemlidir. Geçmişteki teorik çalışmalarda öngörülenin aksine bu çalışmada kullanılan öğretmen değişkenlerinin öğrenci çıktıları üzerindeki etkisinin pek yüksek olmadığı bulunmuştur. Bu nedenle, bu çalışmanın ileride yapılacak çalışmalara rehberlik etmesi beklenmektedir. Ayrıca sonuçların genellenebilmesi için bu çalışmanın tekkrarı önemlidir ve bu çalışma farklı değişkenleri dahil ederek de genişletilebilir.

Appendix G

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Yerdelen, Sündüs
Nationality: Turkish (TC)
Date and Place of Birth: 16 October, 1978, Kars
Marital Status: Single
Phone: +90 312 210 7382
Fax: +90 312 210 7984
e-mail: suyerdelen@gmail.com

EDUCATION

Degree	**Institution**	**Year of Graduation**
MS	Gebze Institute of Technology, Physics	2005
BS	Balıkesir University, Physics	2001
High School	Kazım Karabekir Anatolian Teacher Training High School	1996

CERTIFICATE

2000	Balıkesir University, Necatibey Faculty of Education	Teaching Certificate

VISITING SCHOLAR

September 2011-Agust 2012	Faculty of Education, University of Alberta, CANADA	Studied with Prof. Dr. Robert M. KLASSEN

WORK EXPERIENCE

2006-Present	METU, Department of Elementary Education	Research Assistant
2004-2006	KAfkas University, Department of Science Education	Research Assistant
2003-2004	Gebze Bil Dersanesi	Physics Teacher

PUPLICATIONS

1. Klassen, R. M., **Yerdelen, S.,** & Durksen, T. (2013). Measuring teacher engagement: Development of the engaged teachers scale (ETS). *Frontline Learning Research, 1*(2), 33-52.

2. Sungur, S. & **Yerdelen, S.** (2011). Examination of self-regulated learning processes for low and high achievers in biology. *The New Educational Review, 24*(2), 207-2015.

3. Saraç, Z., Dursun, A., **Yerdelen, S**., & Ecevit, F. N. (2007). Calculation of refractive index changes from thermal lens fringes using continuous wavelet algorithm. *Optics and Laser Technology*, *39*(4), 769-773.

4. Saraç, Z., **Yerdelen, S**., Dursun, A., Saraç-Topkara, H., & Ecevit, F. N. (2007). Processing of thermal lens fringes by S-transform. *Optics Communication*, *271*(2), 349-352.

5. Saraç, Z., Dursun, A., **Yerdelen, S**., & Ecevit, F. N. (2005). Wavelet phase evaluation of white light interferograms. *Measurement Science and Technology, 16*(9), 1878-1882.

6. **Yerdelen, S**. (2002, August). Liquid Crystals. TUBITAK *Science and Technology* Magazine*, 417,* 32.

PRESENTATIONS

1. **Yerdelen, S**. & Sungur, S. (2013, September). *Turkish Elementary Science Teachers' Self-Regulation Profiles: Examınation of Gender Difference.* Paper presented at the annual meeting of European Conference on Educational Research (ECER). Istanbul, Turkey.

2. Klassen, R. M., **Yerdelen**, S., & Durksen, T. L. (2013, August). *Measuring teacher engagement: Development of the Engaged Teachers Scale (ETS).* Paper presented at the bi-annual meeting of the European Association for Learning and Instruction. Munich, Germany.

3. **Yerdelen, S**. & Sungur, S. (2013, April). *Turkish science teachers' job satisfaction and relations with teacher burnout, efficacy beliefs and work load.* Poster session presented at annual conference of The British Psychological Society (BPS). Harrogate, UK.

4. **Yerdelen, S**., Taş, Y., & Sungur, S. (2012, September*). Predictors of pre-service science teacher self-efficacy.* Paper presented at the annual meeting of European Conference on Educational Research (ECER), Cadiz, Spain.

5. **Yerdelen, S**., Sungur, S., & Klassen, R., M. (2012, July). *The role of self-regulatory processes in secondary school students' biology achievement*. Poster session presented at Biennial Meeting of the International Society for the Study of Behavioural Development (ISSBD), Edmonton, AB, Canada.

6. **Yerdelen, S**., & Klassen, R. M. (2012, April). *Effect of self-efficacy for self-regulated learning on anxiety and procrastination.* Paper presented at the annual meeting of the Western Psychological Association, San Francisco, CA.

7. **Yerdelen, S**. & Sungur, S. (2012, April). *Relationship between Turkish Elementary Science Teachers' Occupational Well-Being and Some Contextual and Demographic Characteristics*. Paper presented at the annual meeting of American Educational Research Association (AERA), Vancouver, BC, Canada.

8. Haser, C., Tas, Y., & **Yerdelen, S.** (2010, August). *Perceptions of PhD Qualifying Examination by Doctoral Students and Directors.* Paper presented at the annual meeting of European Conference on Educational Research (ECER), Helsinki, Finland.

9. **Yerdelen, S.** (2009, September). *Conceptual Change Text Oriented Instruction and Science Education.* Poster session presented at the European Science Education Research Association (ESERA) Conference, Istanbul, Turkey.

10. **Yerdelen, S.,** Saraç, Z., & Ecevit, F. N. (2006). September). *Optical characterization of the solutions containing dye by using interferometric methods*. Poster session presented at the 10th National Chemistry Congress, Kayseri, Turkey.

11. **Yerdelen, S**., Saraç, Z., & Ecevit, F. N. (2005, September). *Determining refractive index and temperature change maps of thermal lenses by using wavelet transform method*. Poster session presented at the Turkish Physical Society, 23rd International Physics Congress, Mugla, Turkey.

WORKSHOPS

April 2012	Meeting of the Western Psychological Association, Burlingame, CA, US	Choosing your multivariate technique by Prof. Dr. Barbara TABACHNICK
May 2012	University of Alberta, Edmonton, AB, Canada.	Introduction to Structural Equation Modeling Workshop by Prof. Dr. Gregory HANCOCK

AWARD

April 2012	American Educational Research Association, Annual Conference	International Travel Award

SCHOLARSHIPS

2011-2012	Abroad Research Scholarship for Doctoral Students Education	Turkish Higher Education Council

MEMBER

2011-Present	Alberta Consortium for Motivation and Emotion	Doctoral student member
2012-2013	American Educational Research Association	Doctoral student member
2012-2013	Western Psychological Association	Doctoral student member

PROJECTS

1. Name : Perceptions of PhD Qualifying Examination by Doctoral Students and Directors in METU
   Project Director : Assist. Prof. Dr. Çiğdem HASER
   Date : 2010-2011
   Funded By : METU - BAP

2. Name : Teacher Efficacy And Professional Learning
   Project Director : Prof. Dr. Gary J Heck
   Date : 2011-2012
   Funded By : The Alberta Teachers' Association

FOREIGN LANGUAGES

English

COMPUTER PROGRAMS

Computer: MS Office tools, SPSS, ITEMAN, LISREL, AMOS, HLM, and MATLAB

HOBBIES

Photography, Cycling. Traveling, Karate Do.

Appendix H

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ■

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☐

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı : Yerdelen
Adı : Sündüs
Bölümü : İlköğretim

TEZİN ADI: Multilevel Investigations of Students' Cognitive and Affective Learning Outcomes and Their Relationships with Perceived Classroom Learning Environment and Teacher Effectiveness

TEZİN TÜRÜ : Yüksek Lisans ☐ Doktora ■

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir. ☐
2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir. ☐
3. Tezimden bir (1) yıl süreyle fotokopi alınamaz. ■

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: