MULTILEVEL ANALYSIS OF STUDENTS SCIENCE ACHIEVEMENT IN RELATION TO CONSTRUCTIVIST LEARNING ENVIRONMENT PERCEPTIONS, EPISTEMOLOGICAL BELIEFS, SELF-REGULATION AND SCIENCE TEACHERS CHARACTERISTICS

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

SAVAŞ PAMUK

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY
IN
THE DEPARTMENT OF ELEMENTARY EDUCATION

AUGUST 2014

Approval of the Graduate School of Social Sciences

Prof. Dr. Meliha Altunışık
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Doctor of Philosophy.

Prof. Dr. Ceren Öztekin
Head of Department

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.

Prof. Dr. Ceren Öztekin Co-Supervisor	Assoc. Prof. Dr. Semra Sungur Supervisor

Examining Committee Members

Prof. Dr. Jale Çakıroğlu	(METU,ELE)	
Assoc. Prof. Dr. Semra Sungur	(METU,ELE)	
Assoc. Prof. Dr. Yezdan Boz	(METU,SSME)	
Assoc. Prof. Dr. Ozgul Yılmaz-Tuzun	(METU,ELE)	
Assist. Prof. Dr. Eren Ceylan	(Ankara University, SSME)	

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name: Savaş PAMUK

Signature :

ABSTRACT

MULTILEVEL ANALYSIS OF STUDENTS SCIENCE ACHIEVEMENT IN RELATION TO CONSTRUCTIVIST LEARNING ENVIRONMENT PERCEPTIONS, EPISTEMOLOGICAL BELIEFS, SELF-REGULATION AND SCIENCE TEACHERS CHARACTERISTICS

Pamuk, Savaş
Ph.D., Department of Elementary Education
Supervisor: Assoc. Prof. Dr. Semra Sungur
Co-Supervisor: Prof. Dr. Ceren Öztekin

August 2014, 441 pages

This study aimed to examine student science achievement in relation to constructivist learning environment perceptions, epistemological beliefs, self-regulation and science teacher characteristics. Data were collected using a battery of instruments administered to both 137 science teachers and their 3281 seventh grade students in Ankara, Turkey.

Several Hierarchical Linear Modeling analyses were conducted to analyze the two level-data which were student-level that were self-regulation (i.e., self-efficacy, achievement goal orientations, task value, and metacognitive self-regulation), epistemological beliefs, and constructivist learning environment perceptions students' achievement; and teacher-level that were self-efficacy, achievement goal orientations, epistemological beliefs, student-centered beliefs and practices, and individual citizenship behaviors.

Findings indicated that students' constructivist learning environment perceptions were significant predictors of their epistemological beliefs, self-regulation, and science achievement. Students with sophisticated epistemological beliefs tend to be more self-regulated and successful in science. Also, performance avoidance goals were negatively related to science achievement. Self-regulation variables mediated the relationship of epistemological beliefs variable with science achievement. Students of teachers with sophisticated beliefs tend to perceive their science classes as constructivist learning environment at higher levels. Moreover, students taught by teachers who were self-efficacious for Instructional Strategies and with Ability Approach goals feel free in their classroom respectively to have a shared role and to practice the construction of scientific knowledge. High level of teachers' Efficacy for Student Engagement was negatively related with students' naïve epistemological beliefs. Moreover, teachers' naïve beliefs were positively associated with students' sophisticated beliefs. And lastly, teachers' self-efficacy in classroom management was negatively related with students' self-efficacy.

Keywords: Science Education, Constructivist Learning Environment, Epistemological Beliefs, Self-Regulation, Teacher Characteristics

ÖZ

ÖĞRENCİLERİN FEN BİLİMLERİ DERSİNDEKİ BAŞARILARININ YAPILANDIRMACI ÖĞRENME ORTAMI ALGISI, EPİSTEMOLOJİK İNANÇLAR, ÖZ-DÜZENLEME BECERİLERİ VE ÖĞRETMEN ÖZELLİKLERİ İLE OLAN İLİŞKİSİNİN ÇOK DÜZEYLİ ANALİZİ

Pamuk, Savaş
Doktora, İlköğretim Bölümü
Tez Yöneticisi: Doç. Dr. Semra Sungur
Ortak Tez Yöneticisi: Prof. Dr. Ceren Öztekin

Ağustos 2014, 441 sayfa

Bu çalışmanın amacı öğrencilerin fen bilimleri dersindeki başarılarının yapılandırmacı öğrenme ortamı algısı, epistemolojik inançlar, öz-düzenleme becerileri ve öğretmen özellikleri ile olan ilişkisini araştırmaktır. Bu çalışma Ankara ili ölçeğinde yapılmış olup, çalışmaya 137 fen öğretmeni ve bu öğretmenlere ait 3281 yedinci sınıf öğrenci katılmıştır.

Öğrenci ve öğretmen düzeylerindeki veriler, çok sayıda Hiyerarşik Lineer Model analizi yürütülerek analiz edilmiştir. Öğrenci düzeyi değişkenleri yapılandırmacı öğrenme ortamı algısı, epistemolojik inançlar, öz-düzenleme becerileri (öz-yeterlik, hedef yönelimi, değer verme ve bilişötesi öz-düzenleme) ve fen başarısından oluşmaktadır. Öğretmen düzeyi değişkenleri ise öz-yeterlik inançları, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli uygulamalar ve inançlar ve kişisel vatandaşlık davranışlarından oluşmaktadır.

Bulgular, öğrencilerin yapılandırmacı öğrenme ortamı algısının onların epistemolojik inançları, öz-düzenlemeleri ve fen başarıları için önemli bir yordayıcı olduğunu göstermiştir. Sofistike epistemolojik inançlara sahip öğrenciler yüksek öz-düzenleme becerileri ve yüksek fen başarısı göstermiştir. Öğrencilerin performanstan kaçınma hedeflerinin fen başarıları ile olumsuz ilişki içinde olduğu bulunmuştur. Öte yandan öğrencilerin öz-düzenleme becerilerinin onların epistemolojik inançları ile fen başarısı arasındaki ilişkide aracı rolü oynadığı bulunmuştur. Öğretmenleri sofistike epistemolojik inançlara sahip öğrencilerin yapılandırmacı öğrenme ortamı algısının yüksek olduğu bulunmuştur. Öğretim stratejilerini kullanma açısından yüksek öz-yeterliğe sahip ve daha çok performans yaklaşma hedefleri olan öğretmenlere sahip öğrenciler sınıflarında öğrenme ortamındaki kararlara katılmada ve bilimsel bilgiyi yapılandırmada kendilerini daha özgür hissetmişlerdir. Öğrenciyi derse entegre etmede yüksek öz-yeterliğe sahip olan öğretmenlerin öğrencileri sofistike epistemolojik inançlarda daha zayıf çıkmışlardır. Ayrıca naif epistemolojik inançlara sahip öğretmenlerin öğrencileri daha sofistike epistemolojik inançlara sahip çıkmıştır. Son olarak sınıf yönetimi konusunda yüksek öz-yeterliğe sahip öğretmenlerin öğrencileri daha düşük öz-yeterlik inancına sahip olarak bulunmuşlardır.

Anahtar Kelimeler: Fen Eğitimi, Yapılandırmacı Öğrenme Ortamı Algısı, Epistemolojik İnançlar, Öz-Düzenleme Becerileri, Öğretmenlerin Karakteristik Özellikleri

To My Son, K. Mert PAMUK

ACKNOWLEDGMENTS

I would like to express my deepest appreciation and gratitude to my supervisor Assoc. Prof. Dr. Semra Sungur for her guidance, encouragement, patient, fast feedbacks, and greatest support throughout writing this doctoral dissertation. I would also like to thank my co-supervisor Prof. Dr. Ceren Öztekin. She is a very special person who was always ready to assist me in solving every kind of problem with her valuable feedbacks and to motivate me writing this dissertation.

I would like to express my gratitude to Prof. Dr. Anita Woolfolk-Hoy, one of the pioneers of teacher beliefs, for her supports, feedbacks, invaluable views, and guidance. It is thanks to Prof. Dr. Ann O'Connell for allowing me to follow her Multilevel Analysis Class and Hierarchical Linear Modeling Class and to answer my all questions about HLM Analyses.

My thanks to the dissertation committee; Prof. Dr. Jale Çakıroğlu, Assoc. Prof. Dr. Yezdan Boz, Assoc. Prof. Dr. Özgül Yılmaz-Tüzün, and Assist. Prof. Dr. Eren Ceylan for their help, support, and valuable suggestions to my dissertation. I also would like to thank Prof. Dr. Hamide Ertepınar, Prof. Dr. Ömer Geban, Assoc. Prof. Dr. Gaye Teksöz, Assoc. Prof. Dr. Mine Işıksal, Assoc. Prof. Dr. Feyza Tantekin-Erden, Assoc. Prof. Dr. Erdinç Çakıroğlu, Assist. Prof. Dr. Çiğdem Haser, and Assist. Prof. Dr. Elvan Şahin, Assist. Prof. Dr. Refika Olgan for providing great academic environment.

Special thanks for my son, Kenan Mert Pamuk, and my mother, Zübeyde Pamuk, for her great support, patience, and help from the first step of this process. I would like to say that I devote this dissertation to my son. He is my most valuable

piece of my life and he deserves the best of everything. I would also like to thank my brother and his wife, M. Esat Pamuk and Özlem Pamuk, and my sisters and their husbands, Seda - Murat Daşpınar and Sema - Türker Karagöz, for their help and moral support.

I am thankful to best friend Rıdvan Elmas and my office mates Mehtap Özen, Nursel Yılmaz, Deniz Kahriman-Öztürk, Erdinç İşbilir, and Burak Çaylak for their patience, help, and support during my thesis work. And I will also thank to my co-workers Dr. Yasemin Taş and Dr. Sündüs Yerdelen for their great advices, supports, and recommendations during HLM analyses. Dear Sinem Demirci, Mehmet Şen, Zeynep Akdağ, Burcu Şenler, Aslıhan Osmanoğlu, Murat Aydemir, Sinan Özgelen, Asiye Parlak-Rakap, Ramazan Sak, and all research assistants of Department of Elementary Education, I do not forget all of you. Thanks for your great friendships.

I would like to thanks METU, Akdeniz University, and DPT for providing great learning opportunities, academic and financial resources.

TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

LIST OF ABBREVATIONS

ACHIEVEM: Science Achievement

AGQ: Achievement Goal Questionnaire

CBS: Individual Citizenship Behaviors Scale

CES: Classroom Environment Scale

CFA: Confirmatory Factor Analysis

CFI: Comparative Fit Index

CLE_C_AG: Constructivist Learning Environment - Critical Voice - Aggregated

CLE_CRI: Constructivist Learning Environment - Critical Voice

CLE_N_AG: Constructivist Learning Environment - Student Negotiation - Aggregated

CLE_NEG: Constructivist Learning Environment - Student Negotiation

CLE_P_AG: Constructivist Learning Environment - Personal Relevance - Aggregated

CLE_PER: Constructivist Learning Environment - Personal Relevance

CLE_S_AG: Constructivist Learning Environment - Shared Control - Aggregated

CLE_SHA: Constructivist Learning Environment - Shared Control

CLE_U_AG: Constructivist Learning Environment – Uncertainty - Aggregated

CLE_UNC: Constructivist Learning Environment – Uncertainty

CLES: Constructivist Learning Environment Survey

CUCEI: Classroom Environment Inventory

EP_CER: Epistemological Beliefs – Certainty

EP_DEV: Epistemological Beliefs –Development

EP_JUS: Epistemological Beliefs – Justification

EP_SOU: Epistemological Beliefs – Source

GFI: Goodness of Fit Index

GOAL_MA: Goals - Mastery Approach

GOAL_MAV: Goals - Mastery Avoidance

GOAL_PA: Goals - Performance Approach

GOAL_PAV: Goals - Performance Avoidance

HLM: Hierarchical Linear Modeling

ICC: Intra-Class Correlation Coefficient

I-E: Rotter's Internal-External Scale

Jr. MAI: Junior Metacognitive Awareness Inventory

KCES: Korean version of Classroom Environment Scale

KR-20: Kuder Richardson 20

LEI: Learning Environment Inventory

M: Mean

MC_SR: Metacognitive Self-Regulated Learning

MCI: My Class Inventory

MEB: Turkish Ministry of Education

MSLQ: Motivated Strategies for Learning Questionnaire

MTAT: Music Theory Achievement Tests

NFI: Normed Fit Index

OCB: Organizational Citizenship Behavior

OCBSS: Organizational Citizenship Behavior in School Scale

PISA: Programme for International Student Assessment

QTI: Questionnaire on Teacher Interaction

RMSEA: Root Mean Square Error of Approximation

RSA: Responsibility for Student Achievement Scale

SAT: Science Achievement Test

SCBS: Student-Centered Beliefs and Practices Scale

SD: Standard Deviation

SEBS: Students' Epistemological Beliefs Scale

SELF_EFF: Self-Efficacy

SES: Socio-Economic Status

SLEI: Science Laboratory Environment Inventory

SRMR: Standardized Root Mean Square Residual

TAGOS: Teacher Achievement Goal Orientations Scale

TASK: Task Value

TBS: Teacher's Belief Survey

TCITIZEN: Individual Citizenship Behavior

TEBS: Teacher Epistemological Beliefs Scale

TEP_CER: Epistemological Beliefs – Certainty

TEP_DEV: Epistemological Beliefs –Development

TEP_JUS: Epistemological Beliefs – Justification

TEP_SOU: Epistemological Beliefs – Source

TGOALAAP: Achievement Goal Orientations - Ability Approach

TGOALAAV: Achievement Goal Orientations -Ability Avoidance

TGOALTAS: Achievement Goal Orientations – Task

TGOALWAV: Achievement Goal Orientations - Work Avoidance

TIMMS: Trends in International Mathematics and Science Study

TLC: Teacher Locus of Control

TLI: Tucker-Lewis index

TSELF_CM: Self-Efficacy - Classroom Management

TSELF_IS: Self-Efficacy - Instructional Strategies

TSELF_SE: Self-Efficacy - Student Engagement

TSES: Teachers' Sense of Efficacy Scale

TSTU_CEN: Student-Centered Beliefs and Practices

WIHIC: What Is Happening In This Class

CHAPTER I

INTRODUCTION

International assessment studies (Programme for International Student Assessment, [PISA], 2003; 2006; 2009; Trends in International Mathematics and Science Study, TIMMS, 1999; 2007) revealed unsuccessful results regarding science education in Turkey compare to other countries: average scores in science achieved by Turkish students were considerably lower than that of average countries. These results prompted researchers in Turkey to investigate the possible factors influencing students' science achievement. They produced similar findings those reported by other researchers. Among them are self-regulation (e.g. Sungur & Gungoren, 2009; Tas, 2008; 2013; Yerdelen, 2013; Yuruk, 2007), epistemological beliefs (e.g. Kizilgunes, Tekkaya, & Sungur, 2009, Uysal, 2010), and learning environment perceptions (e.g. Sungur & Gungoren, 2009; Uysal, 2010; Yerdelen, 2013) are considered as significant factors affecting students' achievement. In addition, teachers' some personal characteristics, such as self-efficacy (e.g. Tschannen-Moran, Woolfolk-Hoy, & Hoy, 1998; Woolfolk Hoy & Davis, 2005; Yerdelen, 2013), achievement goals (e.g. Butler, 2007), epistemological beliefs (e.g. Luft & Roehrig, 2007), student-centered beliefs and practices, and individual citizenship behaviors (e.g. Woolfolk Hoy, Hoy, & Kurz, 2008) have influences on students' achievement. Therefore, the aim of this dissertation is to examine the interrelations among them and to determine the possible predictors that influencing students' science achievement.

Considerable body of research in educational psychology indicated that students' self-regulation has a significant role in their learning and academic achievement (e.g., Bandura, 1986; Pintrich, 2000; Zimmerman, 2000). Self-regulation refers to "an active, constructive process whereby learners set goals for their learning, and the attempt to monitor, regulate, and control their cognition, motivation and behavior, guided and constrained by their goals and the contextual features in the environment" (Pintrich, 2000, p. 453). According to Risemberg and Zimmerman (1992), self-regulated students are likely to be more successful than students that depended on their teachers to do a learning task. Indeed, self-regulated students believe in their abilities to do given tasks successfully, set effective goals for themselves, and have positive perceptions of task, as well as use metacognitive strategies effectively (Pintrich, 2000; Risemberg, & Zimmerman, 1992). Thereby, self-regulation consists of not only cognitive components but also motivational components. Motivational component involves motivational beliefs, such as self-efficacy, achievement goals, and task value. Cognitive component, on the other hand, concerns the ability of choosing appropriate cognitive and metacognitive strategies to use for own learning (Pintrich, 2000).

As far as each component of self-regulation are considered, motivational component emphasizes motivational beliefs. As a one of the key constructs in motivational component, *self-efficacy* refers to judgment people make about their capabilities to organize and perform actions to reach designated levels of attainment (Bandura, 1997). Accordingly, if individuals have beliefs that they can achieve a task, they have greater motivation to act (Pajares, 2002). In a similar manner, Pintrich and Schunk (1996) defined self-efficacy as their task specific judgments about their academic abilities. Thus, higher self-efficacy beliefs not only enable students to attempt more difficult tasks, but also to have more persistence in face of the difficulties, and to construct different strategies to learn meaningfully. Thus, students with higher confidence in their learning abilities are more successful academically (Areepattamannil, Freeman, & Klinger, 2011; Britner & Pajares, 2006; Kupermintz, 2002; Lent, Brown, & Larkin, 1984; Pajares, Britner, & Valiante, 2000; Pintrich & DeGroot, 1990; Yerdelen, 2013). Within the motivational component, another self-regulation variable that affects students' academic achievement is *achievement goals*. Achievement goals concern the purposes for engaging in achievement behavior (Pintrich & Schunk, 2002). According to achievement goal theory, students' goals for learning guide their behavior in achievement settings (Ames, 1992; Pintrich, 2000). Therefore, the main focus of the theory is on students' thinking about themselves, their tasks, and their performance (Anderman & Midgley, 1997). Two major goal orientations with different labels have been identified by researchers regarding function in an achievement situation: mastery goals and performance goals. Mastery goals are related with adopting to learn and to master a task, to develop new skills to do it, to enhance competence, and to gain new insights about doing that task (Pintrich & Schunk, 2002). Performance goals, on the other hand, concern with adopting to demonstrate own competence or ability to others and to be the best in a group on doing a task (Pintrich & Schunk, 2002). Elliot and Harackiewicz (1996) further defined mastery and performance goal orientations under two dimensions, namely approach and avoidance. According to this division, learning and mastering to achieve a task are most important for an individual with mastery approach goals. Conversely, an individual with mastery avoidance goals is most concerned with not falling short of their own self set standards for mastery (Elliot, 1999; Pintrich, 2000). On the other hand, whereas for an individual with performance approach goals, focusing on outperforming others and having favorable judgments about their competence is most important, for an individual with performance avoidance goals, focusing on avoiding unfavorable judgments about their competence and looking incompetent is more critical (Elliot & Harackiewicz, 1996). Studies examining the relationship between achievement goals and academic achievement generally revealed positive association between mastery goals and achievement (e.g, Bargezar, 2012; Linnenbrink-Garcia, Tyson, & Patall, 2008; Yerdelen, 2013). However, findings were inconsistent concerning the relationship between performance goals and achievement. While some studies demonstrated positive relations (Barzegar, 2012; Elliot and McGregor, 2001; Wolters, 2004), others reported no relationship (Tas, 2008, 2013; Yerdelen, 2013).

These findings suggest that students who adopt mastery goals are more likely to take more difficult tasks and use effective learning strategies, but performance approach goals adapted students focus on outperforming other, thus, may not be successful as mastery approach goals adapted students. Last important aspect of motivational component of self-regulation is *task value* defined as students' perception of relative value attributed to the tasks in terms of their interest and significance and it is a motivator factor for engagement them in academic activities (Wigfield & Eccles, 1992). Task value is composed of three values, attainment value, intrinsic value, and utility value, which are considered as affective on achievement-related outcomes in the expectancy-value model (Wigfield & Eccles (1992). While attainment value concerns with "importance of what task?", intrinsic value that deals with "interest", utility value, however, that focus on "usefulness", and "cost". Research on the relationship between task values and academic achievement, on the other hand, were produced inconsistent finding. While some studies found a positive relation (Bong, 2001, Kzehri azar, Lavasani, Malahmadi, & Amani, 2010), Liem, Lau, and Nie (2008) reported no relation.

In with the available literature on motivational components of self-regulation, in this dissertation, it was expected that students' self-efficacy, mastery and performance goals, and task values significantly and positively predict their academic achievement. It was believed that if students have high self-efficacy beliefs, are intrinsically goal oriented, and appreciate the value of learning tasks, they challenge the difficulties in learning science and try to use new strategies to overcome these difficulties, show willingness to learn more difficult tasks, as well as give importance learning activities and aware of their benefits. As far as performance approach are considered, current study expected to find science achievement correlated positively with performance approach goals, but negatively with Mastery and performance avoidance goals. It is reasonable assumed that students who are adopted to mastery and performance avoidance goals, avoid to misunderstand and refrain from looking incompetent as well as stupid compare to others tended to exhibit standard efforts of not being wrong and use normative standards not to be lowest performer in class (Pintrich, 2000) (see Figure 1.1).

Within the cognitive component, however, *metacognitive self-regulation* can be regarded as a key aspect of self-regulation (Pintrich, 2000). Metacognition, according to Brown (1987, p. 66), is “one’s knowledge and control of own cognitive system” Brown’s (1987) framework divided metacognition into two components: knowledge of cognition and regulation of cognition. Former one is related to knowledge of individuals about their own cognition, latter one, on the other hand, is focused on individuals’ metacognitive activities to regulate their cognition about their learning (Schraw & Moshman, 1995). Similarly, Flavell (1979) proposed metacognition as an individual’s knowledge about own cognitive activities and regulation of cognition in his/her learning processes. But, his framework, which were quite different from Brown’s (1987) framework, explained metacognition by including metacognitive knowledge and metacognitive experiences or regulations. In his framework, metacognitive knowledge included three components namely, knowledge of task, knowledge of person, and knowledge of strategy. Metacognitive experiences or regulations, however, dealing with the regulation of an individual’s own cognition, cover three stages namely, planning, monitoring, and evaluation (Schraw & Moshman, 1995). The correlation between metacognitive skills, thought has been regarded as important components of self-regulation, and science achievement is not clear. Some found positive correlation (Akyol, Sungur, Tekkaya, 2009; Georghiades, 2004; Topcu & Yilmaz-Tuzun, 2009; Yuruk, 2007), but some others did not found (Yerdelen, 2013; Yumusak, Sungur, & Cakiroglu, 2007). Nevertheless, in the present study, it is expected that metacognitive self-regulation is positively linked to students’ science achievement. Since students who are metacognitively active plan, monitor, and evaluate their learning process and change the strategies tended to be successful in their class and have better understandings of science topics.

Apart from self-regulation, students' beliefs about nature of knowledge are also found to be significantly related to their learning outcomes (see Hofer & Pintrich, 2002). Hofer and Pintrich defined epistemological beliefs (1997, p. 435) as "how individuals come to know, the theories and beliefs they have about knowing, and the manner in which such epistemological premises are part of and an influence on cognitive process of thinking and reasoning beliefs about the processes of knowing and the nature of knowledge". Hofer and Pintrich (1997) proposed that there are two general structure of epistemological beliefs. First one is *beliefs about the nature of knowledge* (i.e., including *certainty of knowledge* and *simplicity of knowledge)* second one is *beliefs about the nature or process of knowing* (i.e., including *source of knowledge* and *justification of knowing*) (Hofer & Pintrich, 1997). Beliefs about certainty of knowledge refers to absolute or fixed understanding of knowledge, while beliefs about simplicity of knowledge is related to complexity or accumulation of knowledge. Beliefs about source of knowledge refers that knowledge belongs to an external authority. And finally, beliefs about justification of knowing is related with the evaluating knowledge claims of an individual. Accordingly, individuals who have sophisticated beliefs in these dimensions are more likely to believe that scientific knowledge is tentative, subjective, and evolving, Individuals with naïve beliefs, on the other hand, tend to perceive scientific knowledge as certain and unchanging, objective, and discovered. Studies that examined the role of epistemological beliefs on academic achievement generally found positive associations between sophisticated beliefs and academic performance (Conley, Pintrich, Vekiri, & Harrison, 2004; Elder, 1999; Kizilgunes, et al., 2009; Schommer, 1990; Smith, Maclin, Hougthon, & Hennessey, 2000), learning approaches (Kizilgunes, et al., 2009; Ozkan, 2008; Ozkal, Tekkaya, Cakiroglu, & Sungur, 2009), and motivational beliefs and cognitive strategies (Braten & Stromso, 2004; Bruning, Schraw, & Ronning, 1995; Hofer, 1994; Hofer & Pintrich, 1997; Kizilgunes et al., 2009; Paulsen & Feldman, 1999; Schutz, Pintrich, & Young, 1993). For instance, Paulsen and Feldman (1999) showed that that students who had sophisticated beliefs in simple knowledge were more likely to be self-efficacious about their learning capacity, to hold an intrinsic goal orientation, and to appreciate the value of their learning task. Students having naive beliefs in quick learning were less likely to appreciate the value of learning tasks and have intrinsic goals. Sophisticated beliefs in fixed ability were positively related with being self-efficacious about their learning capacity, holding an intrinsic goal orientation, and appreciating the value of their learning task. Sophistication in epistemological beliefs was also found to be positively related with adapting to mastery goals and engaging in material more deeply (Schutz, Pintrich, & Young, 1993), and with intrinsic motivation, self-efficacy, self-regulation, and academic achievement in mathematics. (Hofer 1994). Furthermore, in Braten and Stromso' (2004) study, naïve beliefs in quick learning were negatively associated with mastery approach goals, but positively with performance approach and performance avoidance goals. Kizilgunes et al. (2009) found that students' achievement motivation mediated the relations between their epistemological beliefs and science achievements. Based on the abovementioned findings, current study expected that sophisticated epistemological beliefs are positively associated with self-efficacy, intrinsic goals, task value, metacognitive self-regulation, and achievement (see Figure 1.1).

The quality of learning environment that are perceived by students is assumed to be another predictor of their academic achievement (Baek, & Choi, 2002; Dorman, 2001; Fraser, 1994; Margianti, Fraser & Aldridge, 2002). Walberg (1981) stated that psychological model of educational productivity has a multifactor structure that includes quality learning environment, quality of instructions, roles of age, ability, and motivation. All of these factors in a multiplicative structure (Fraser, 2007). It means that "any factor at a zero point will result in zero learning, thus either zero motivation or zero time for instruction will result in zero learning" (Fraser, 2007, p. 104). Thus, it is obvious that learning environment has been a significant focus for researchers as well as other factors that affect educational productivity. The studies on learning environment perception have generally focused on the development and validation of instruments to measure participants' perceptions of it (Fraser, 1998). At early stages of developing instruments, instruments were mostly teacher-centered, but student-centered instruments has been focus for recent instruments (Fraser, 2007). The Constructivist Learning Environment Survey (CLES; Taylor & Fraser, 1991) among others, assist researchers and teachers to determine students' perceptions of learning environment in their student-centered classrooms which in turn help them to re-design their teachings by reflecting on their own epistemological expectations. It had five sub-scales assessing to which extent they relate science to students' out of school experiences, practice provisional status of scientific knowledge, question what is going on in the lesson, participate in planning, conducting, and assessing of learning, and communicate with their classmates and teachers in the classroom. Inevitable, the relationships of learning environment perceptions with students' cognitive and affective learning outcomes has been focused on many research studies (for review see Fraser, 2007). For example, students' constructivist learning environment perceptions were investigated either in a relation to students' academic achievement (Allen & Fraser, 2007; Baek & Choi, 2002; Dorman, 2001; Goh & Fraser; 1998; Roth, 1997; Snyder, 2005; Sungur & Gungoren, 2009; Wolf & Fraser, 2008; Yerdelen, 2013), epistemological beliefs (Ozkal et al., 2009; Yilmaz-Tuzun & Topcu, 2010), and some self-regulation variables, such as self-efficacy (Arisoy, 2007; Dorman, 2001; Dorman, Fisher, & Waldrip, 2006; Sungur & Gungoren, 2009; Yerdelen, 2013), achievement goals (Ames, 1992; Arisoy, 2007; Sungur & Gungoren, 2009; Yerdelen, 2013), task value (Arisoy, 2007), and metacognition (Yilmaz-Tuzun & Topcu, 2010; Yerdelen, 2013) or indirectly through its effect on other constructs. For example, self-regulation found to moderates the influence of learning environment perceptions on academic achievement (Kizilgunes, et al., 2009; Patrick, Ryan, & Kaplan, 2007; Peters, 2013; Sungur & Gungoren, 2009; Yerdelen, 2013). The more students perceive science class as constructivist, the more they are capable of doing well in science, intrinsically goal oriented, aware of the value of learning tasks, metacognitively active, and have sophisticated beliefs about knowledge and knowing. Ozkal et al. (2009) stated that science teachers can help students realize that scientific knowledge is evolving and developing to change by providing more constructivist learning environment. Thus, this study proposed that students' perception of learning environment may have effect on their epistemological beliefs, self-regulation, and their science achievement. The study further proposed that the association of their perceptions and science achievement may be mediated by self-regulation. With this study, students' perception of learning environment was examined at both Level-1 and Level-2 (as an aggregated variable). Accordingly, it was proposed that class' aggregate perceptions of learning environment could also play a role in the prediction of students' academic achievement, epistemological beliefs, and self-regulation (see Figure 1.1).

Besides the role of student's outcomes related to their personal characteristics on their achievement, the critical role of teachers' beliefs on teaching and learning and on students' achievements were suggested to discuss (see Butler, 2007). Teachers' beliefs are known to have a critical role on their planning, decisions about class management, teaching strategies, relationships with students, and assessment (Woolfolk Hoy, Hoy, & Davis, 2009). Teacher self-efficacy, among many others, emerged as a powerful belief that can shape or guide their own thoughts and actions while acting as a teacher. Teacher self-efficacy beliefs defined as "the teacher's belief in her and his ability to organize and execute the courses of action required to successfully accomplish a specific teaching task in a particular context" (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998, p. 233). Tschannen-Moran, et al. (1998) examined teachers' sense of efficacy under three dimensions, namely *Instructional Strategies* (i.e., confidence in using various instructional strategies), *Classroom Management* (i.e., confidence in managing classroom effectively), and *Student Engagement* (confidence in engaging students to do success for a task). According to a proposed framework by Woolfolk Hoy and Davis (2005), there are directly or indirectly links among teachers' efficacy beliefs and many students' outcomes, such as goal orientation, self-efficacy, task value, self- regulation, and academic achievement. However, Klassen, Tze, Betts, and Gordon's (2011) literature review of the studies between 1998 and 2009 indicated that there were so little research in the literature that these studies found positive correlation or no correlation among these variables. According to Guo, Mcdonald Connor, Yang, Roehring, and Morrison

(2012), Guo, Piasta, Justice, and Kaderavek (2010), and Woolfolk Hoy and Davis (2009), teachers' self-efficacy beliefs had an effect on students' self-regulation and academic achievement, and also the interaction of students' perception of learning environment, and their academic achievements. In addition to teachers' self-efficacy beliefs, achievement goal theory can provide a significant focus to conceptualize teacher motivation (Butler, 2007). According to Butler and Shibaz (2008), teachers' goal orientations predict students' perceptions about teachers' support, inhibited questioning, and help seeking. This might create direct or indirect effect on students' motivational outcomes and academic achievement. Various information can be found in the literature that investigated the influence of teachers' goal orientations (Butler, 2007) on their students' academic achievement. On the other hand, Deevers (2000) and Friedel, Cortina, Turner, and Midgley (2007) indicated that teachers' mastery and performance goals were found as predictors of students' achievement goals. Teachers with a strong sense of efficacy and intrinsic goal orientations are more likely to be more open to new ideas; to experiment with new methods to better meet the needs of their students; to use powerful but potentially difficult-to-manage methods such as inquiry and small group work; to select strategies that support students greater learning; to attend to the special needs of exceptional students; to set clear, challenging, and high learning goals; to persistently reteach when necessary, to be motivated to students to reach goals; to cooperate in class activities and value learning. In this settings, students tend to have more confidence in learning science, to be intrinsically goal-oriented, to attain value of learning activities, to be metacognitively active, to have tentative beliefs about knowledge and knowing, to percept positive learning environment to their learning, and to be more successful in science. In this dissertation, it was expected that teachers' high level of self-efficacy and intrinsic goal orientations may have positive effects on students' science achievements, self-regulation components, epistemological beliefs, and their perception of learning environment (see Figure 1.1).

As emphasized before, teachers' beliefs have a guider effect on teacher's planning, decisions about class management, teaching strategies in other words on teachers' practice (Woolfolk Hoy, Hoy, & Davis, 2009). Therefore, to understand a teachers' practice, their beliefs has a critical value (Luft & Roehrig, 2007). Educational researchers that studied in this area generally stated that teachers' beliefs are directly connected with their actions in the classroom (Fang, 1996; Guskey, 1986; Hashweh, 1996; Kang & Wallace, 2004). With respect to this perspective, teachers that have student-centered beliefs are adjusted to be aware about their students' interests, capabilities, knowledge, and requirements, because these teachers believe that if the instructional plans are adapted to the needs of the students, they can learn better (Woolfolk Hoy, Hoy, & Kurz, 2008). On the other hand, Meece, Herman, and McCombs (2003) claimed that if teachers use learner-centered practices, their students reported stronger mastery and performance goals. Thus, this study was a new attempt to investigate direct or indirect effects of student-centered beliefs and practices on students' science achievements, self-regulation components, epistemological beliefs, and their perception of learning environment. In this study, it was expected that student-centered beliefs and practices are positively linked to students' achievement, their perception of learning environment, epistemological beliefs, and self-regulation, because it was believed that student-centered beliefs and, especially, practices may promote students feeling to challenge learning difficulties, to try to better understanding, to use new strategies to learn better, and to appreciate the value of learning activities (see Figure 1.1).

Another teacher level variable that may be related to student related outcomes involve individual citizenship behavior. Individual citizenship behavior was described by Woolfolk Hoy, Hoy, and Kurz (2008) as "voluntary and discretionary citizenship behavior of teachers that exceed the formal expectation of the job" (p. 825). Greater citizenship behaviors mean teacher's willingness to exceed the formal expectations of a teacher. Such teachers exhibit extra effort to help students to be successful, to meet and work with students' parents. Teachers who are high on organizational citizenship use their talents to enhance students' achievement and adapt easily to apply new teaching approaches and useful teaching strategies in their teaching (DiPaola & Hoy, 2005, Woolfolk Hoy, Hoy, & Kurz, 2008). This is actually related with students' learning environment. Teachers that have high level of citizenship behaviors are thoughtful to act students' achievement, give high importance to teach professionally, and are unselfish to help their students (Woolfolk et al., 2008). These characteristics give an attempt to them and their students to create positive learning environment. If students perceive their classroom learning environment positively, they learn better and have better academic achievement (Allen & Fraser, 2007; Baek & Choi, 2002; Dorman, 2001; Fraser, 1989; Goh & Fraser; 1998; Roth, 1997; Snyder, 2005; Sungur & Gungoren, 2009; Wolf & Fraser, 2008; Yerdelen, 2013). Based on the research reviewed above the current study aims to examine the relationship of practices and individual citizenship behaviors with students' achievement, perception of learning environment, and self-regulation to arrive an information about these relationships. Expectation of this study was that high level of teachers' citizenship behaviors are positively linked to students' achievement, their perception of learning environment, epistemological beliefs, and self-regulation (see Figure 1).

Educational researchers were also interested in teachers' epistemological beliefs as one of the factors influencing student related outcomes. Teachers' epistemological beliefs concern teachers' views about nature and acquisition of knowledge (Luft & Roehrig, 2007). The definition of epistemological beliefs was done by Hofer and Pintrich (1997) as "how individuals come to know, the theories and beliefs they have about knowing, and the manner in which such epistemological premises are part of and an influence on cognitive process of thinking and reasoning beliefs about the processes of knowing and the nature of knowledge" (p. 435). According to Luft and Roehrig (2007), epistemological beliefs and other teachers' beliefs about learning, understanding, and student knowledge are interplayed. Brownlee, Boulton-Lewis, and Purdie (2002) and Hashweh (1996) claimed that teachers' conceptualization of knowledge shapes their teaching beliefs. Accordingly, teachers that have sophisticated epistemological beliefs are more aware of student alternative conceptions, use more effective teaching strategies, and create more qualified learning environment for students to enhance their learning. Thereby, it may be expected that students that are taught by teachers that have sophisticated epistemological beliefs are more successful. However, the literature has little information about the effect of teachers' epistemological beliefs on students' outcomes. With this study, it was proposed that teachers who have sophisticated epistemological beliefs are more likely to provide a positive learning environment for their students to be highly motivated to learn science, and finally, to be successful in science class. And also, their epistemological beliefs may be in a relationship with their students' epistemological beliefs (see Figure 1.1).

Overall, in the field of science, there is a need to explore the predictors of students' science achievement regarding their self-regulation (i.e. self-efficacy, achievement goal orientations, task value, and metacognitive self-regulation), epistemological beliefs, and perception of learning environment by controlling mediator role of teacher's characteristics (i.e. self-efficacy, achievement goal orientations, epistemological beliefs, student-centered beliefs, and individual citizenship behaviors). And also, there is a need to investigate the predictors of self-regulation, epistemological beliefs, and perception of learning environment. Accordingly, the purpose of the present study was to investigate the ways in which teacher or class level (Level-2) variables affect student level (Level-1) variables, and in turn affect 7th grade students' science achievement in Ankara. The main outcome variable was students' science achievement and student level variables were Self-Regulation (i.e. Self-Efficacy, Achievement Goal Orientation, Task Value, and Metacognitive Self-Regulated Learning), Epistemological Beliefs, and Constructivist Learning Environment. Teacher level variables were Self-Efficacy, Achievement Goal Orientation, Epistemological Beliefs, Student-Centered Beliefs and Practices, and Individual Citizenship Behavior. By using these level-1 and level-2 variables, interrelationships among 7th grade students' self-regulation, epistemological beliefs, constructivist learning environment, science achievement, and their science teachers' personal characteristics were investigated. To achieve this purpose, numerous Hierarchical Linear Modeling analyses were conducted. The proposed model for this study was presented in Figure 1.1. Accordingly, all student level factors have directly effects on students' science achievement. All teacher level factors also have direct effects on students' achievement. Moreover, it was expected that some teacher level variables mediated the relationship between student level variables and students' science achievement. On the other hand, interaction of teacher level variables with student level variables was suggested. And lastly, students' self-regulation variables were proposed to mediate the relationship of students' epistemological beliefs and constructivist learning environment with students' science achievement.

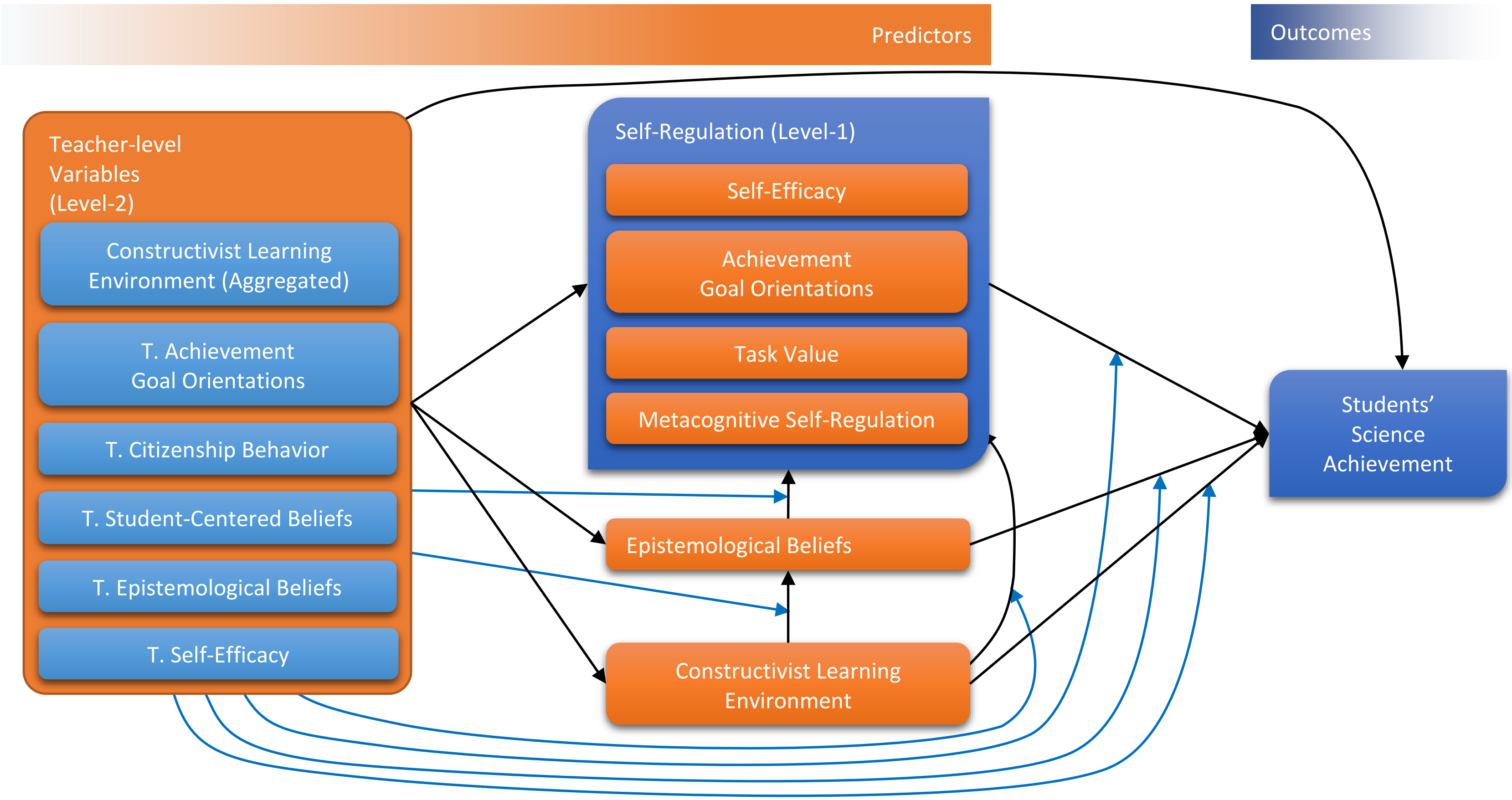


Figure 1.1 The proposed model that presented the relationships among teacher level (Level-2), student level (Level-1), and students' science achievement.

Note. Black arrows refer to relationship from predictors to outcome variables. Blue arrows refer to mediator effects of level-2 variables on level-1 predictors and outcome variables.

1.1 Significance of the Study

Over the decades, the main focus of educational psychology has been student motivation and how to improve students' achievement (Butler, 2007). The foremost theorists of the educational psychology, Bandura (1986), Pintrich (2000), and Zimmerman (2000), claimed that students' learning and academic achievement are affected from their background characteristics, beliefs, and self-regulation. Additionally, students' perception of their learning environment and their concerns about the nature of knowledge and justification of beliefs, in other word epistemological beliefs, affect students learning outcomes (Fraser & Walberg, 1991). Although, in the literature some studies did not indicate any significant effect of these constructs on students' learning, considerable research revealed powerful effects of self-regulation, epistemological beliefs, and the perception of learning environment on students' academic achievement. Similarly, although some research indicated that students' self-regulation is in a relationship with their epistemological beliefs and the perception of learning environment, little is known about the influence of epistemological beliefs and the perception of learning environment on students' self-regulation. In addition to all of these relationships, it cannot be denied that teachers' beliefs have influences on students' achievement (Butler, 2007). Tschannen-Moran, Woolfolk-Hoy, and Hoy (1998) stated that teachers' beliefs about own teaching performance or achievement had positive effects on students' learning outcomes. However, little is known about the influence of teachers' beliefs, goal orientations, and practices on students' self-regulation, epistemological beliefs, and the perception of their learning environment. This study aims at investigating factors that influence students' academic achievement by examining their beliefs, self-regulation, and the perceptions of their learning environment in relation to their teachers' beliefs, goal orientations, and practices.

Moreover, Wolters and Pintrich (1998) claimed that motivational and cognitive components of self-regulation are differentiated with respect to different domains. Therefore, examining the students' self-regulation, epistemological beliefs, the perception of learning environment in science class are important to make their learning environment active and student-centered and improve their positive perception of learning environment. Many of assessment studies (Programme for International Student Assessment, [PISA], 2003; 2006; 2009; Trends in International Mathematics and Science Study, TIMMS, 1999; 2007) indicated that average scores of students from Turkey with respect to science and technology were considerably lower than average countries. These results created a need to develop new curriculum to improve students' achievement in science and Turkish Ministry of National Education designed a new curriculum to educate students as scientifically and technologically literate, thereby, to enhance their learning science (Ministry of National Education, 2013). The new curriculum was developed by focusing on being actively engaged and constructivist-oriented learning environment, classroom environment, and learning approaches. With this respect, the present study may have valuable contributions in developing Turkish education system by examining how students perceive constructivist learning environment and how these perceptions are related with other students' and teachers' characteristics in addition to achievement. This, also, might be attempt for teachers to enhance their teaching strategies regarding their students' learning approaches through the new curriculum perspectives. It was expected that the results of this study may provide implications for teachers, developers of teacher education programs, elementary science curriculum developers, and educational policy makers.

And finally, nested structure of the data set that was gathered from students was another important point of this study. Raudenbush and Bryk (2002) claimed that students in the same class or same group might be influenced by their learning environment, classmates, and teachers' personal characteristics. This was not disregarded point to examine the data gathered from a population that consists of many class. Hierarchical Linear Modeling (HLM) Analysis provides a new way to examine the relationships in these situations that include cross-level interactions among the constructs (Raudenbush & Bryk, 2002). Seeing the literature on science education, it was obvious that the data that were gathered from students were not examined by paying attention to the nested structure of these data and conducting Hierarchical Linear Modeling (HLM) analysis. There are few studies in Turkey that considered the nested structure of such data (den Brok, Telli, Cakiroglu, Taconis, & Tekkaya, 2010, Tas, 2008, 2013, Yerdelen, 2013, Yildirim, 2012). Therefore, another important contribution of this study was to contribute to the body of literature by employing multilevel analysis to examine the role of student-level (Level-1) variables (i.e. self-regulation, epistemological beliefs, and the perception of learning environment) on students' science achievement by considering the role of their teachers' personal characteristics (Level-2) due to the nested structure of the data. These analyses and results might be used to enhance the learning of science and technology in Turkey.

To sum up, the contributions of this study can be explained as (1) providing a new perspective that examine the role of self-regulation, epistemological beliefs, and the perception of learning environment on students' academic achievement considering teacher characteristics, (2) providing a new perspective that examine the role of epistemological beliefs and the perception of learning environment on students' self-regulation variables by considering teacher characteristics, (3) providing a new perspective that examine the role of teacher characteristics on students' epistemological beliefs and the perception of learning environment, (4) being science subject specific, and (5) conducting Hierarchical Linear Modeling Analysis to examine the nested data.

1.2 Research Questions

Followings were the research questions that were addressed:

1. Research Questions were about Students' Perceptions of Constructivist Learning Environment

1.a. Are there differences in students' perceptions of constructivist learning environment (i.e., *personal relevance, uncertainty*, *critical voice, shared control*, and *student negotiation*) among classes?

1.b. Which teacher level variables (i.e., *self-efficacy, achievement goal orientations, and epistemological beliefs*) are associated with the differences in students' perceptions of constructivist learning environment (i.e., *personal relevance*, *uncertainty, critical voice, shared control*, and *student negotiation*)?

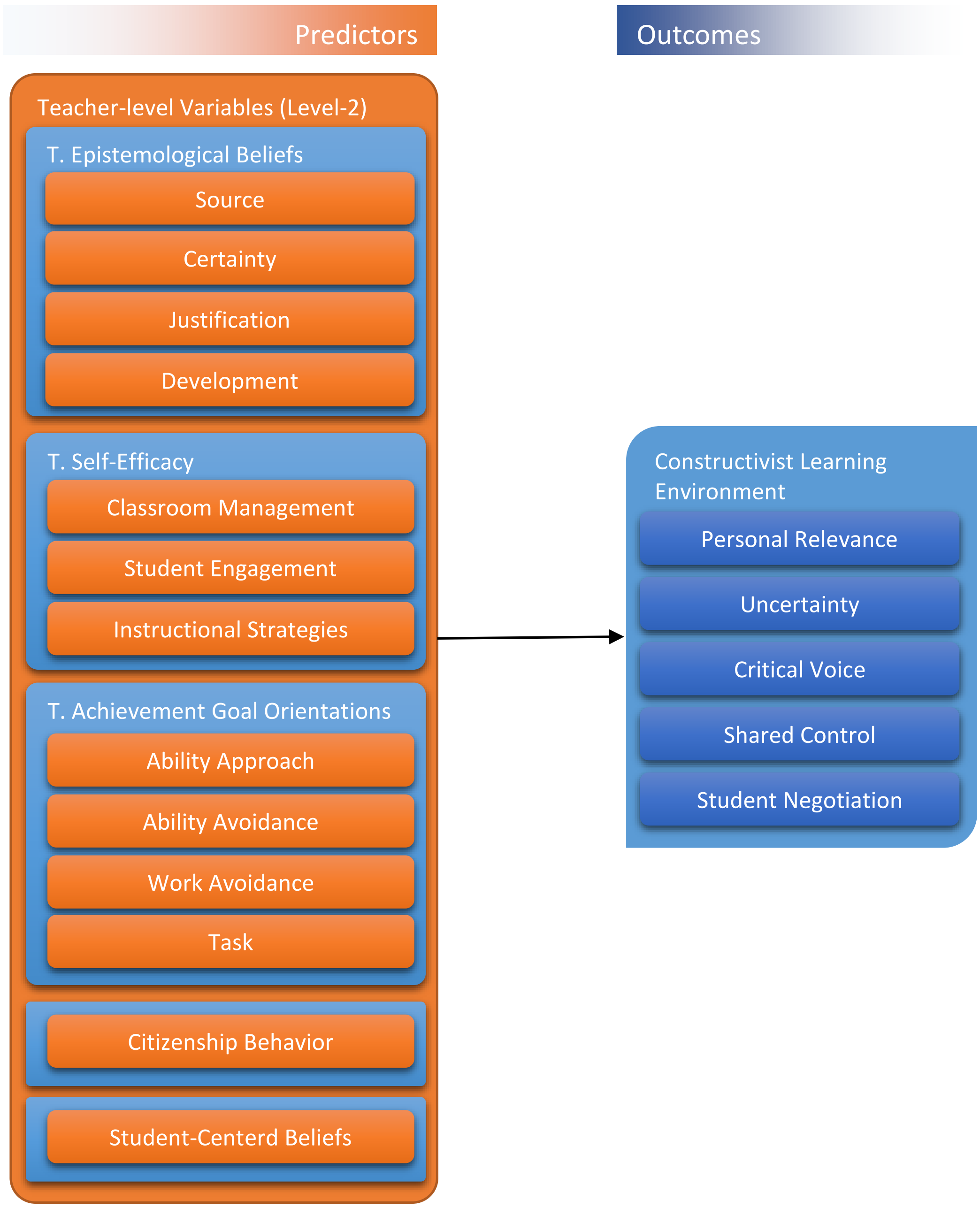


Figure 1.2 The proposed model to present predicting constructivist learning environment by teacher variables.

2. Research Questions were about Students' Epistemological Beliefs

2.a. Are there differences in the students' epistemological beliefs (i.e., *certainty, development, justification, and source*) among classes?

2.b. Which teacher level variables (i.e., *self-efficacy, achievement goal orientations, epistemological beliefs, individual citizenship behavior, student-centered beliefs, and aggregated constructivist learning environment*) are associated with the differences in the students' epistemological beliefs?

2.c. Which student level variables (i.e., *the dimensions of constructivist learning environment*) explain the differences in the students' epistemological beliefs?

2.d. Which teacher level variables (i.e., *self-efficacy, achievement goal orientations, epistemological beliefs, individual citizenship behavior, student-centered beliefs, and aggregated constructivist learning environment*) influence the effect of student level variables (i.e., *the dimensions of constructivist learning environment*) on the students' epistemological beliefs?

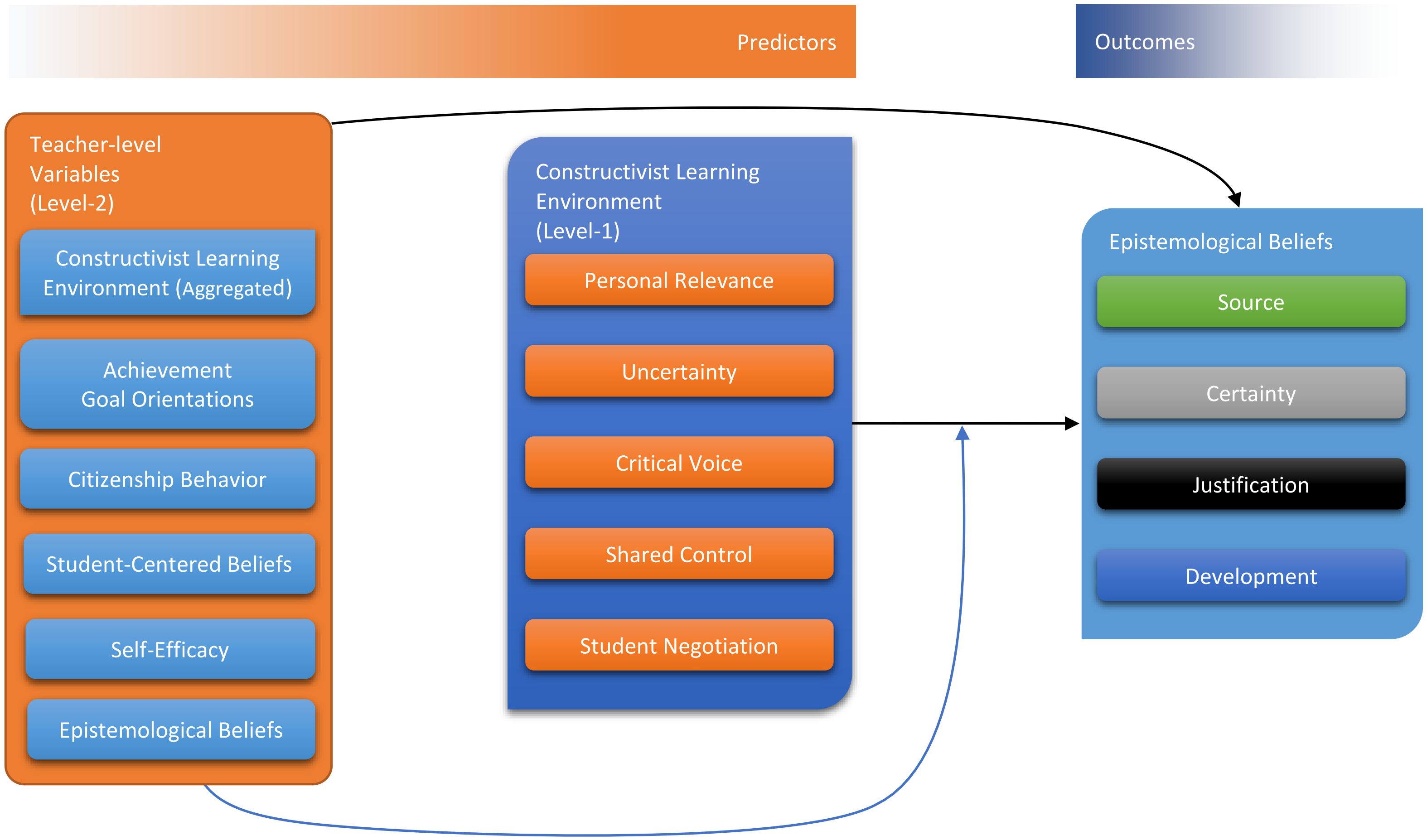


Figure 1.3 The proposed model to present predicting students' epistemological beliefs by constructivist learning environment and teacher variables.

3. Research Questions were about Students' Self-Efficacy

3.a. Are there differences in the students' self-efficacy beliefs among classes?

3.b. Which teacher level variables (i.e., *self-efficacy, achievement goal orientations, epistemological beliefs, individual citizenship behavior, student-centered beliefs, and aggregated constructivist learning environment*) are associated with the differences in the students' self-efficacy beliefs?

3.c. Which student level variables (i.e., *epistemological beliefs and constructivist learning environment*) explain the differences in the students' self-efficacy beliefs?

3.d. Which teacher level variables (i.e., *self-efficacy, achievement goal orientations, epistemological beliefs, individual citizenship behavior, student-centered beliefs, and aggregated constructivist learning environment*) influence the effect of student level variables (i.e., *epistemological beliefs and constructivist learning environment*) on the students' self-efficacy beliefs?

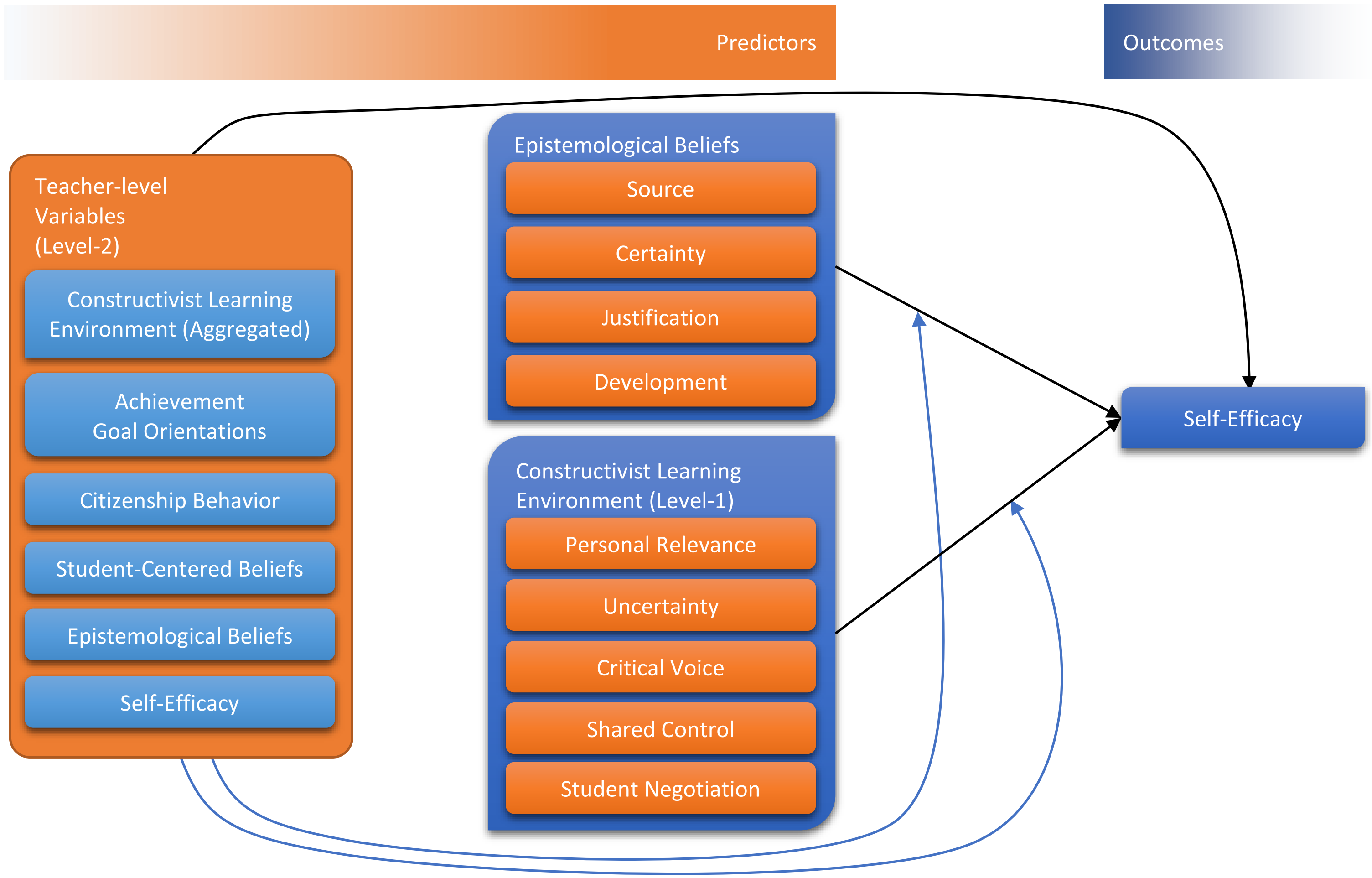


Figure 1.4 The proposed model to present predicting students' self-efficacy beliefs by students' epistemological beliefs, constructivist learning environment, and teacher variables.

4. Research Questions were about Students' Achievement Goal Orientations

4.a. Are there differences in each dimension of the students' achievement goal orientations (i.e., *mastery approach, performance approach, mastery avoidance, and performance avoidance*) among classes?

4.b. Which teacher level variables (i.e., *self-efficacy, achievement goal orientations, epistemological beliefs, individual citizenship behavior, student-centered beliefs, and aggregated constructivist learning environment*) are associated with the differences in each dimension of the students' achievement goal orientations?

4.c. Which student level variables (i.e., *epistemological beliefs and constructivist learning environment*) explain the differences in each dimension of the students' achievement goal orientations?

4.d. Which teacher level variables (i.e., *self-efficacy, achievement goal orientations, epistemological beliefs, individual citizenship behavior, student-centered beliefs, and aggregated constructivist learning environment*) influence the effect of student level variables (i.e., *epistemological beliefs and constructivist learning environment*) on the students' achievement goal orientations?

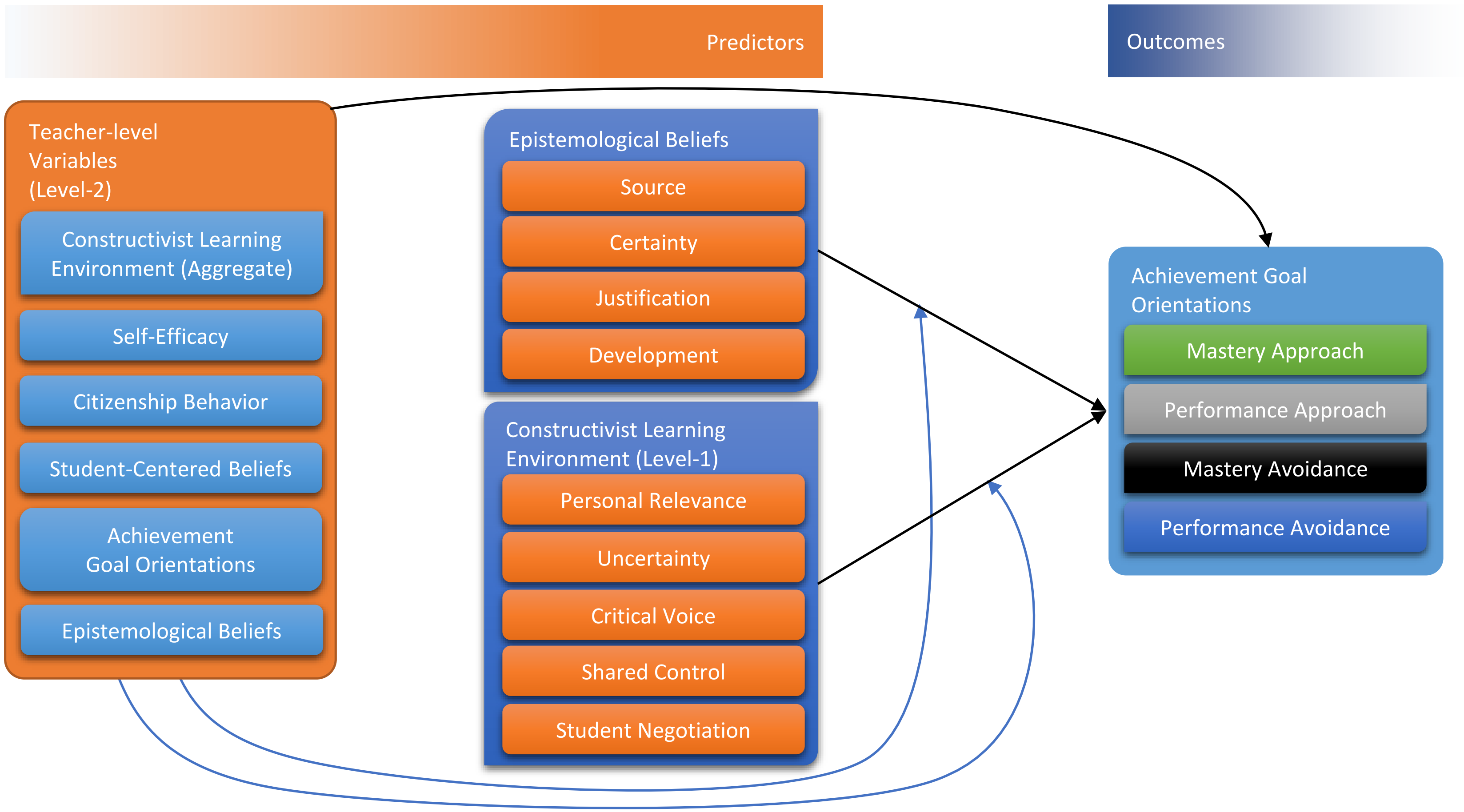


Figure 1.5 The proposed model to present predicting students' achievement goal orientations by students' epistemological beliefs, constructivist learning environment, and teacher variables.

5. Research Questions were about Students' Perception of Task Value

5.a. Are there differences in the students' perception of task value among classes?

5.b. Which teacher level variables (i.e., *self-efficacy, achievement goal orientations, epistemological beliefs, individual citizenship behavior, student-centered beliefs, and aggregated constructivist learning environment*) are associated with the differences in the students' perception of task value?

5.c. Which student level variables (i.e., *epistemological beliefs and constructivist learning environment*) explain the differences in the students' perception of task value?

5.d. Which teacher level variables (i.e., *self-efficacy, achievement goal orientations, epistemological beliefs, individual citizenship behavior, student-centered beliefs, and aggregated constructivist learning environment*) influence the effect of student level variables (i.e., *epistemological beliefs and constructivist learning environment*) on the students' perception of task value?

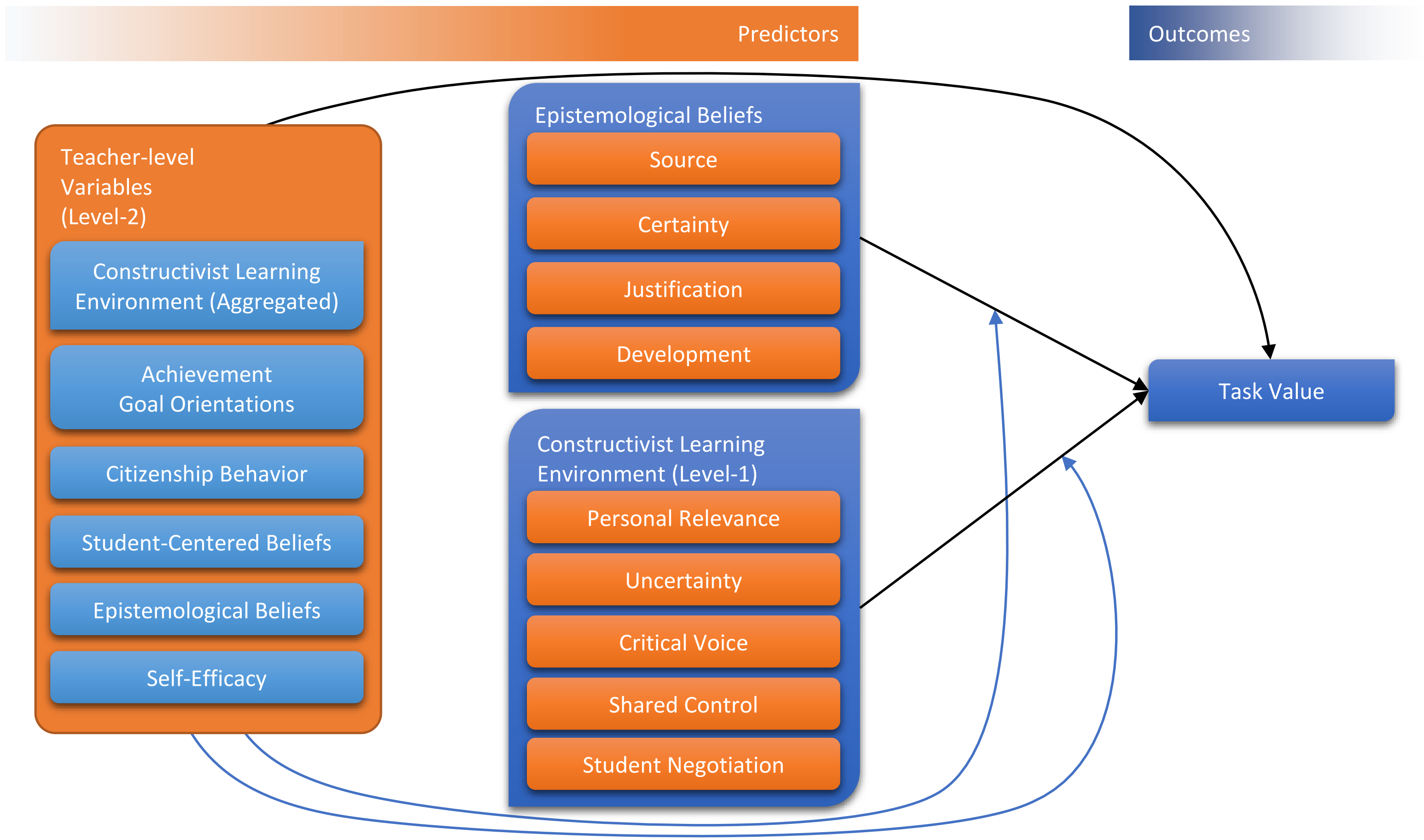


Figure 1.6 The proposed model to present predicting students' perception of task value by students' epistemological beliefs, constructivist learning environment, and teacher variables

6. Research Questions were about Students' Metacognitive Self-Regulation:

   6.a. Are there differences in the students' metacognitive self-regulated learning among classes?

   6.b. Which teacher level variables (i.e., *self-efficacy, achievement goal orientations, epistemological beliefs, individual citizenship behavior, student-centered beliefs, and aggregated constructivist learning environment*) are associated with the differences in the students' metacognitive self-regulated learning?

   6.c. Which student level variables (i.e., *epistemological beliefs and constructivist learning environment*) explain the differences in the students' metacognitive self-regulated learning?

   6.d. Which teacher level variables (i.e., *self-efficacy, achievement goal orientations, epistemological beliefs, individual citizenship behavior, student-centered beliefs, and aggregated constructivist learning environment*) influence the effect of student level variables (i.e., *epistemological beliefs and constructivist learning environment*) on the students' metacognitive self-regulated learning?

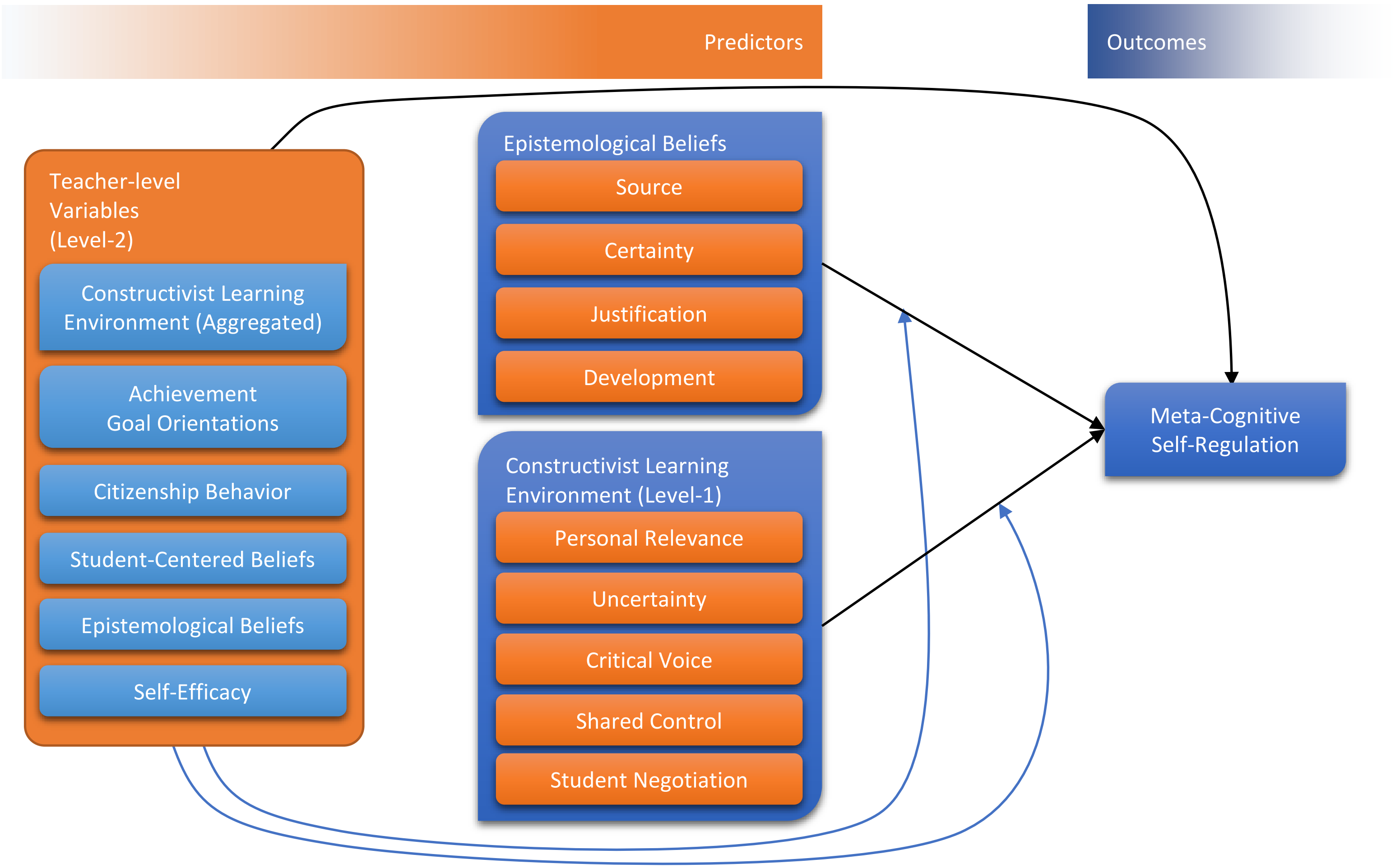


Figure 1.7 The proposed model to present predicting students' metacognitive self-regulated learning by students' epistemological beliefs, constructivist learning environment, and teacher variables.

7. Research Questions were about Students' Science Achievement:

7.a. Are there differences in the students' science achievement among classes?

7.b. Which teacher level variables (i.e., *self-efficacy, achievement goal orientations, epistemological beliefs, individual citizenship behavior, student-centered beliefs, and aggregated constructivist learning environment*) are associated with the differences in the students' science achievement?

7.c. Which student level variables (i.e., *self-efficacy, achievement goal orientations, task value, metacognitive self-regulation, and constructivist learning environment*) explain the differences in the students' science achievement?

7.d. Which teacher level variables (i.e., *self-efficacy, achievement goal orientations, epistemological beliefs, individual citizenship behavior, student-centered beliefs, and aggregated constructivist learning environment*) influence the effect of student level variables (i.e., *self-efficacy, achievement goal orientations, task value, metacognitive self-regulation, and constructivist learning environment*) on the students' science achievement?

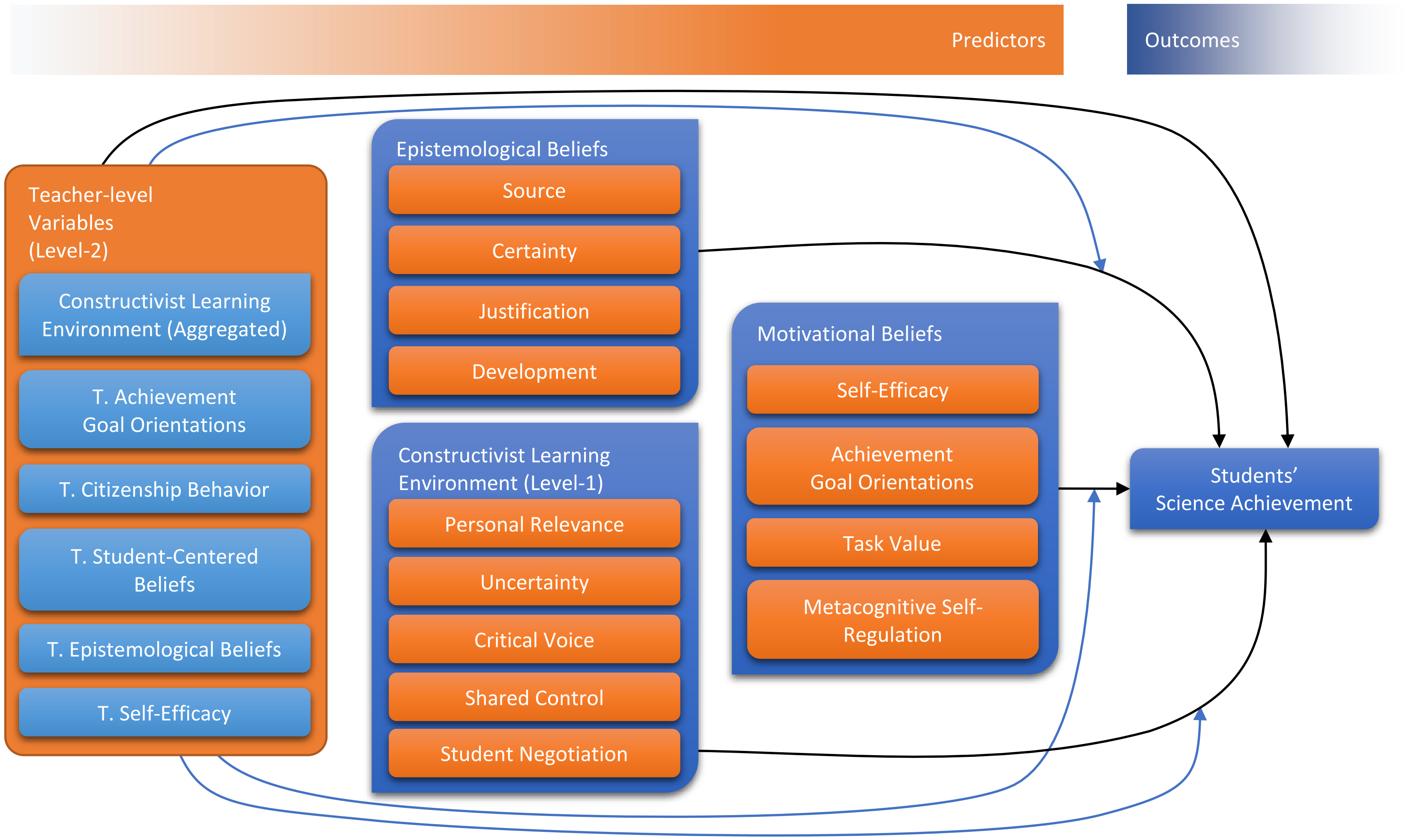
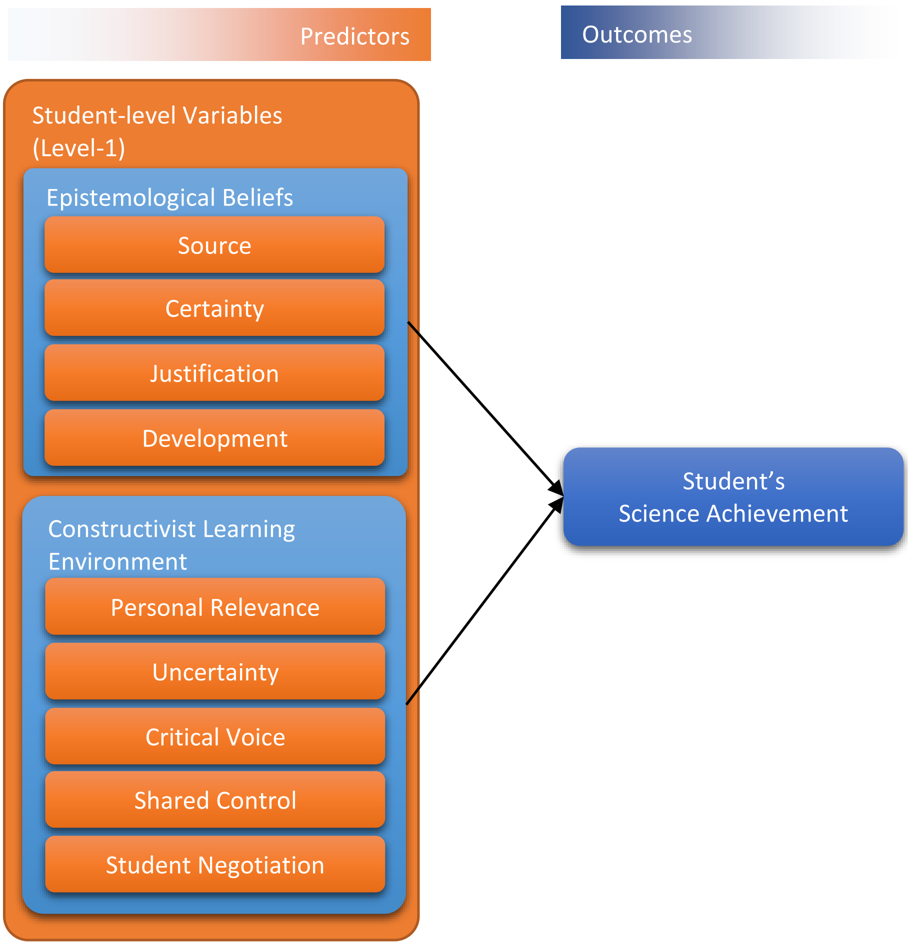


Figure 1.8 The proposed model to present predicting students' science achievement by students' level variables and teacher variables.

8. Research Question was about Mediation Effect of Self-Regulation on the relationship of students' epistemological beliefs and constructivist learning environment with science achievement (Model 1 vs. Model 2):

8.a. Are students' self-regulation variables (*Self-Efficacy, Achievement Goals, Task Value, and Metaconginitve Self-Regulation*) mediating the effect of their epistemological beliefs and perception of constructivist learning environment



on their science achievement?

Figure 1.9 The proposed model-1 based on the results of the HLM analysis for research question 8.

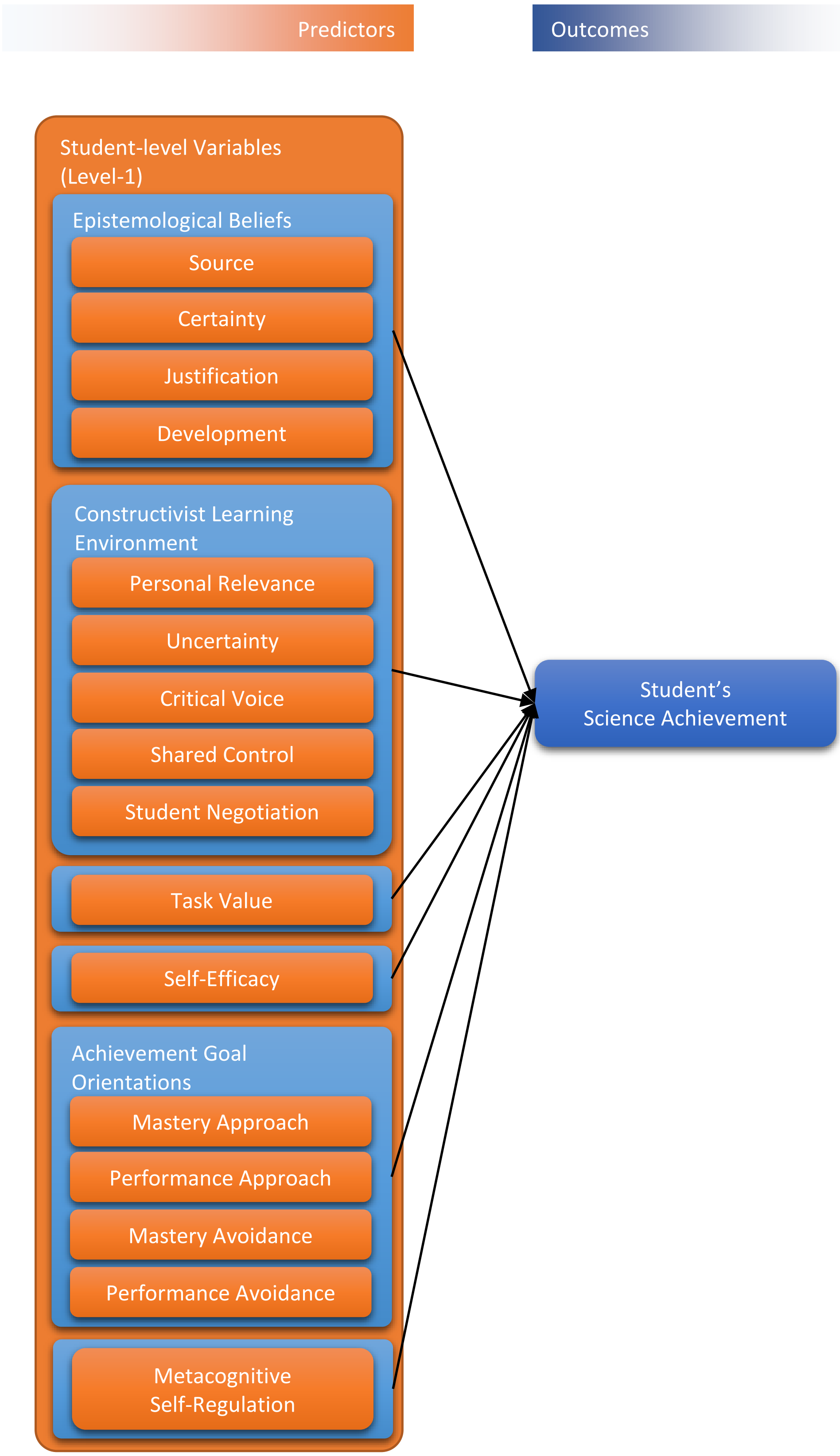


Figure 1.10 Model-2 based on the results of the HLM analysis for research question 8.

1.3 Definition of the Terms

1.3.1 Student Level Variables

Science Achievement: It refers to students' academic performance that was measured by conducting a 14-item multiple-choice science achievement test that covered "Body System", "Force and Motion", and "Electricity".

Self-Efficacy: It refers to students' judgments about their capabilities to success a school related activity or a task in science class.

Achievement Goal Orientations: It refers to students' set of beliefs that reflect the reasons why they approach and engage in academic tasks to achieve these tasks.

Task Value: It refers to students' perception of relative value attributed to the tasks in terms of their interest and significance.

Metacognitive Self-Regulation: It refers to students' own process to plan, to monitor, and to regulate the activities while they are learning in science class.
Epistemological Beliefs: It refers to students' beliefs that they have about the nature of knowledge and knowing.

Constructivist Learning Environment: It refers to students' perception of their learning environment by promoting constructivist oriented teaching in science classroom.

1.3.2 Teacher Level Variables

Teacher Self-Efficacy: It refers to teachers' judgments about their capability to organize and perform their courses to achieve a specific teaching task in a particular context.

Teacher Achievement Goal Orientations: It refers to teachers' set of beliefs for teaching toward developing or demonstrating teaching competence.

Teacher Epistemological Beliefs: It refers to teachers' beliefs that they have about the processes of knowing and the nature of knowledge.

Individual Citizenship Behavior: It refers to teachers' individually voluntary and optional citizenship behavior that surpasses the formal requisites of their job.

Student-Centered Beliefs and Practices: It refers to teachers' beliefs and practices to be aware about students' interests, capabilities, knowledge, and requirements.

CHAPTER II

LITERATURE

This chapter aims to give a theoretical and empirical background regarding self-regulation, epistemological beliefs, and perception of classroom learning environment. Two main headings are used with respect to explaining the Social Cognitive Theory and the Self-Regulated Learning Theory. Then, the definitions and effects of four components of self-regulated learning which are self-efficacy, achievement goal orientation, task-value, and metacognitive self-regulation) on students' academic achievement are given under students part. Moreover, students' perception of constructivist learning environment and epistemological beliefs are defined and examined regarding their influences on students' academic achievement. And lastly, self-regulation variables are examined as mediators of students' perception of constructivist learning environment and their epistemological beliefs. Last part is related to teachers' variables that are self-efficacy for teaching, achievement goals, epistemological beliefs, individual citizenship behaviors, and student-centered beliefs and practices.

The Self-Regulated Learning Theory based on the Social Cognitive Theory. Thus, these two theory, first of all, will be explained briefly and then the literature review will be continued with explaining related variables.

2.1 Social Cognitive Theory

Bandura (1986) describes human behavior as self-organizing, proactive, self-reflecting, and self-regulating and explains human functioning as a product of a triadic reciprocal interaction of behavioral, personal, and environmental influences. This interaction was labeled as *triadic reciprocal determinism*. Accordingly, there are interactions among human behavior, personal factors, and environmental factors and these interactions are mutual, but may not be equal and concurrent (Bandura, 1983) (Figure 2.1).

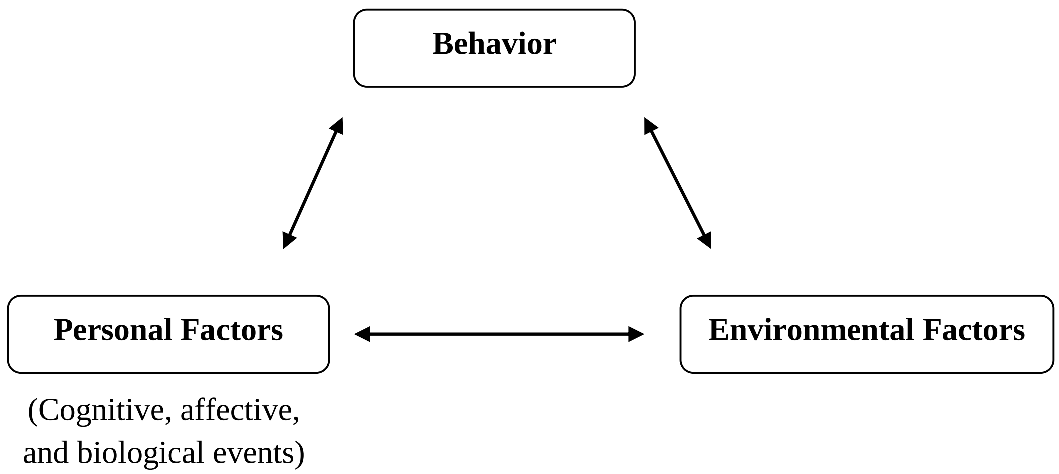


Figure 2.1 Triadic Reciprocal Determinism Model.
Source: Adapted from Pajares, 2002, p.1.

Pajares (2002, p.2) explained triadic reciprocal determinism based on an example;

> "In school, for example, teachers have the challenge of improving the academic learning and confidence of the students in their charge. Using social cognitive theory as a framework, teachers can work to improve their students' emotional states and to correct their faulty self-beliefs and habits of thinking (personal factors), improve their academic skills and self-regulatory practices (behavior), and alter the school and classroom structures that may work to undermine student success (environmental factors)."

According to social cognitive theory (Bandura, 1986), students' emotional states, self-beliefs, and habits of thinking (personal factors) will influence their academic skills and self-regulatory practices (behavior), and vice versa because personal factors and behavior have a bi-directional interaction. For example, anxiety, an emotional state, can affect attention and concentration (behaviors) and behaviors such as improved study skills can affect anxiety. Similarly, students' emotional states, self-beliefs, and habits of thinking (personal factors) have a bi-directional interaction with the school and classroom structures (environmental factors). And finally, there is a two-way interaction between students' personal factors and environmental factors. All of these bi-directional interactions are included in the concept of *triadic reciprocal determinism* (Bandura, 1983, 1986).

Bandura (1986) stated that humans are active agents who have the power to affect and to change their actions. Therefore, humans are both products and producers of their social systems (Pajares, 2002). Bandura (1997) emphasized the importance of self-efficacy as the basis of agency. In order to perform an action, humans must believe they are cable of performing the action.

Social cognitive theory stresses that there are five fundamental capabilities that characterize and indicate what it is to be human, namely symbolizing, forethought, vicarious learning, self-regulation, and self-reflection (Bandura, 1986). Humans can form symbols to represent ideas, actions, and events (i.e. *Symbolizing*). This capability allows humans to solve their problems cognitively and communicate with others through shared symbols (Pajares, 2002). Bandura identified symbols as the vehicle of thought for humans. Humans can also develop and store their actions for future behaviors by creating internal models. In addition to symbolizing capabilities, humans plan future actions by setting goals to motivate themselves and anticipating the likely consequences of these actions which is *Forethought*. As a result they construct expectations and use them choosing actions and planning alternative strategies to act effectively. Humans can learn vicariously (i.e. *Vicarious Learning),* in other words, learn by observation. Observing other's actions allows individuals to learn a new behavior without risks, extended time commitments, and errors. Another capability is *Self-Regulation* which is a mechanism that enables humans to control and change their actions. They set personal standards as a result of their self-observation, judgments, choices, and attributions, evaluate themselves according to these personal standards, and thus are motivated to reach the goals. Last capability called *Self-Reflection*. Humans explore, analyze and evaluate their experiences and their own cognitions. Accordingly, they modify their thinking and their behaviors by reflecting on their actions and exploring self-beliefs. As a specific focus of this dissertation, in the following part only Self-Regulated Learning was explained.

2.2 Self-Regulated Learning

Bandura (1986) stated that self-regulation process is derived from the interaction of personal, behavioral, and environmental triadic processes. The self-regulation models that were proposed by Zimmerman (2000) and Pintrich (2000) are the most popular models that explain self-regulation processes based on social cognitive theory. Zimmerman's (2000) definition of self-regulation is "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals" (p. 14). It can be considered that self-regulation processes are derived from three cyclical stages: Performance (eg. *monitoring*), Self-Reflection (eg. *self-evaluation and self-reaction*), and Forethought (eg. *setting goals and planning*). Three components, namely affective, metacognitive, and behavioral components, are also included into these processes (Zimmerman, 2000).

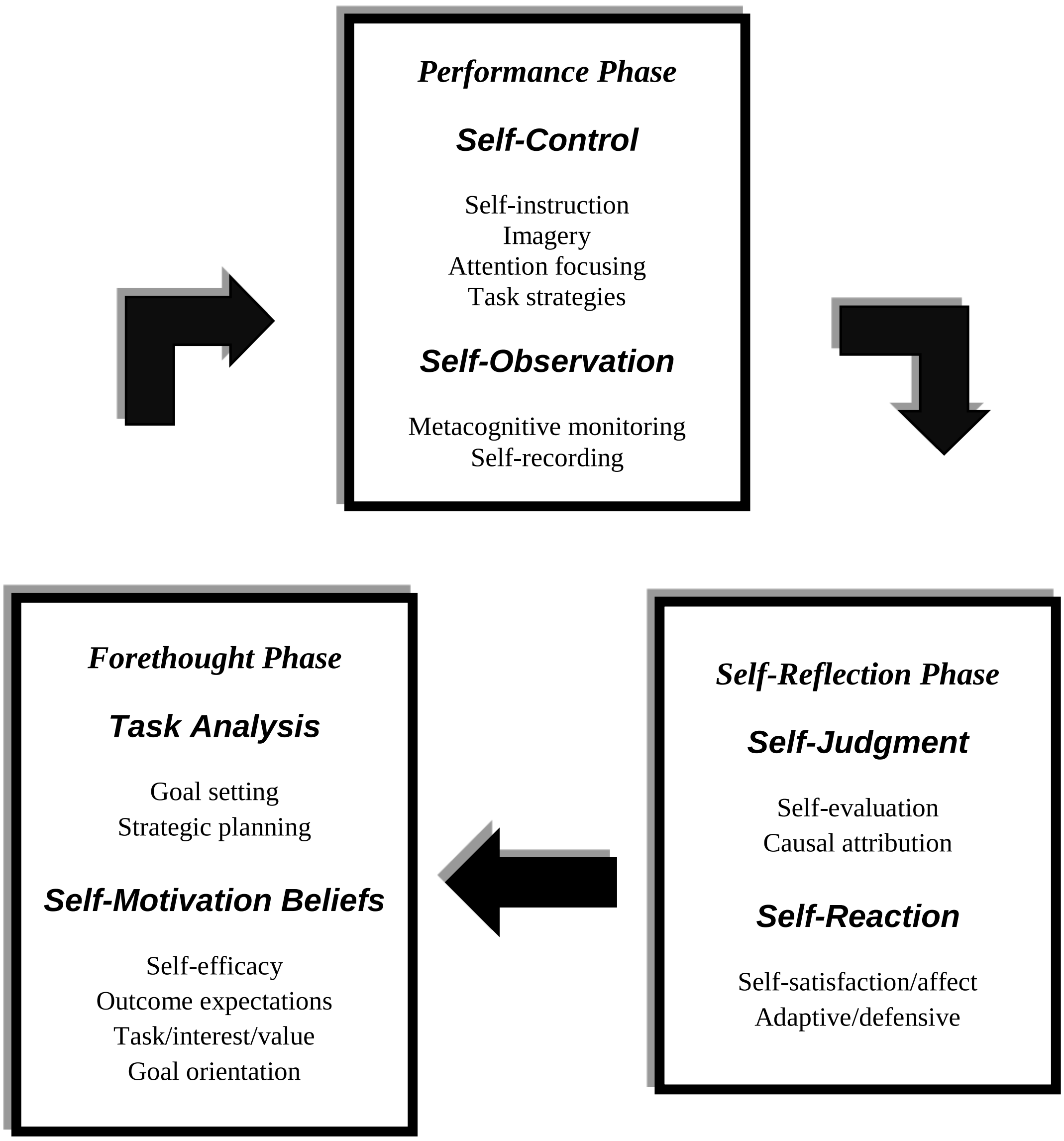


Figure 2.2 Zimmerman's (2000) Model of Self-Regulation. Source: Zimmerman &. Campillo, 2003, p.239.

Another popular model that is based on social cognitive theory is Pintrich's (2000) Self-Regulation Model. Self-regulated learning, according to Pintrich, is "an active, constructive process whereby learners set goals for their learning, and the 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). As understand the definition, Pintrich's model has more detailed information about the processes of self-regulation compared to Zimmerman's model. Pintrich used 4x4 matrix to reveal self-regulation phases (*Forethought*, *Monitoring*, *Control*, and *Reaction*) and areas (*Cognition*, *Motivation*, *Behavior*, and *Context*) of regulation (Table 2.1). Regarding c*ognition area*, individuals give importance different cognitive strategies to learn and perform a task and metacognitive strategies to control and regulate their cognition. Regarding m*otivation* area, individuals' motivational beliefs like 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 have a significance value to regulate their learning. *Behavior area* implied the regulation of behaviors by time planning, help seeking, and effort. And finally, c*ontext area* concern the learning area or contexts.

Pintrich (2000) emphasized the importance of students' self-regulation process to affect their academic achievement. Students that are self-efficacious about abilities doing a task, set goals effectively, have positive perception of task, and use metacognitive strategies can be considered as self-regulated students. Risemberg and Zimmerman (1992) stated that self-regulated students have a tendency to be more successful than students that feel them depended to their teachers to do these tasks.

Self-efficacy, goal orientation, perception of task value that are from motivation and effective area, and metacognitive self-regulation that is from cognitive area can be considered as main focus of Pintrich's model. Thus, Pintrich's model appears to be more appropriate as thinking the scope of this dissertation, Accordingly, in the next /following part, constructs of Pintrich's (2000) Self-Regulation Model, together with their correlates are explained and discussed based on the social cognitive theory. At first, self-efficacy are explained and discussed based on the social cognitive theory under student variables title. Student variables title also includes achievement goal orientation, task value, metacognitive self-regulated learning, and also their epistemological beliefs and perception of constructivist learning environment.

Table 2.1 Conceptual Framework of Studying Self-Regulated Learning (Pintrich, 2000).

	Areas for Regulation			
Phases	***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 adaption 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

2.3 Student Variables

In this section, self-efficacy, achievement goal orientation, task value perception, metacognitive self-regulation components of self-regulation and their correlations with achievement are explained in the light of related literature. Furthermore, in the following this section, epistemological beliefs, constructivist learning environment, and their correlations with academic achievement and self-regulation components are explained.

2.3.1 Self-Efficacy

Self-efficacy, as the most prominent type of self-reflection, is a belief that is central to social cognitive theory. Bandura (1997) defined a self-efficacy belief as a judgment people make about their capabilities to organize and perform actions to reach designated levels of attainment. Accordingly, if individuals have beliefs that they can achieve a task, they have greater incentive to act (Pajares, 2002). Bandura (1997) stressed that human functioning can be influenced by self-efficacy beliefs in various ways. For instance, according to Bandura (1997), self-efficacy beliefs can influence people's *choices*. If people feel capable and confident about an activity or task, they tend to engage in the activity or work on the task. People's *efforts*, *perseverance*, and *resilience* can also be influenced positively by their self-efficacy beliefs. And finally, people's *thought patterns* and *emotional reactions* are under the influences of their self-efficacy beliefs. Bandura identified four main sources that are interpreted by individuals shape their self-efficacy beliefs which are enactive mastery experiences, vicarious experiences, verbal persuasions, and physiological states. *Mastery experiences* are considered as the most influential source for self-efficacy beliefs. Mastery experiences are gained by interpreting the results of previous performances (Bandura, 1997). If individuals perceive successful outcomes on tasks or actions, they have a tendency to develop higher self-efficacy for those tasks or actions, whereas unsuccessful outcomes tend to lower self-efficacy. A second important source of information that influences self-efficacy beliefs is *vicarious* *experience* that is formed by observing others perform tasks. Observing another person performing a task successfully leads to higher self-efficacy beliefs, as long as the observers see the person performing the task as similar to them. Vicarious experiences are less powerful than mastery experiences with respect to their influences on self-efficacy. However, if people have limited experiences performing a task, vicarious experiences become more important in developing self-efficacy beliefs. Another significant source to develop self-efficacy beliefs is *verbal or social persuasion*. Verbal persuasion includes encouragement about performing a task or feedback that helps the person succeed on the task. Bandura (1997) stated that verbal persuasion is a weak source of self-efficacy and less likely to create or change self-efficacy beliefs. Therefore, persuaders must be powerful if they are to help individuals to succeed at a particular task. The last source of self-efficacy beliefs is *psychological and emotional states* such as anxiety, stress, arousal, and mood which give individuals information to use in developing self-efficacy beliefs about performing a task. If individuals have negative thoughts or fears about their capabilities to perform a task, they tend to develop low self-efficacy beliefs.

Bandura (1997) emphasized that individuals filter and interpret the information from these sources and judge them to develop self-efficacy beliefs. This is cognitive and multidimensional process because individuals select, integrate, interpret, and recollect information to make their efficacy judgments.

With respect to students, self-efficacy can be defined as students' judgments about their capabilities to successfully perform a school related activity or a task (Pintrich & Schunk, 1996). Specially, students' self-efficacy beliefs are their task specific judgments of academic abilities (Pintrich & Schunk, 2002). Higher self-efficacy beliefs enable students to attempt more difficult tasks, to have more persistence in face of the difficulties, and to construct different strategies to learn meaningfully. In fact, review of relevant literature indicated that students' self-efficacy is a good indicator with respect to academic achievement and motivation (Pintrich & DeGroot, 1990; Pintrich & Schunk, 2002). There are many studies that reveal a positive relationship between students' self-efficacy and their science achievement by examining this relationship regarding different grade level or different domains (Areepattamannil, Freeman, & Klinger, 2011; Britner & Pajares, 2006; Kupermintz, 2002; Lent, Brown, & Larkin, 1984; Multon, Brown, & Lent, 1991; Pajares, Britner, & Valiante, 2000).

Multon, Brown, and Lent (1991)'s meta-analysis study can be considered as a core research to explore and indicate the relationship between self-efficacy beliefs and academic performance. In their meta-analyses, they synthesized 38 articles that were published between 1981 and 1988 to uncover the relations of self-efficacy to academic performance and persistence. More than half study, correspond to 23 articles, were conducted on elementary school students. Remaining were conducted either on high school or college students. In the study, the relationship between self-efficacy beliefs and academic performance were examined by dividing academic performance under three conceptual categories that are standardized tests, classroom-related tests, and basic skill tests. The results of the study showed moderately positive association between students' self-efficacy beliefs and their academic performance. The amount of the correlation were different regarding the grade level. For instance, self-efficacy beliefs were more accountable on academic performance of high school and college students, whereas less accountable for elementary school students. Another important result of the study were that self-efficacy beliefs were more effective on students' achievements on basic skills.

Britner and Pajares (2006) examined the degree to which sources of self-efficacy based on social cognitive theory predict science self-efficacy beliefs of middle school students. A total of 319 middle school students in grades 5-8 were participated. Authors found science self-efficacy beliefs as a significant predictor of science achievement across 5^{th} to 8^{th} grade level. They also confirmed the sources of self-efficacy, that are mastery experiences, vicarious experiences, social persuasions, psychological states, to support the theoretical tenets of Bandura's social cognitive theory, but the results revealed that only mastery experiences, as a source of self-efficacy, predicted science self-efficacy.

Similarly, Chen and Usher (2013), in a recent study, explored middle and high school students' (N=1225) self-efficacy beliefs to examine effectiveness of sources of self-efficacy and relation of it with academic achievement with respect to science ability, gender, and grade level were examined in the study. The results indicated that the four sources of self-efficacy, that are mastery experiences, vicarious experiences, were supported and mastery experiences were found as a powerful source of self-efficacy. According to the results of the study, students' latent profiles, self-efficacy, and their achievement were in a positive relationship.

Lent, Brown, and Larkin (1984) explored the relationships among 105 undergraduate students' self-efficacy beliefs, educational/vocational choices, and college grades. The results of the hierarchical regression analyses revealed that students' self-efficacy beliefs significantly and positively related with their college grades. In another study, Pajares, Britner, and Valiante (2000) investigated the relationship between some motivation constructs such as achievement goals and self-efficacy beliefs and science achievement of middle school students. One of the results of the study was that there was a significant relationship between students' self-efficacy and their achievements.

In another study, utilizing data provided by PISA 2006, Areepattamannil, Freeman, and Klinger (2011) examined 13,985 fifteen-year-old Canadian students' science achievement under the effect of motivation to learn science, science self-beliefs, and science instructional practices. Hierarchical Linear Modeling (HLM) was used to analyze the data, because some students and school based demographic characteristics were controlled such as gender, immigration status, parental occupational status, enjoyment in science, general interest in science, self-concept in science, school location, school size, science teaching using hands-on activities, etc.

According to the results, students' science achievement was predicted by motivational beliefs that were self-efficacy and self-concept and enjoyment of science.

In a more recent study, Yerdelen (2013) investigated the interactions among 7^{th} grade students' perception of classroom learning environment, self-regulation, science achievement, and their science teachers' beliefs and occupational well-being in Turkey. She did a nationwide cross-sectional study with 372 science teachers and their 8198 seventh grade students. The nested data of the study were analyzed with Hierarchical Linear Modeling by testing by several models. Student variables included self-efficacy, achievement goal orientations, metacognitive self-regulation, learning environment perceptions, and gender. Teacher level variables comprised teachers' self-efficacy beliefs, implicit theories about ability in science, emotional exhaustion, personal accomplishment, and job satisfaction, experience, and gender. The findings of this study that self-efficacy beliefs were found as best predictors of science achievement. Students who had higher self-efficacy beliefs had higher scores on science achievement test.

To Sum up, the literature indicated that self-efficacy is a significant predictor of academic achievement in different grade levels and different domains. Students' task specific judgments of academic abilities affect their academic performance. These research studies indicated the importance of self-efficacy beliefs with respect to students' academic achievements. Thus, it is expected that high self-efficacious students have higher science achievement.

2.3.2 Achievement Goal Orientation

Achievement goal theory has been developed by developmental, motivational, and educational psychologists to explain the achievement behavior of an individual and, therefore, achievement motivation has been one of the core areas for educational researchers (Elliot & Harackiewicz, 1996; Pintrich, 2000; Pintrich & Schunk, 2002). Goal orientation concerns the purposes for engaging in achievement behavior

(Pintrich & Schunk, 2002). Individuals judge their performance and success or failure in reaching a goal (Pintrich, 2000). Therefore, it can be said that goal orientation reflects the way that individuals come to define and evaluate their competence in terms of some standards of excellence. For instance, an individual may pursue the goal of increasing his or her competence in an achievement situation, whereas another individual may pursue the goal of displaying ability and achieving favorable judgments or avoiding unfavorable judgments about his or her competence (Elliott & Dweck, 1988). Achievement goals also provide influential information to individuals to gain new skills (Heyman & Dweck, 1992).

Two major goal orientations with different labels have been identified by researchers with respect to the function in an achievement situation: task-involved and ego-involved (Nicholls, 1984), learning and performance goals (Dweck & Legett, 1988; Elliott & Dweck, 1988), task-focused and ability focused goals (Maehr & Midgley, 1991), and mastery goals and performance goals (Ames, 1992; Ames & Archer, 1988). Pintrich and Schunk (2002) stressed that all of these dual terms have almost same meaning conceptually. Therefore, they decided to use the terms of "mastery goals" and "performance goals." For the sake of simplicity, this desertion utilized mastery and performance goals.

A mastery goal orientation is defined by Pintrich and Schunk, (2002, p. 214) as "in terms of a focus on learning, mastering the task according to self-set standards or self-improvement, developing new skills, improving or developing competence, trying to accomplish something challenging, and trying to gain understanding or insight." On the other hand, a performance goal orientation "represents a focus on demonstrating competence or ability and how ability will be judged relative to others, for example, trying to surpass normative performance standards, striving to be the best in the group or class on a task, avoiding judgments of low ability or appearing dumb, and seeking public recognition of high performance levels (Pintrich and Schunk (2002, p. 214). Elliot and Harackiewicz (1996) stated that there are two main dimensions of mastery and performance goals, approach and avoidance, with respect to motivation. Accordingly, mastery and performance goals are explained by dividing these two dimensions, namely mastery approach goals, mastery avoidance goals, performance approach goals, and performance avoidance goals (Elliot, 1999; Pintrich, 2000; Pintrich & Schunk, 2002). According to this new division, for an individual with mastery approach goals, learning and mastering in order to achieve task mastery and improvement are most important. Conversely, an individual with mastery avoidance goals is most concerned with not falling short of their own self set standards for mastery (Elliot, 1999; Pintrich, 2000). On the other hand, whereas for an individual with performance approach goals, focusing on outperforming others and having favorable judgments about their competence is most important, for an individual with performance avoidance goals, focusing on avoiding unfavorable judgments about their competence and looking incompetent is more critical (Elliot & Harackiewicz, 1996).

According to achievement goal theory, students' goals for learning guide their behavior in achievement settings (Ames, 1992; Pintrich, 2000). Therefore, the main focus of the theory is on students' thinking about themselves, their tasks, and their performance (Anderman & Midgley, 1997). Students' goals determine their approach to, engagement in, and evaluation of performance in school and learning (Dweck & Leggett, 1988). Goal orientations influence motivation for students to complete their academic tasks (Ames, 1992; Dweck, 1986). In the following part, students' achievement goals are defined and their associations with achievement are explained in the light of related literature.

Generally, studies interested in identifying the relationship between achievement goals and academic achievement yielded inconsistent result. In their review study that cover the relation of mastery and performance approach to academic achievement, Linnenbrink-Garcia, Tyson, and Patall (2008) examined over 90 peer-reviewed journal articles. Based on the self-reported achievement goal orientations, mastery goals were found positively correlated with academic achievement in about 40% of all studies, whereas about 5% of them found negative relationship between them. Similar results were also found for performance approach goals. In their review, experimental studies were also examined regarding this relation. Approximately 20% of studies found positive effects of mastery goals, 10% of them found positive effects of performance goals. Interestingly, the remaining percent, 70%, was indicating no relationship between achievement goals and academic achievement.

To see the association of achievement goals with academic achievement, Elliot and McGregor (2001) tested mastery goals by dividing it into approach mastery approach goals, mastery avoidance goals, performance approach goals, and performance avoidance goals. In the study, an achievement goal questionnaire and an achievement test were administered to 182 undergraduate students and the data analyzed with zero order correlation to see the relationships between 4 forms of achievement goals and regression analysis to determine the predictors of academic achievement. The results showed that academic achievement was positively predicted by performance approach goals, but negatively predicted by performance avoidance goals. Results also indicated that academic achievement was not predicted by mastery approach or mastery avoidance. To see 2x2 form of achievement goals, Bargezar (2012) studied on 260 undergraduate students to investigate the relationships between achievement goal orientations and academic achievement. The results of the study revealed positive associations of academic achievement with mastery and performance approach goals, whereas no significantly association with mastery and performance avoidance.

Wolters (2004), in his study, examine how achievement goals were associated with students' motivation, cognitive engagement, and achievement. He conducted a self-report survey to 525 junior high school students to measure their perceived classroom goal structures, personal goal orientations, a collection of motivational outcomes, and achievement. In the study, three goal orientation types were examined, namely mastery goals, performance approach goals, and performance avoidance goals. However, performance approach goals were only found as predictor of teacher-assigned grades. Mastery goals and performance avoidance goals were not significantly associated with achievement.

In a serious of studies by Tas (2013; 2008) found similar results regarding the relationship between two type of achievement goals and science achievement in Turkish context. In the first study, Tas (2008), Patterns of Adaptive Learning Scale (Midgley, et al., 2000) and science achievement test administered to 1950 seventh grade elementary students to assess mastery and performance approach goals and to measure students' science achievement respectively. This study revealed that students' mastery goals significantly and positively associated with their science achievement, but no relationship between their performance approach goals and their science achievement was reported. Second study (Tas (2013) investigated the predictors of seventh grade elementary students' science achievement by using achievement goals that focused on homework. The results were analyzed by conducting HLM analysis indicated that students' science achievements were significantly and positively predicted by mastery approach goals, but not by performance approach goals.

As stated in self-efficacy part, Yerdelen's (2013) findings related with the effects of achievement goals on science achievement revealed that after controlling other student-level and teacher-level variables, students' science achievement was found as positively correlated with mastery approach goals, but negatively with performance avoidance goals. Performance approach goals and mastery avoidance goals were not significantly associated with science achievement.

To be brief, the literature indicated that, among four types of achievement goals that are mastery approach goals, mastery avoidance goals, performance approach goals, and performance avoidance goals, having mastery oriented goals are substantially related to higher level of academic achievement (Bargezar, 2012; Tas, 2008, 2013; Yerdelen, 2013). However, the associations of performance approach goals, mastery avoidance goals and performance avoidance goals with academic achievement were not clear. Some research revealed positive or negative relationship between other academic achievement, but some others did not found any relationship.

2.3.3 Task Value

According to the achievement motivation literature, theorists have attempted to learn people's choice of achievement tasks, giving value to these tasks, and performance on them (Eccles, Wigfield, & Schiefele, 1998; Pintrich & Schunk, 1996; Wigfield & Eccles, 2000). Expectancy-value theory, one of the important theories on motivation explain people's choice, tenacity, and performance by using their beliefs about doing an activity and values on an activity (Wigfield & Eccles, 1992). Expectations for achievement and value attributed to the task are known as basic components of students' motivation to learn. Task value is defined as students' perception of relative value attributed to the tasks in terms of their interest and significance and it is a motivator factor for engagement them in academic activities (Wigfield and Eccles (1992). Accordingly, task value is composed of three values, attainment value, intrinsic value, and utility value, which are considered as affective on achievement-related outcomes in the expectancy-value model (Wigfield & Eccles (1992). While attainment value concerns with "importance of what task?", intrinsic value that deals with "interest", utility value, however, that focus on "usefulness", and "cost". While Wigfield and Eccles (1992) defined task value as motivator factor for engagement in academic activities, it is one of very little-known constructs in expectancy aspects of motivation (Brophy, 1999). Studies on Task Value expressed that people's expectancies about succeeding a task have a mediator role on their motivation and academic achievement. For instance, Bong (2001) searched the role of self-efficacy and task value to predict students' course performance and assessed college students' (n=168) self-efficacy beliefs (i.e. self-efficacy for self-regulated learning, self-efficacy for academic achievement, content-specific self-efficacy, problem-specific self-efficacy), perception of task value, and their roles in predicting students' course performance in a longitudinal study. The results of the study indicated that all self-efficacy factors were associated with each other except for problem-specific self-efficacy and the perception of task value, that students' midterm scores and enrolment intentions were best predicted by task value for the first assessment (T1). Moreover, achievement scores were best predicted by self-efficacy and enrolment intentions were best predicted by task value for the second assessment (T2). In another study, Khezri azar, Lavasani, Malahmadi, and Amani (2010) investigated the relationships among self-efficacy, task value, achievement goals, learning approaches, and academic achievement. A total of 280 high school students were participated to the study. According to the results of path analysis, self-efficacy, mastery goals, and performance goals were positively correlated with the perception of students' task value. Correlation between task value and math achievement were found as significant and positive.

Studying with 1475 ninth grade students, Liem, Lau, and Nie (2008), examined the role of self-efficacy, task value, and achievement goals on predicting learning strategies, task disengagement, peer relationship, and achievement in English. The results yielded that task value was a predictor for only mastery goals, but not for self-efficacy, performance approach goals, and performance avoidance goals. However, students' English test scores were not predicted by the perception of their task value.

To conclude, the literature indicated that task value is motivator factor for engagement in academic activities (Wigfield & Eccles, 1992) and an individuals' expectancies about succeeding a task and subjective task values have a mediator role on their motivation and academic achievement. However, the role of task value, directly or indirectly, on students' academic achievement was not clear. Some research indicated task value as a significant predictor for academic achievement, but some others did not.

2.3.4 Metacognitive Self-Regulation

Students' self-regulatory skills and development of these skills are considered as main goals of self-regulated learning research. According to Zimmerman (1986), self-regulated learners exhibit metacognitively, motivationally, and behaviorally active participation to their own learning. With this respect, metacognitive self-regulation attract attention for researchers. Flavell (1979) mentioned metacognition as an individual's knowledge about own cognitive activities and regulation of them in his/her learning processes. Brown (1987), similarly, defined metacognition as "one's knowledge and control of own cognitive system" (p. 66). Flavell (1979) and Brown (1987) present metacognition by using own classifications. Flavell's (1979) framework explained metacognition by including metacognitive knowledge and metacognitive experiences or regulations. Knowledge of task, knowledge of person, and knowledge of strategy are three components of metacognitive knowledge. Metacognitive experiences or regulations deal with the regulation of an individual own cognition. This regulation process covers three stages. Planning, monitoring, and evaluation are three stages that are followed for appropriate strategy (Schraw & Moshman, 1995). Brown's (1987) framework divided metacognition into two components: knowledge of cognition and regulation of cognition. Former one is related to knowledge of individuals about their own cognition, latter one is related to individuals' metacognitive activities to regulate their cognition process about their learning (Schraw & Moshman, 1995).

Effects of students' metacognition and their awareness and management of their metacognitive actions have been studied as an important research area by several researchers. Sperling, Howard, Miller, and Murphy (2002) did a review literature about metacognition, metacognitive skills, metacognitive strategy use, and their effects on students' academic achievement. Accordingly, the review results indicated inconsistency with respect to their relationships with academic achievement. Some studies revealed that metacognition had positive effects on students' achievement, but some others indicated that there was no any relationship among them. Sperling et al.

(2002) also investigated measures of children's metacognition. They used two self-report inventories of Junior Metacognitive Awareness Inventory (Jr. MAI) to measure knowledge of cognition and regulation of cognition. The results revealed that, for 3rd to 5th grade students, metacognition and achievement were in a significant relationship, but not in a relationship for 6th to 8th grade students.

In another study in the literature of metacognition, Al-Harty and Was (2013) examined the relation of knowledge monitoring that is a fundamental or prerequisite metacognitive process and some motivational constructs, namely self-efficacy and goal orientations. Proposing a path model, students' academic achievement were predicted by analyzing the data that were gathered from undergraduate students in the Educational Psychology course. The results of the path analysis showed that students' academic achievement was predicted by knowledge monitoring and mastery goals. However, Al-Harty and Was (2010), in a past research, did not found a significant correlation between the use of metacognitive strategy use and students' academic achievement. This study was done with participation of undergraduate students in the Educational Psychology course by administrating Motivated Strategies for Learning Questionnaire (MSLQ).

van Kraayenoord and Schneider (1999) studied on 140 German school students in grade 3 and 4 grade to examine the achievement in reading, metacognitive knowledge in reading and memory, reading self-concept, and interest in reading. The results of the study indicated that students in both grade levels that had greater metacognitive knowledge in memory had higher level of reading achievement. Seeing another result of the study, it was obvious that good and poor readers showed different level of metacognitive knowledge with respect to reading and memory.

Fritz and Peklaj (2009) studied to investigate the relationships between processes of self-regulated learning and achievement in Music Theory. A total of 457 Slovenian music schools students that were fifth- and sixth- graders were participated to the study and completed two questionnaires that were about affective-motivational processes and metacognitive processes of self-regulated learning and two Music Theory Achievement Tests (MTAT). The results of the study revealed that almost all affective-motivational processes, metacognitive processes, and students' achievement were in relationships. Comparing the predictor values of affective-motivational and metacognitive factors of self-regulated processes, affective-motivational processes were better than metacognitive processes to predict students' achievement in Music Theory.

Another study that indicated the positive relationship between metacognition and academic achievement was Ozsoy and Ataman's (2009) research. In the study, the effect of using metacognitive strategy training on mathematical problem solving achievement was investigated by conducting a 9-week experimental study with 47 fifth grade students. The experimental groups' instruction included a training program that improved students' metacognitive skills, whereas control group did not take any special training program. According to the results, the students in the experimental group significantly enhanced their mathematical problem solving achievement and also metacognitive skills.

Similarly, Topçu and Yilmaz-Tuzun (2009) investigated this relationship, differently by using Junior Metacognitive Awareness Inventory (Jr. MAI). They, indeed, focused two different point that were (1) investigating the association of science achievement, metacognition, and epistemological beliefs; and (2) exploring the association of gender socioeconomic status, metacognition, and epistemological beliefs. A total of 941 elementary students were answered the questionnaires. The results of the study showed that two components of Jr. MAI that were knowledge of cognition and regulation of cognition were positively related with students' science achievement scores.

Yumuşak, Sungur, and Cakiroglu (2007) examine the influence of motivational beliefs, cognitive, and metacognitive strategy use on students' biology achievement. A total of 519 high school students were administrated MSLQ and a biology achievement test. According to the multiple linear regression analyses, students' metacognitive strategy use did not found in an association with their academic achievement in biology. In another study, Yerdelen, Sungur, and Klassen (2012) and Yerdelen (2013) did not found a significant correlation between metacognitive strategy use and academic achievement. Yerdelen et al. (2012) studied on high school students by administrating MSLQ. Yerdelen (2013) did a complex study to investigate the interrelations among students' self-regulation, perception of classroom learning environment, science achievement, and some teachers personal characteristics. A total of 372 science teachers and 8198 seventh grade students participated to the study. As said before, the results of the study indicated that metacognitive strategy use was not a significant predictor of students' science achievement.

As stated in some previous parts, Yerdelen (2013) examined the interrelations among students' perception of classroom learning environment, self-regulation, science achievement, and their science teachers' beliefs and occupational well-being. Her findings related with the effects of metacognitive self-regulation on science achievement revealed that after controlling other student-level and teacher-level variables, students' science achievement was not found as significantly correlated with metacognitive self-regulation.

To summary, effects of students' metacognition and metacognitive strategy use have been studied as an important research area by several researchers. The results of the study in the literature revealed inconsistent findings with respect to metacognitive self-regulation with academic achievement. Some studies revealed that metacognition had positive effects on students' achievement, but some others indicated that there was no any relationship among them. To see the predictive effect of metacognitive self-regulation on students' achievement, more study is needed to conduct on a large sample in a culturally different context. Therefore, the one of the purposes of this study is to examine this relations in the context of Turkey.

2.3.5 Student Epistemological Beliefs

In the relevant literature, apart from self-regulation, Hofer and Pintrich (2002) stated that students' epistemological beliefs are also found to be significantly related to their learning outcomes. Epistemological beliefs refer to the nature of knowledge and justification of beliefs, so it includes more than one independent dimensions (Schommer, 1990). Epistemology defined by Schommer as "a belief system that is composed of several more or less independent dimensions" (p.498). Schommer proposed a four-factor structure to measure epistemological beliefs, namely simple knowledge (i.e. knowledge is simple rather than complex), certain knowledge (i.e. knowledge is certain rather than tentative), innate ability (i.e. the ability to learn is innate rather than acquired), and quick learning (i.e. learning is quick or not at all). Hofer and Pintrich (1997) determined two main areas for epistemological beliefs: Beliefs about the nature of knowledge and beliefs about the nature of knowing. Certainty of Knowledge and Simplicity of Knowledge are dimensions of epistemological beliefs about the nature of knowledge, whereas Source of Knowledge and Justification for Knowing are dimensions about the nature of knowing. Certainty of Knowledge is related to beliefs that knowledge is absolutely truth and does not change (less sophisticated beliefs). Beliefs in Simplicity of Knowledge is related that knowledge is discrete, concrete, and knowable facts. Source of Knowledge refers to beliefs about knowledge belong to an external expert. And finally, Justification for Knowing is about evaluating knowledge. Conley et al. (2004) examined epistemological beliefs under four dimensions, namely source, certainty, development, and justification. Source refers people's beliefs about knowledge belong to external authorizes such as teachers, Certainty refers a certain belief about answers of questions, Development is beliefs about changing and developing science, and Justification is about how people justify knowledge.

In the literature, studies that examined the role of epistemological beliefs indicated that epistemological beliefs were positive predictors for students' academic performance (Cano, 2005; Conley et al., 2004; Schommer, 1990; 1993; Schommer, Crouse, & Rhodes, 1992; Smith, Maclin, Hougthon, & Hennessey, 2000; Topcu & Yilmaz-Tuzun, 2009). For instance, Schommer (1990) examined students' preferences about their knowledge and learning. Her findings indicated that students who had less sophisticated beliefs in quick learning, simple knowledge, certain knowledge, and fixed ability had better academic achievement. Schommer (1993), in another study, investigated the development of secondary school students' epistemological beliefs and also their effects on students' academic achievements. The findings of this study revealed that epistemological beliefs were not only effective directly, but also effective indirectly on academic achievement. Students who had sophisticated beliefs in quick learning, simple knowledge, certain knowledge, and fixed ability were likely to exhibit higher achievement in their course.

In another study, Conley et al. (2004) did a study to investigate the enhancement of students' epistemological beliefs at the end of nine week hands on science. A hundred and eighty seven fifth grade students participated to the study and data were collected at the beginning and end of the unit. The findings of the study indicated that if students had low SES and low academic achievement, they had less sophisticated beliefs in Source, Certainty, Development, and Justification dimensions. Cano (2005) did a study to analyze the change in epistemological beliefs and learning approaches in students and examine the effects of epistemological beliefs on learning approaches, and learning approaches on academic performance. The study was conducted on 1.600 secondary school Spanish students. The results indicated that epistemological beliefs had direct effects on academic achievement, and also indirectly effects via students' learning approaches. Accordingly, students who were successful in their course believed that learning occurs gradually and is not a fixed ability. Also, they believed that knowledge is an organized structure and is not absolute.

Moreover, students' epistemological beliefs also affect their motivational beliefs and cognitive strategies (Braten & Stromso, 2004; Cavallo, Rozman, Blickenstaff, & Walker, 2003; Cavallo, Potter, & Rozman, 2004; Hofer, 1994; Hofer

& Pintrich, 1997; Kizilgunes, Tekkaya, & Sungur, 2009; Paulsen & Feldman, 1999; Rastegar, Jahromi, Haghighi, & Akbari, 2010; Schommer, 1990; Schutz, Pintrich, & Young, 1993). Kizilgunes, Tekkaya, and Sungur (2009) examined students' epistemological beliefs, achievement motivation, and learning approaches as the predictors of achievement in science. The study was conducted with a total of 1041 sixth grade students. The results of the study revealed that students' academic achievements were in a relationship with their epistemological beliefs, learning approaches, and goal orientations. Another important result of this study was that learning goals, performance goals, and self-efficacy were predicted by their epistemological beliefs. Regarding achievement motivation, the findings indicated that if students believed that knowledge is evolving (development) and handed down by authority (source), they were more likely to be self-efficacious and had higher levels of learning and performance goals in their learning.

Paulsen and Feldman (1999), in their study, indicated the association between epistemological beliefs and motivational constructs (i.e. self-efficacy, goal orientations, task value, etc.). They used the Schommer Epistemological Questionnaire (Schommer, 1993) and the Motivational Strategies Learning Questionnaire (Pintrich, Smith, Garcia, & McKeachie, 1993) to collect data from 246 college students. The results of the study revealed that students who had more sophisticated beliefs in simple knowledge were more likely to be self-efficacious about their learning capacity, to hold an intrinsic goal orientation, and to appreciate the value of their learning task. Also, students who had more sophisticated beliefs in quick learning were less likely to appreciate the value of learning tasks and more likely to have intrinsic goal orientation. Sophisticated beliefs in fixed ability were positively related with having as intrinsic goal orientation, appreciating the value of learning tasks, and high self-efficacy of students. On the other hand, any correlation was not found between motivational constructs and certain knowledge.

Schutz, Pintrich, and Young (1993) revealed that sophistication in epistemological beliefs was found to be positively related with adapting to mastery goals and engaging to material more deeply. Additionally, Hofer (1994) claimed that sophisticated epistemological beliefs were associated with intrinsic motivation, self-efficacy, self-regulation, and academic achievement. A total of 438 students in a university participated to the study. The results revealed that sophistication in epistemological beliefs were positively correlated with intrinsic motivation and self-efficacy. Students with highly sophisticated beliefs exhibited mastery-oriented goals and high academic performance in mathematics.

Cavallo et al. (2003) and Cavallo et al. (2004), in these studies, examined the correlation among epistemological beliefs, motivation, learning approach, and achievement. For instance, Cavallo et al. (2003) studied on 291 college students and analyzed data by using correlation and stepwise regression analyses. They found that meaningful learning and tentative epistemological beliefs positively predicted the learning goals for biology students. However, epistemological beliefs did not predicted course grade for both biology and physics students. Cavallo et al. (2004) studied on 290 physics students and the result indicated that tentative science beliefs were negatively associated with performance goals.

In another study, Braten and Stromso (2004) examined epistemological beliefs and implicit theories of intelligence as predictors of achievement goals. A sample of 80 Norwegian preservice teachers participated to the study. The findings indicated that student teachers' achievement goals were predicted by their epistemological beliefs in the speed of knowledge acquisition. Naïve beliefs in quick learning were negatively associated with mastery approach goals, but positively with performance approach and performance avoidance goals. Moreover, preservice teachers with epistemological beliefs in stable and given knowledge tended to have mastery goals adoption. Regarding overall results about predictive effects on achievement goals, the study indicated that epistemological beliefs had more important roles than implicit theories of intelligence.

Rastegar et al. (2010) investigated the mediation effects of self-efficacy, achievement goals, and cognitive engagement on the relationship between students' epistemological beliefs and mathematics achievement. To conduct study, 473 basic science students participated and took four subscales to employing study. The results revealed that mathematics self-efficacy, achievement goals, and cognitive engagement mediated the association of epistemological beliefs and mathematics achievement. The correlation between naïve epistemological beliefs and math achievement was weaker, if students have mastery goal adoption, high level of math self-efficacy, and use metacognitive self-regulation strategies.

To summary, the review of literature stated that students' epistemological beliefs were related with a variety of student outcomes such as self-efficacy, achievement goals, and academic achievement. The results of the study in the literature revealed generally similar, but sometimes different findings with respect to relationships of epistemological beliefs with self-regulation and academic achievement. To see the predictive effect of epistemological beliefs on students' achievement and self-regulation, a new study is needed to conduct on a large sample in a different context. Therefore, the present study purposed to examine these relations in the context of Turkey.

2.3.6 Constructivist Learning Environment

Students' behaviors and perceptions in classroom were become one of the main focuses of Educational research. Research on the perception of learning environment in the learning process indicated valuable findings in the literature. Accordingly, like self-regulation variables, the perception of classroom learning environment can be a good predictor of students' academic achievement (Baek, & Choi, 2002; Dorman, 2001; Fraser, 1994; Margianti, Fraser & Aldridge, 2002). The results of the study indicated a simple finding; if students perceive their classroom learning environment positively, they learn better and have better academic achievement.

In the area of educational psychology, the studies of learning environment perception have focused on the development and validation of instruments to measure participants' perceptions of it (Fraser, 1998). Walberg and Anderson (1968) developed the *Learning Environment Inventory (LEI)* and the final version of it had 105 statements to describe the classrooms. The scale had 4-choice to answer, namely Strongly Disagree, Disagree, Agree, and Strongly Agree. Then, Trickett and Moss (1973) developed the *Classroom Environment Scale (CES)* as a different scale to measure the perception of classroom environment. It had nine scales that each one had ten true-false items. The *My Class Inventory (MCI)* (Fisher & Fraser, 1981) was the simplified version of the LEI, but simplification of the LEI differed the MCI in terms of four important ways. The MCI was useful for the junior high school students, was more readable, had Yes-No response format, and had own answer sheet on the questionnaire. The final form of the questionnaire had 38 items. The *College and University Classroom Environment Inventory (CUCEI)* (Fraser & Treagust, 1986) was developed to use in small classes to examine classroom environment in college and universities. It had seven scales that had seven four-choice Likert type items. Wubbels and Levy (1993) developed the *Questionnaire on Teacher Interaction (QTI)* to measure students' perceptions of learning environment with respect to the nature and quality of interpersonal relationships teachers and students. The aim of the development of *Science Laboratory Environment Inventory (SLEI)* was to measure the environment of science laboratory classes (Fraser and McRobbie, 1995). The focusing groups for this scale were the senior high school and higher education level students. To see the students' perception of learning environment and to be able to provide a learning environment to learn more meaningfully, the *Constructivist Learning Environment Survey (CLES)* was developed by considering to construct a constructivist learning environment. The CLES (Tylor & Fraser, 1991; Taylor, Fraser, & Fisher, 1997) was developed to measure students' perceptions of learning environment in their student-centered classrooms. It was originally developed by Taylor and Fraser (1991) and revised by (Taylor, Dawson & Fraser, 1995; Taylor et al., 1997, Johnson & McClure, 2004). After revision of original one, the final scale had 20 items under 5 sub-scales that are Personal Relevance, Uncertainty, Critical Voice, Shared Control, and Student Negotiation. And finally, Fraser, Fisher, and McRobby (1996) developed the W*hat Is Happening In This Class (WIHIC) Questionnaire* by combining existing questionnaire. This scale also had additional items that response the needs for contemporary educational concerns. Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity were seven dimensions of the WIHIC Questionnaire.

The perception of learning environment in classroom were studied by several researchers by using above instruments with respect to the relationship with other students' variables, such as academic achievement, epistemological beliefs, and some self-regulation variables. Following part will continue to present some studies summarily by examining the correlation between classroom learning environment and academic achievement.

The Perception of Learning Environment in Classroom and Academic Achievement

The literature on the effects of learning environment perception on students' academic achievement indicated that perceptions of learning environment are strong predictors of academic achievement. General findings revealed that if students perceive their learning environment positively, they have higher achievements. For instance, Ogbuehi and Fraser (2007) investigated the effectiveness of enhancing students' learning environment by using innovative teaching strategies on students' learning. A total of 661 students was educated in constructively enhanced computer laboratories. Before and after nine week teaching, personal relevance, shared control, and student negotiation items of CLES, involvement, task orientation, and investigation items of WIHIC were conducted to the students to measure their perception of learning environment. The findings revealed that positive perception of learning environment and academic achievements of students were higher in experimental groups than control group. These results supported that students who have positive perception of their learning environment are more likely to successful in their course.

In another study, Snyder (2005) did a study to examine the relationships between students' perception classroom learning environment and their science achievement. WIHIC questionnaire was used on 840 middle school students to assess their classroom learning environment. The findings of the study showed that each dimension of WIHIC explained less than 10% of the variation in students' science achievement. Although the relationship between the dimensions of WIHIC and science achievement were weaker, positive and significant correlations were found. Snyder (2005), then, run a multilevel analysis to explained variation in science achievement by adding only Task Orientation and Involvement dimension of WIHIC. The results indicated that both of them were significant predictors and explained 10% of variation of students' science achievement.

Wolf and Fraser's (2008) study was another research that found significant and positive correlation between perception of learning environment and science achievement. They studied with 1434 middle school students and conducted WIHIC questionnaire to measure their learning environment perceptions. They conducted simple correlation and multiple correlation analyses to the data. The results of the simple correlation analyses revealed that in individual level Investigation, Task Orientation, and Equity dimensions of WIHIC were found as positively correlated with science achievement scores, but considering the class mean, there was no any correlation between them. Multiple correlation analysis indicated that in individual level Teacher Support, Task Orientation, Equity, and Cooperation were found as significant predictors of science achievement, but similar to simple correlation analyses, any dimension of WIHIC was not found as significant predictors of science achievement considering the class mean.

Baek and Choi (2002) studied with 1012 high school students to explore the correlation between learning environment perception and academic achievement.

They used 9-dimension Korean version of CES (KCES) to measure students' perception of classroom learning environment and 25-item multiple choice English test to measure students' achievement in English. Simple correlation and multiple regression analyses were conducted to analyze data. Simple correlation analysis showed that Involvement, Affiliation, Competition, Task Orientation, Order and Organization, Rule Clarity, and Teacher Control dimensions of KCES were found as significantly associated with academic achievement, but Teacher Support and Innovation dimensions were not significantly related with achievement. The results of multiple regression indicated that 9 dimensions of KCES explained 7% of variance in achievement scores and R for multiple correlation was found as .27.

The literature about learning environment perceptions revealed non-significant correlation between academic achievement and perception of learning environment. For instance, den Brok, Telli, Cakiroglu, Taconis, and Tekkaya (2010) did not found any correlation among biology achievement and six distinct profiles identified by using WIHIC items, namely Self-Directed Learning Classroom, Task-Oriented Individualised Classroom, Low-Effective Learning Classroom, and High Effective Learning Classroom. Allen and Fraser's (2007) study was another research that used WIHIC questionnaire and did not found any correlation among science achievement and any dimension of WIHIC questionnaire.

Yerdelen (2013) examined the interrelations among students' perception of classroom learning environment, self-regulation, science achievement, and their science teachers' beliefs and occupational well-being. Perception of classroom learning environment were examined with Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity dimensions of WIHIC. The findings related with the effects of perception of classroom learning environment on science achievement revealed that after controlling other student-level and teacher-level variables, students' science achievement was found as significantly and positively correlated with Involvement, Task Orientation, and Equity. Investigation and Cooperation were found as negatively correlated.

Accordingly, she suggested that providing highly qualified classroom learning environment to the students may support their science achievement.

In sum, there are many studies that examined the relationships between perception of learning environment and academic achievement and that used different scales to measure learning environment perceptions, such as CLES, WIHIC, KCES. The findings generally indicated that perceptions of learning environment were positively associated with academic achievement (Baek & Choi, 2002; Ogbuehi & Fraser, 2007; Snyder, 2005; Wolf & Fraser, 2008). Some others did not found any relationships (Allen & Fraser, 2007; den Brok et al., 2010). In this study, it is expected that students' perceptions of Constructivist Learning Environment are positively correlated with their science achievement. To see the predictive effect of perceptions of learning environment on students' science achievement, learning environment perception will be examined in both individual and class level by conducting multilevel analysis.

The Perception of Learning Environment in Classroom and Self-Regulation

Ames (1992) stated that students' social learning environment and their subjective perceptions about this environment have influences on their achievement motivation. In the literature, some empirical research had focused on the relations between learning environment perceptions and self-regulation variables, such as self-efficacy (Arisoy, 2007; Dorman, 2001; Dorman et al., 2006; Sungur & Gungoren, 2009;Yerdelen, 2013), achievement goal orientations (Ames, 1992; Arisoy, 2007; Church, et al., 2001; Lau, Lien, Nie, 2008; Sungur & Gungoren, 2009; Sungur & Senler, 2010; Thoomen, Sleegers, Peetsma, & Oort, 2011; Yerdelen, 2013), task value (Arisoy, 2007), and metacognitive self-regulation (Ozkal, et al., 2009; Sungur & Gungoen, 2009; Yerdelen, 2013; Yilmaz-Tuzun & Topcu, 2010).

The studies in the literature that examined the relationships between perception of learning environment and *self-efficacy* generally indicated positive correlation. For instance, Arisoy (2007) administrated CLES and MSLQ to 956 8th grade students to examine perception of learning environment and motivational beliefs. CLES included Personal Relevance, Student Negotiation, Shared Control, Critical Voice, and Uncertainty. Motivational beliefs included Self-Efficacy, Intrinsic Goal Orientations, Task Value, and Control of Learning Beliefs. The results of canonical correlation analysis revealed that students' positive perception in personal relevance, uncertainty, critical voice, shared control, and student negotiation were correlated with higher level of self-efficacy beliefs. Another result that was related to the present study was correlation between dimensions of CLES and perception of *task value*. The results also indicated that positive learning perceptions were positively associated with perception of task value.

Dorman (2001) explored the correlation of learning environment perceptions and self-efficacy by using 7 scales from WIHIC namely Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity and 3 scales from CLES namely, Personal Relevance, Shared Control, and Student Negotiation. A total of 1055 secondary school students participated to the study and the data were analyzed by conducting simple correlation and multiple correlation analyses. Simple correlation analysis indicated that all 7 dimensions of WIHIC and 3 dimensions of CLES were found as positively correlated with self-efficacy. Multiple correlation analysis revealed some different results. About 22% of variances in self-efficacy was explained by all ten dimensions. Whereas Involvement, Investigation, and Task orientation were positively correlated with self-efficacy, Teacher Support and Cooperation were negatively correlated. Also, Student Cohesiveness, Equity, v Personal Relevance, Shared Control, and Student Negotiation were not found as significantly correlated with self-efficacy. In another study, Dorman et al., (2006) investigated the relationships of perceived learning environment, self-efficacy beliefs, and attitudes towards science. Student Cohesiveness, Teacher Support, Involvement, Task orientation, and Equity were selected from WIHIC questionnaire to measure students' perception of learning environment. The results of stepwise multiple regression analyses indicated that

Teacher Support, Involvement, Task orientation were found to be positively correlated with self-efficacy beliefs.

Sungur and Gungoren (2009), in another study, examined the role of classroom environment perceptions in some self-regulation variables and science achievement. They studied with 900 elementary students and used MSLQ, Approaches to Learning Instrument, and Survey of Classroom Goals Structures to collect data. Their structural equation modeling indicated that students' perceptions of classroom learning environment (Motivation Tasks, Autonomy Support, and Mastery Evaluation) were directly related with self-efficacy and other motivational components. In the Yerdelen's (2013) study, self-efficacy predicted by perception of classroom learning environments. The findings indicated that Student Cohesiveness, Involvement, Investigation, Task Orientation, Cooperation, and Equity were positively correlated, but Task Orientation was negatively correlated with self-efficacy.

Classroom structures were emphasized as effective predictors of *achievement goals* in Ames's (1992) research. Ames (1992) claimed that students' mastery goals can be supported by positive perception in classroom structures, because students can be supported by classroom structures to focus on meaningful aspects of activities, to participate in decision making process, and to develop their learning by providing opportunities. Church, Elliot, and Gable (2001), in their study, investigated the relationships between learning environment perceptions and achievement goals. According to the results, mastery goals adaption was positively predicted by Lecture Engagement, but negatively predicted by Evaluation Focus and Harsh Evaluation. Performance approach goals adaption was predicted by Evaluation Focus, whereas performance avoidance goals adoption was predicted by Harsh Evaluation. Arisoy's (2007) and Sungur and Gungoren's (2009) study were another studies that found positive correlation between constructivist learning environment and intrinsic goal orientations. Sungur and Senler (2010), in another study, examined students' academic motivation, achievement goals, competence expectancies, and classroom environment perceptions. A total of 482 elementary students participated to the study. Perceptions of learning environment was measured by Threat and Challenge construal developed by Elliot and Reis (2003). The findings of the study indicated that classroom learning environment perception was found to be positively related with mastery avoidance, but negatively with performance approach goals. In the Yerdelen's (2013) study, achievement goals that were mastery approach goals, performance approach goals, mastery avoidance goals, and performance avoidance goals predicted by perception of classroom learning environments. The findings indicated that mastery approach goals were positively associated with Student Cohesiveness, Task Orientation, and Equity, but was negatively correlated with Cooperation. Performance approach goals were positively associated with Student Cohesiveness, Task Orientation, and Equity. Mastery avoidance goals were negatively associated with Involvement, but was positively correlated with Task Orientation and Cooperation. And finally, performance avoidance goals were positively associated with Student Cohesiveness, Task Orientation, Cooperation, and Equity, but was negatively correlated with Involvement.

Metacognitive self-regulation is rarely studied self-regulation variable in learning environment literature. Yilmaz-Tuzun and Topcu (2010) examined the relationships among students' perceived constructivist learning environment, metacognition, and epistemological beliefs. In the study, data were gathered from 626 elementary students from 6^{th}, 7^{th}, and 8^{th} grade level. Personal Relevance, Student Negotiation, and Uncertainty dimension of CLES, Junior Metacognitive Awareness Inventory (Jr. MAI) and Schommer Epistemological Belief Questionnaire were conducted to the students. The results of the regression analysis showed that contribution of metacognition was higher than students' epistemological beliefs for perception of constructivist learning environment. In detail, metacognition predicted to all three dimensions of CLES. In the Yerdelen's (2013) study, metacognitive self-regulation predicted by perception of classroom learning environments. The findings indicated that Student Cohesiveness, Teacher Support, Involvement, Investigation, Cooperation, and Equity were positively correlated, but Task Orientation was negatively correlated with metacognitive self-regulation.

The Perception of Learning Environment in Classroom and Epistemological Beliefs

Tsai (2000), in a study, claimed that classroom learning environments that was shaped by science teachers can have a role on affecting students' beliefs about how knowledge is created. Sample of the study included 1176 Taiwanese 10th grade students. Science Epistemological Beliefs (SEB) survey and earlier version of CLES (developed by Taylor & Fraser, 1991) were used to collect data. This version of CLES included Negotiation, Prior Knowledge, Autonomy, and Student-Centeredness scales to measure students' perception of constructivist learning environment. Two form of CLES were administrated to the students. Former one was actual (or perceived) form to assess current perception of constructivist learning environment, latter one was to learn ideal learning environment in students' views. Tsai administrated the CLES actual form first, then the CLES preferred form was conducted after one to two weeks. The SEB survey was administrated between two forms of the CLES to all subjects. The findings of the study indicated that students' scores on Negotiation and Prior Knowledge scales were significantly associated with their SEB scores. It means that students that had constructivist oriented science epistemological beliefs did not perceive positively their learning environment to find opportunities to negotiate their ideas and to integrate with their prior knowledge. The results about the CLES preferred form revealed positive correlation among three dimensions of CLES (Negotiation, Prior Knowledge, and Autonomy) and science epistemological beliefs. Tsai (2000) drawn attention that students preferred more constructivist oriented learning environments. Also, teachers should be aware of students' epistemological orientations and their preferences related to providing constructivist-based classroom environment.

Ozkal et al. (2009) proposed a conceptual model to investigate the relationships among constructivist learning environment, scientific epistemological beliefs, and learning approach. A total of 1152 students that were 8^{th} grade elementary school students. To data collection, CLES (Personal Relevance, Uncertainty, Critical Voice, Shared Control, and Student Negotiation), Scientific Epistemological Beliefs Questionnaire (Fixed and Tentative), and Learning Approach Questionnaire were administrated to the participants. The results revealed that all dimension of constructivist learning environment were significantly and positively correlated with tentative epistemological beliefs except for Shared Control. This means that students that had tentative epistemological beliefs were more likely to find personal relevance in their study, to feel free to demonstrate their concern about own learning, to think about science as ever changing, and to interact with other students to enhance comprehension. On the other hand, only Personal Relevance was significantly related with fixed beliefs.

Yilmaz-Tuzun and Topcu (2010), in their study, also examined the relationships between epistemological beliefs and constructivist learning environment. According to the results, Personal Relevance was predicted by Omniscient Authority and Uncertainty was predicted by Innate Ability. These implied that students' epistemological beliefs have predictor power on their perception of learning environment. In the light of these findings, Yilmaz-Tuzun and Topcu (2010) emphasized the importance of epistemological beliefs on learning environment perception and suggested that science teachers should be aware of their students' beliefs about knowledge and learning and enhance their practice on considering these beliefs.

To conclude, studies on the correlation between epistemological beliefs and perceived learning environments revealed that sophisticated epistemological beliefs are significantly and positively related with positively perceived learning environment (Ozkal et al., 2009; Tsai, 2000; Yilmaz-Tuzun & Topcu, 2010). Thus, in the present study, it is expected that correlation between students' epistemological beliefs and perceptions of learning environment is found to be significant and positive.

Mediator Role of Self-Regulation in Predicting Academic Achievement by Perception of Learning Environment in Classroom and Epistemological Beliefs

Pintrich (2000) emphasized the mediator roles of self-regulatory activities between individuals' characteristics personally and contextually and academic achievement. Literature indicated that students' self-regulation moderates the influence of epistemological beliefs and learning environment perceptions on academic achievement (Chen & Pajares, 2010; Rastegar et al., 2010). For instance, Chen and Pajares (2010) did a study to examine the associations and effects of implicit theories and epistemological beliefs on students' academic motivation and academic achievements. A total of 508 students from 6th grade level participated to the study. Path analysis indicated that Self-Efficacy was a mediator role for Epistemological Beliefs in Justification and Certainty and students' Science Achievement. On the other hand, Rastegar et al. (2010) investigated the relationships between epistemological beliefs and mathematics achievement under the mediator role of achievement goals, self-efficacy, and cognitive engagement. From a university 473 students participated to the study. The findings indicated that achievement goals, self-efficacy, and cognitive engagement scores mediated the relationships between epistemological beliefs and math achievement. Self-efficacy, mastery goals and performance approach goals, and metacognitive and cognitive strategies strengthened the associations between sophisticated beliefs and achievement, whereas naïve beliefs weakened these correlations.

The literature also stated that self-regulation has a mediator effects on the relationships between classroom environment perceptions and academic achievement (Patrick et al., 2007; Peters, 2013; Sungur & Gungoren, 2009; Yerdelen, 2013). Patrick et al. (2007) tested a model that showed mediator effects of motivational beliefs on the associations between classroom social environment, self-regulation strategies and task related interaction as students' engagement components, and academic achievement. Motivational beliefs were mastery goals, academic efficacy, and social efficacy. Structural equation modeling analysis was conducted to the data that were gathered from 602 5th grade students. According to the results, task-related interactions positively predicted math achievement scores. Moreover, all motivational beliefs variables mediated the relationships between classroom social environment and students' engagement by strengthening these relationships. On the other hand, Peters (2013) studied with 326 college students to investigate the mediator effects of classroom environment (teacher-centered and learner-centered) on the relationships between their self-efficacy beliefs and math achievements. Classroom environment perception scores were aggregated for multilevel analysis. The findings indicated that, in student level, math self-efficacy was found as predictor of math achievement. At class level, teacher-centered classroom environment and self-efficacy were found as positively correlated, but any correlation was not found between classroom environment and math achievement. Regarding mediator effects, classroom environment did not mediate the relationships between math self-efficacy and math achievement. Contrary to Peters (2013), Fast et al. (2010) found a mediation effect of math self-efficacy on perceived classroom learning environment and math achievement. In the context of Turkey, Sungur and Gungoren's (2009) findings also support the mediator effects of motivational beliefs on the relationships between learning environment and academic achievement. Accordingly, motivational components (self-efficacy, intrinsic value, mastery goals, and performance goals) mediated the effects of classroom learning environment perceptions on science achievement. In the Yerdelen's (2013) study, examined the mediator effects of self-regulation variables on the relationships between perception of classroom learning environments and science achievement. The findings indicated that after including self-regulation variables, Cooperation and Equity dimensions of classroom learning environment were found as non-significant predictors of science achievement. These findings revealed that Self-regulation variables that were self-efficacy, achievement goals, and metacognitive self-regulation mediated the relationships between perception of classroom learning environments and science achievement.

To conclude, in line with the existing literature, it is expected that self-regulation variables (self-efficacy, achievement goals, task value, and metacognitive self-regulation) mediate the relationships of epistemological beliefs and learning environment perceptions with science achievement.

2.4 Teacher Variables

2.4.1 Teacher Self-Efficacy

Teacher efficacy was defined by Tschannen-Moran, Woolfolk Hoy, and Hoy (1998) as "the teacher's belief in her and his ability to organize and execute the courses of action required to successfully accomplish a specific teaching task in a particular context" (p. 233). As indicated by this definition, the judgment about accomplishing a specific teaching task is central for teacher efficacy. A RAND study that examined teachers' characteristics and student learning gave birth to teacher efficacy studies at the mid-1970s (Armor et al., 1976; cited in Tchannen-Moran and Woolfolk Hoy, 2001). The RAND study used Rotter's (1966) locus of control theory to conceptualize teachers' sense of efficacy. Later research turned to Bandura's (1977) social cognitive theory to ground research on efficacy. Thus, these two theoretical orientations affected the teacher efficacy literature tremendously (Tchannen-Moran et al., 1998) and directed the studies as well as the development of scales to measure teacher efficacy.

The first attempt to measure teacher efficacy was in the RAND studies that had two items to reveal teachers' level of efficacy. These two items were: (1) "When it comes right down to it, a teacher really can't do much because most of a student's motivation and performance depends on his or her home environment," and (2) "If I really try hard, I can get through to even the most difficult or unmotivated students." The first item emphasized factors external to the teachers such as parents' influence, and the second item emphasized internal factors such as teacher personal responsibility (Guskey & Passaro, 1994). However, there were reliability problems with the first teacher efficacy measures due to having only two items.

Afterwards, the Responsibility for Student Achievement (RSA) scale was developed by Guskey in 1981 (Guskey, 1987). RSA had 30 items and asked respondents to distribute 100 percentage points between two alternatives. One of the RSA items as an example is: “When your students seem to have difficulty learning something, is it usually (a) because you are not willing to really work at it, or (b) because you weren’t able to make it interesting for them?” The results of the research indicated that teacher efficacy is positively related to teacher responsibility for student success and failure.

In the same year, the Teacher Locus of Control (TLC) scale was developed by Rose and Medway (1981). It had 28 items and measured teachers’ tendencies about attributing student success and failure to teacher locus of control. One of the TLC items as an example is: “If the students in your class perform better than they usually do on a test, would this happen (a) because the students studied a lot for the test, or (b) because you did a good job of teaching the subject area?” Rose and Medway stressed the *TLC* as a better predictor of teacher behaviors than Rotter’s Internal-External (I-E) Scale with respect to specificity of covering the teaching context.

The Webb Efficacy Scale was another attempt to measure teacher efficacy based on Rotter’s theory and the RAND measure (Ashton, et al., 1982; cited in Tschannen-Moran, et al., 1998). An example item for the 7-item Webb Efficacy Scale is: “(a) My skills are best suited for dealing with students who have low motivation and who have a history of misbehavior in school. (b) My skills are best suited for dealing with students who are academically motivated and generally well behaved.” The scale was designed for participants to select the most suitable choice. The results of the study revealed that the higher scores on the Webb scale, the fewer negative interaction in teachers’ teaching style.

Bandura (1997) stated two different definitions to show the distinction between *outcome expectation* and *efficacy expectation*. Accordingly, the efficacy expectation is “a judgment of one’s ability to organize and execute given different types of performances” whereas the outcome expectation is “a judgment of the likely consequences such performances will produce,” (Bandura, 1997, p. 21). Ashton and Webb (1986) further developed the RAND measure based on Bandura’s distinction. They considered the first RAND item to measure the teaching efficacy dimension. The second RAND item was considered to measure the personal teaching efficacy.

Gibson and Dembo (1984) developed a 30-item 6-point Likert scale, the Teacher Efficacy Scale, to measure teacher efficacy. It was tested on 208 elementary teachers and analyzed by using factor analysis. The results supported two a factor model (28.8% of the total variance), the first factor stands for a teacher’s sense of personal teaching efficacy and the second factor stands for teacher’s sense of teaching efficacy. Gibson and Dembo suggested that these two factors captured Bandura’s self-efficacy and outcome expectancy dimensions and were named *personal teaching efficacy* and *general teaching efficacy* by Gibson and Dembo. Although the first version of the scale had 30 items, Gibson and Dembo suggested the use of the 16-20-item scale that was the revised version.

Woolfolk and Hoy’s (1990) study challenged Gibson and Dembo’s conceptualization of teacher efficacy. Gibson and Dembo (1984) labeled the dimension related to outcome expectation as teaching efficacy, whereas Woolfolk and Hoy claimed that teaching efficacy cannot be considered as an outcome expectation. According to them, teaching efficacy is an efficacy expectation. They expanded the 16-item version of Gibson and Dembo scale by adding two RAND items and four new items related to teacher preparation. They tested the instrument by analyzing using a two-factor and more than two factor solutions. The two factor solution explained 27% variance. To conduct more than two factor solution, Kaiser’s criterion of eigenvalues greater than 1 and a scree plot were used by the authors. The results indicated 32.8% of variance for three-factor model. The first factor was for teaching efficacy, the second and third factor were for personal efficacy that were teacher’s sense of personal responsibility for positive student outcomes and for negative student outcomes. These results pointed to problems and inconsistencies Gibson and Dembo measure.

Work by. Guskey and Passaro (1994) identified some additional biases in the Gibson and Dembo items. Personal efficacy items used "I" wording, but teaching efficacy items used "teachers." In addition, personal efficacy items were positive, but teaching efficacy items were negative. Guskey and Passaro revised the items by changing their wording, whereby the scale had a balance through the entire items. After revisions, Guskey and Passaro tested the scale on 342 teachers. According to the results, Guskey and Passaro determined that the Gibson and Dembo scale actually measured internal and external dimension of efficacy, not self-efficacy and outcome expectations. All of these problems indicated that the Gibson and Dembo instrument had some conceptual and statistical problems; and a new and powerful measure was needed (Tschannen-Moran & Woolfolk Hoy, 2001).

In an undated study, Bandura developed a teacher efficacy scale that has seven subscales: (1) efficacy to influence decision making, (2) efficacy to influence school resources, (3) instructional efficacy, (4) disciplinary efficacy, (5) efficacy to enlist parental involvement, (6) efficacy to enlist community involvement, and (7) efficacy to create a positive school climate. It is 30-item 9-point scale to give a general picture of teachers' efficacy (Tschannen-Moran & Woolfolk Hoy, 2001). A sample item for Bandura's teacher efficacy scale is: "How much can you influence the decisions that are made in your school?" Although Bandura's scale measures teacher efficacy beliefs with respect to many aspects, teachers and teacher educators stated some problems for it, such as accurately reflecting the kinds of tasks teachers actually do. Therefore, a new measure that is valid and reliable was still necessary to be able to measure teacher efficacy beliefs (Tschannen-Moran, et al., 1998).

The latest attempt to develop a measure for teacher efficacy was Teachers' Sense of Efficacy Scale (TSES). It was initiated in a seminar on self-efficacy in teaching and learning at the Ohio State University, so it was first named as Ohio State

Teacher Efficacy Scale. The members of the seminar examined previous formats to use a basic structure to develop a new teacher efficacy scale. Bandura's format was found as an appropriate base by the members of group. To expand the scale by adding new items, the items from Bandura's scale were independently selected by each member. Then, each member produced 8-10 new items that covered tasks not represented on the Bandura's scale. As a result, over 100 items were gathered for the item pool of teacher efficacy scale. These items included tasks not represented on the Bandura's scale, such as assessment, adjusting the lesson to individual student needs, dealing with learning difficulties, repairing student misconceptions, and motivating student engagement (Tschannen-Moran & Woolfolk Hoy, 2001). As a result of the process, 52 items were selected to measure teaching tasks and capabilities by removing some overlaps and similarities among items.

The new scale was tested and developed in three studies. In the first study, the new scale was tested on a sample of 146 preservice and 78 inservice teachers. Data were examined by conducting principal-axis factoring with varimax rotation. After the analysis, the number of items of the scale was reduced from 52 to 32. After the first study, Tschannen-Moran and Woolfolk Hoy (2001) tested the 9-point 32-item scale on 217 participants, 70 preservice teachers and 147 inservice teachers. Principal-axis factoring with varimax rotation was used to examine the factor structure of the scale. It yielded eight factors with eigenvalues greater than one, and also a scree test suggested two or three factors structure for solutions. The scree test results indicated that three-factor solution was better to explain the factor structure of the scale. Based on the three-factor solution, 14 items were removed from the scale due to the low factor loadings. After reducing the number of items, there were 18 items under three factors, accounting for 51% of the variance. Tschannen-Moran and Woolfolk Hoy (2001) labeled these factors, *efficacy for student engagement* (8 items), *efficacy for instructional strategies* (7 items), and *efficacy for classroom management* (3 items). And then, alpha coefficients were computed for all subscales: 0.82 for student engagement, 0.81 for instructional strategies, and 0.82 for classroom management. After the further analysis that examined one strong factor with factor loadings ranging from .74 to .84 by using samples from study 1 and study 2, Tschannen-Moran and Woolfolk Hoy decided that the TSES could be used for assessment of three factors of efficacy (for inservice teachers) or one specified efficacy factor (for preservice or inservice teachers). After the second study, Tschannen-Moran and Woolfolk Hoy (2001) planned a third study, because Robert and Henson (2001) expressed concern about third factor, classroom management. Robert and Henson examined 18-item TSES by collecting 183 inservice teachers and they found that classroom management factor has only three items, so it was weak for a factor. Therefore, they proposed deleting the third factor from the scale. However, Tschannen-Moran and Woolfolk Hoy claimed that classroom management is a significant part of teaching tasks. Instead of omitting the third factor's items, they developed new 18 items by using Emmer's (1990, cited in Tschannen-Moran and Woolfolk Hoy, 2001) teacher efficacy for classroom management scale. A third study tested the 36-item scale on 410 preservice and inservice teachers. Although Principal-axis factoring with varimax rotation yielded four factors with eigenvalues greater than one, the scree test suggested a three-factor solution. Accordingly, Tschannen-Moran and Woolfolk Hoy selected 8 items that had highest factor loadings for each factor and reduced the number of items from 36 to 24. Final tests indicated the same factor structure for 24-item scale. Alpha coefficients were 0.91 for instructional strategies, 0.90 for classroom management, and 0.87 for student engagement. Then, they select 4 items for each factor to develop short version of TSES and computed new alpha coefficients for them: 0.86 for instructional strategies, 0.86 for classroom management, and 0.81 for student engagement. As a result, both long and short forms of TSES were determined to be reliable scales to measure the teacher efficacy construct in further research. Following items are samples from TSES: (1) "How much can you do to motivate students who show low interest in school work?" for student engagement (2) "To what extent can you provide an alternative explanation or example when students are confused?" for instructional strategies (3) "To what extent can you make your expectations clear about student behavior?" for classroom management. To check construct validity of the TSES, the relationship between TSES and previous measures of teacher efficacy was examined. While the participants were responding the TSES, RAND items and the Hoy and Woolfolk (1993) a 10-item adaptation of the Gibson and Dembo TES was given to the participants at the same time. Obviously, there were strong correlations between TSES and previous measurements.

Ross (1998) reviewed 88 teacher efficacy studies and stated that high efficacious teachers tend to (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 control. After Ross's (1998) synthesis, Woolfolk Hoy and Davis (2005) proposed a framework to show links among teachers' efficacy beliefs, teacher outcomes, and student outcomes (Figure 2.3).

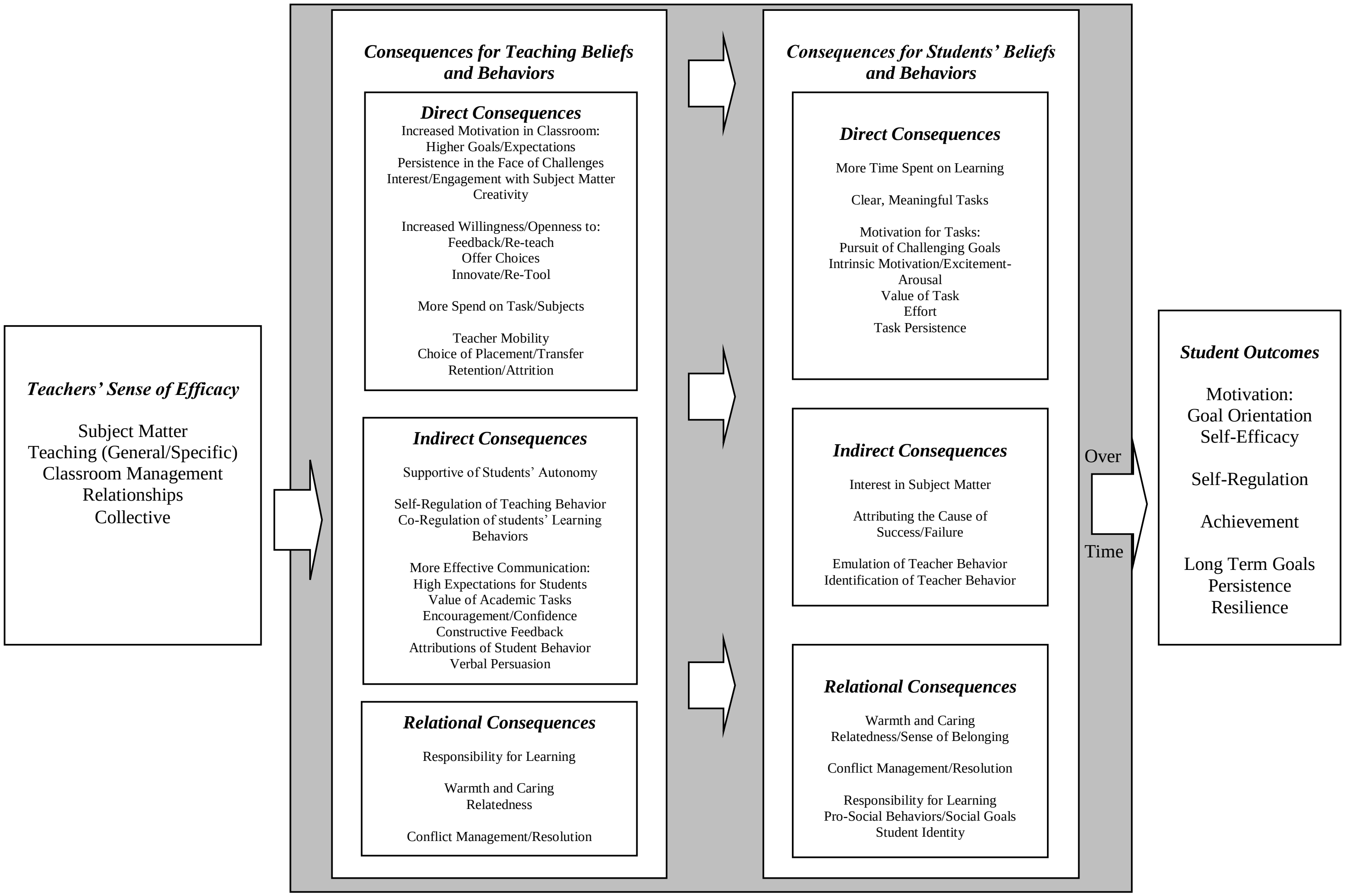


Figure 2.3 A Model of Possible Relationships Between Teachers' Self-Efficacy and Student Outcomes (Woolfolk Hoy & Davis, 2005).

Accordingly, teachers' sense of efficacy directly, indirectly, and relationally influence their planning, decisions, attention, monitoring, and interactions with their students. In terms of *direct influential effects*, teachers with a strong sense of efficacy are more likely to show greater levels of planning, organization, direct teaching, and enthusiasm; spend more time teaching in that subject areas; be more open to new ideas, more willing to experiment with new methods to better meet the needs of their students; use powerful but potentially difficult-to-manage methods such as inquiry and small group work; select strategies that support students greater learning. In terms of *indirect influential effects*, higher efficacious teachers tend to confront management problems and seek solutions; work longer with struggling students; attend to the special needs of exceptional students; work with parents; offer students choices; set learning rather than performance goals. In terms of *relational effects*, if teachers have high level of efficacy, they tend to need less control of students, so listen to students; be less ego-involved, angered, or insulted by the students' behaviors, to be more willing to solve the problem rather than punish the students (Woolfolk Hoy, et al., 2009).

Moving to influences on students, teachers' sense of efficacy directly, indirectly, and relationally influence students' achievement and is related with other student outcomes. Accordingly, in terms of *direct effects on student outcomes*, if teachers are active and organized; set clear, challenging, and high learning goals; and persistently reteach when necessary, time to learn is increased, and also students tend to be motivated to reach goals. *Indirect effects of student outcomes* are related with student motivation and engagement. Teachers who set higher goals enable students to be more willing to cooperate in class activities and value learning, to make controllable attributions themselves. And also, students' intrinsic motivation to learn is encouraged. Although, there were fewer studies on *the relationship between teachers' sense of efficacy and its connection to relational consequences for students*, the findings indicated that students feel more closeness and experiencing less conflict with teachers who have higher level of efficacy beliefs at the end of the academic year (Woolfolk Hoy, et al., 2009).

Ross (1992) did a study to measure history teachers' personal and general teaching efficacy beliefs and to examine the predictive effects of these efficacy beliefs on students' academic achievements. The efficacy questionnaire of Gibson and Dembo's (1984) that included two parts that were teachers' sense of efficacy to influence student learning and teachers' sense of efficacy by considering the effects of external factors. The regression analysis results indicated that students' academic achievement was positively predicted by teachers' personal self-efficacy.

Capara, Barbaranelli, Steca, and Malone (2006) investigated the relationships among teachers' self-efficacy, job satisfaction, and their students' academic achievement. The data that were collected from 2184 teachers were analyzed by conducting structural equation modeling analysis. The results of the study indicated that students' achievement scores and teachers' self-efficacy beliefs were in a low relationships. On the other hand, teachers' these beliefs were in a relationship with students' prior achievement. Capara et al. (2006) interpreted that this revealed a reciprocal relationships between teachers' self-efficacy beliefs and their students' academic achievement. In other words, teachers that had higher achiever students in the beginning of the semester were positively affected to improve their self-efficacy beliefs in teaching. Then, their improvement in self-efficacy in teaching affected their students to be more successful in semester.

Vasquez (2008), on the other hand, did not found a correlation between teachers' self-efficacy and student achievement. The aim of the study was to investigate the influence of teacher efficacy for instructional strategies, classroom management, and student engagement on 9^{th} and 10^{th} students' reading achievement. A total of 110 teachers and their 2061 students participated to the study. The results of HLM analysis revealed that teacher efficacy was not found as significant predictors of students' reading achievements.

According to the proposed framework, Woolfolk Hoy and Davis (2005) claimed directly or indirectly links among teachers' efficacy beliefs and many students' motivational outcomes, whereas there were so few studies in the literature that examined the direct relationships and these studies indicated positive or no correlation among these variables (Guo et al., 2012; Guo et al., 2010; Kurien, 2011; Thoonen et al., 2011; Yerdelen, 2013). For instance, Yerdelen (2013) found positive correlation between teachers' self-efficacy for student engagement and science achievement. Moreover, she found direct and positive correlation among teachers' self-efficacy beliefs and students' perceptions of classroom learning environment, but indirect correlation among teachers' self-efficacy beliefs and students' perceptions of classroom learning environment, self-efficacy, metacognitive self-regulation, and achievement goals. On the other hand, Kurien (2011) investigated the correlation among teacher personal efficacy, teacher efficacy for inquiry-based science, students' self-efficacy for science, and students' self-efficacy for inquiry-based science. For the study, 660 students and their 26 teachers were selected. HLM analyses indicated that teacher personal efficacy and teacher efficacy for inquiry-based science were not found as significant predictors of students' self-efficacy for science and students' self-efficacy for inquiry-based science. In another study, Thoonen et al. (2011) examined the importance of teachers' teaching and self-efficacy on their students' motivation. The data were collected from 3462 students and their 194 teachers. The results of the multilevel analyses revealed that teachers' sense of efficacy did not have any impact on students' motivation to learn, such as academic self-efficacy, mastery goal orientation, performance avoidance, and intrinsic motivation.

Guo et al. (2010) examined the indirect effects of classroom learning environments on the association between teachers' self-efficacy and students' language and literacy gains. For this study, 67 preschool teachers and their 328 students participated and the data that gathered from them were analyzed with HLM. The findings indicated that students' vocabulary gains and print awareness were positively affected from the relationship of teachers' self-efficacy and instructional support. Moreover, students' vocabulary gains were positively affected from the relationship of teachers' self-efficacy and emotional support, but print awareness was not significantly affected from this correlation. These findings were considered as indicators of the positive correlation of teachers' self-efficacy with students' achievement gains and perception of learning environments. In another study, Guo et al. (2012) examined the influences of teachers' self-efficacy on students' literacy skills via classroom learning environments. Structural equation modeling was conducted to the data that were collected from 1043 fifth grade students. The findings showed that teachers who had higher self-efficacy created more supportive and positive learning environment. Also, students in these classroom had higher literacy skills than students in other classroom. These findings implied that teachers' self-efficacy had an indirect effect on students' literacy skills via their supportive and positive learning environment.

In sum, teachers' sense of efficacy as an important teacher belief shapes their teaching life powerfully and higher self-efficacy for teaching is a positive factor for teachers' decisions, thoughts, planning, relationships with students; and for students' achievement and motivation (Woolfolk Hoy, et al., 2009). However, empirical studies are rare in the literature and indicated that teachers' self-efficacy have directly or indirectly effect on students' achievement and related outcomes, self-regulation, and learning environment perceptions. This literature review indicated that new empirical studies about the effects of teachers' self-efficacy on students' outcomes are needed. With this research, it is aimed to investigate the effects of teachers' self-efficacy on students' self-regulation, epistemological beliefs, perception of learning environment, and science achievement.

2.4.2 Achievement Goal Orientation

Classroom has been generally debated as an achievement area for students, but Butler (2007) claimed that it also creates settings for teachers to be successful at their job and to develop their achievement goals for teaching. Woolfolk Hoy et al. (2009) indicated teachers' beliefs as main source for explaining existing differences in the student outcomes. In addition to teachers' beliefs, achievement goal theory can provide a significant focus to conceptualize teacher motivation (Butler, 2007).

According to Butler and Shibaz (2008) teachers' goal orientations predict students' perceptions about teachers' support, inhibited questioning, and help seeking. This might create direct or indirect effect on students' perception of learning environments, self-regulation, and academic achievement (Woolfolk Hoy, 2008). Various information can be found in the literature that investigate the influence of teachers' goal orientations for teaching (Butler, 2007) on their students' academic achievement. Deevers (2000), Luyten and Hoeven-van Doornum (1994), and Friedel, Cortina, Turner, and Midgley (2007) indicated that teachers' mastery and performance goals for teaching were found as predictors of students' self-efficacy, achievement goals, and academic achievement.

Deevers (2000) examined teachers' achievement goals as mastery goal endorsements and performance goal endorsements and investigated the relationships among teacher goal endorsements, student goal orientations, and mathematics achievement. The findings of the study indicated that teachers' mastery goals endorsements were found to be positively correlated with students' mastery and performance approach goal adoptions and negatively correlated with performance avoidance goals. Also, teachers' performance goal endorsements were positively correlated with performance approach and performance avoidance goal adoptions. Another results of the study revealed that teachers' mastery and performance goal endorsements were found as positively effective predictors of students' mathematics achievements. In another study, Luyten and Hoeven-van Doornum (1994) examined the effects of classroom composition on achievement. They collect data to examine also effects of teacher goals set for their students on achievement. One of the findings showed that these teacher goals had a considerable effect on students' academic achievement. Friedel et al. (2007) investigated effects of children's perceptions of their parents' and teachers' achievement goals on their personal achievement goals, self-efficacy beliefs, and coping strategies. The findings of the study revealed that teachers' mastery goals were found to be positively related with children's mastery goals and self-efficacy beliefs, whereas teachers' performance goals were positively related with only children's performance goals.

Butler and Shibaz (2008) did a study to predict students' perception of teacher support and inhibition of question asking and help seeking. A total of 53 teachers and 1287 students participated to the study. Hierarchical linear modeling analysis indicated that teachers' mastery goals were found as significantly and positively effective predictors of higher level of perceived teacher support. Contrary to this finding, teachers' ability-avoidance goals were negatively associated with perceived teacher support. It means that teacher support as a component of classroom learning environment was affected from teachers' achievement goals.

Although, in the literature, there have been some studies that suggested a close relationships between teacher achievement goal orientation and student characteristics and achievement outcomes, empirical studies investigating these associations are so rare (e.g. Butler & Shibaz, 2008; Deevers, 2000; Friedel, Cortina, Turner, & Midgley, 2007; Luyten & Hoeven-van Doornum, 1994). Those studies generally indicated that mastery oriented goals of teachers are positively related with high self-efficacy beliefs, mastery oriented goals, and positive perception of learning environments for students. Regarding performance oriented goals, expectation is not clear, because related literature exhibited unclear results. Accordingly, in this study, it was expected that teachers' goal orientations have accounts in explaining students' outcomes and these relations are positive for mastery goals, but may be also positive for performance goals.

2.4.3 Teachers' Epistemological Beliefs

Educational researchers were also interested in teachers' epistemological beliefs as one of the factors influencing student related outcomes. Teachers' epistemological beliefs concern teachers' views about nature and acquisition of knowledge (Luft & Roehrig, 2007). The definition of epistemological beliefs was done by Hofer and Pintrich (1997) as "how individuals come to know, the theories and beliefs they have about knowing, and the manner in which such epistemological premises are part of and an influence on cognitive process of thinking and reasoning beliefs about the processes of knowing and the nature of knowledge" (p. 435). According to Luft and Roehrig (2007), epistemological beliefs and other teachers' beliefs about learning, understanding, and student knowledge are interplayed. Brownlee, et al. (2002) and Hashweh (1996) claimed that teachers' conceptualization of knowledge shapes their teaching beliefs. In another research, Fang (1996) review the literature about on beliefs and practices and emphasized the effects of beliefs on behaviors. Thereby, teachers' beliefs about knowledge tend to have an effective power on actions in their classroom (Hashweh, 1996). Hashweh's (1996) study was conducted on 35 science teachers to examine their epistemological beliefs and classroom practices. The results supported that teachers that have sophisticated epistemological beliefs are more aware of student alternative conceptions, use more effective teaching strategies, and create more qualified learning environment for students to enhance learning.

Thereby, it may be expected that students that are taught by teachers with sophisticated epistemological beliefs are more successful and have positive perceptions about their learning environment, and highly motivated to learn. However, the literature has little information about the effect of teachers' epistemological beliefs on students' outcomes. With this study, it was proposed that teachers that have sophisticated epistemological beliefs may provide positive learning environment and effects students to have sophisticated epistemological beliefs, to be highly motivated to learn science, and finally, to be successful in science class.

2.4.4 Individual Citizenship Behaviors

Individual citizenship behavior was described by Woolfolk Hoy, Hoy, and Kurz (2008) as "voluntary and discretionary citizenship behavior of teachers that exceed the formal expectation of the job" (p. 825). Its origin was from the construct of organizational citizenship behavior that was used firstly by Organ. Organ (1997, p. 95) defined organizational citizenship as "performance that supports the social and psychological environment in which task performance takes place." Accordingly, workers in an organization may behave in organizationally beneficial ways and freely help others achieve a task at hand (Bateman & Organ, 1983). These behaviors that show extra efforts beyond the formal obligations of their status are important supports for an effective organizational performance.

DiPaola and Tschannen-Moran (2001) did a study to explore organizational citizenship behaviors in schools. Accordingly, organizational citizenship behaviors are context-specific. In other words, organizational citizenship behaviors may change from one organization to another organization. In addition, public schools have a different structure from other private organizations. Teachers in the schools are generally committed to do the best for their students. This separates public schools from private organizations. These results emphasized the importance of teacher's behaviors in the school as an organization. DiPaola and Hoy (2005) defined teacher's behaviors, like volunteering to help their colleagues and to go out of their way to introduce themselves to others, as organizational citizenship behaviors. These teachers also help their students on their own time also spend more time in the school to help. In addition, they use time effectively in their class or in the school. They make it easy for their students and parents. Teachers as professionals may exhibit willingness to "go the extra mile" to make sure that students succeed (Woolfolk Hoy et al., 2008). These are also individual citizenship behaviors. Teachers who behave in this way are personally devoted in the success of students and feel themselves responsible for student learning (DiPaola & Hoy, 2005).

DiPaola and Tschannen-Moran (2001), in their study, developed a new questionnaire to measure organizational citizenship behaviors in K-12 schools and examine the correlation between organizational citizenship behaviors and school climate. Sample items of the new questionnaires include: "Teachers help students on their own time", "Teachers voluntarily help new teachers", and Teachers begin class promptly and use class time effectively". They believed that greater citizenship behaviors support creating a positive and open climate in schools. A positive and open climate has many beneficial results including student achievement. They conducted two different studies to test the new measure of organizational citizenship behaviors. The first study had 664 teachers in 42 public schools and the second study had 1210 teachers in 97 public schools. The 15-item scale, Organizational Citizenship Behavior in Schools Scale, had high reliability scores for both studies (.96 for study I and .87 for study II). Their correlational analyses indicated that there was a strong link between organizational citizenship behaviors and school climate. Accordingly, collegial leadership, which is one of the dimensions of school climate, predicted greater organizational citizenship. Collegial leaders support teacher professionalism because professional norms in schools support organizational citizenship. Moreover, the goals of professionals include a strong press for academic achievement. As a result, DiPaola and Tschannen-Moran stressed that there is a strong correlation between academic press and organizational citizenship.

In other study, DiPaola and Hoy (2005) investigated the relationships between organizational citizenship behaviors of the faculty and achievement of high school students. They administered DiPaola and Tschannen-Moran (2001)'s Organizational Citizenship Behavior in School Scale (OCBSS) in 97 high schools in Ohio. They also used Socioeconomic Status (SES) as a covariate variable in the analysis. Their results supported the theoretical rationale that claimed the relationship between organizational citizenship behaviors and student achievement. According to DiPaola and Hoy, the relationship between these two variables is not surprising because teachers who work in schools that have great organizational citizenship exhibit extra effort; tend to try innovative approaches to curriculum and instruction; devote themselves for the success of students; and take responsibility easily for student learning. Furthermore, they spend own time at school by staying and working with students. Consequently, all of these extra efforts have an impact on students and result as higher students' achievement.

Woolfolk Hoy, Hoy, and Kurz (2008) developed and tested a new construct, teacher's academic optimism, by examining its relationships with sets of teachers' beliefs and practices, such as individual citizenship behavior. Teacher's academic optimism was defined as "a teacher's positive belief that he or she can make a difference in the academic performance of students by emphasizing academic and learning, by trusting parents and students to cooperate in the process, and by believing in his or her own capacity to overcome difficulties and react to failure with resilience and perseverance" (Woolfolk Hoy, Hoy, & Kurz, 2008, p. 822). Academic optimism has cognitive (teacher's sense of efficacy), affective (teacher trust in students and parents), and behavioral (teacher academic emphasis) aspects. Because the construct of teacher's academic optimism covers teachers' beliefs about themselves, their students, and their instruction, Woolfolk Hoy, Hoy, and Kurz claimed that a set of teacher's characteristics including individual citizenship behavior are positive predictors of teacher's academic optimism. To measure individual citizenship behavior, they used DiPaola and Tschannen-Moran (2001)'s Organizational Citizenship Behavior in School Scale (OCBSS), modified to access teacher-level beliefs and they added the 3 items from the Teacher's Belief Survey (TBS: Woolley, Benjamin, & Woolley, 2004). Reliability of items that measured individual citizenship behavior was .69. The result of the study indicated that the set of teacher variables, namely dispositional optimism, humanistic classroom management, student-centered teaching, and teacher individual citizenship behavior, support teacher's academic optimism. Accordingly, the greater individual citizenship behaviors are, the more optimistic teachers.

As indicated in the literature, greater citizenship behaviors mean teacher's willingness to exceed the formal expectations of a teacher. Such teachers exhibit extra effort to help students to be successful, to meet and work with students' parents. Teachers who are high on organizational citizenship use their talents to enhance students' achievement and adapt easily to apply new teaching approaches and useful teaching strategies in their class. Based on the research reviewed above the current study aims to examine the relationship between individual citizenship behaviors and students' achievement. In addition, the research reviewed above also revealed that individual citizenship behavior is one of the predictors of academic optimism, that is, the greater teachers' citizenship behaviors, the more optimistic the teachers. Teacher's sense of academic optimism is a construct that includes three main elements; Teacher's Sense of Efficacy, Teacher Trust, and Teacher Academic Emphasis. Woolfolk Hoy et al. (2008) claimed that construct of teacher's academic optimism covers teachers' beliefs about themselves, their students, and their instruction. Thereby, individual citizenship behaviors of a teacher may be a predictor for a set of students' perception of learning environment, beliefs, self-regulation, and academic achievements.

2.4.5 Student-Centered Beliefs and Practices

As emphasized before, teachers' beliefs have a guider effect on teacher's planning, decisions about class management, teaching strategies in other words on teachers' practice and instructional choices (Woolfolk Hoy, Hoy, & Davis, 2009; Woolfolk Hoy, Hoy, & Kurz, 2008). Educational researchers that studied in this area generally stated that teachers' beliefs are directly connected with their actions in the classroom (Fang, 1996; Guskey, 1986; Hashweh, 1996; Kang & Wallace, 2004). With respect to this perspective, if teachers have student-centered beliefs, they adjusted their teaching practices to meet their students' interests, capabilities, knowledge, and requirements. These teachers believe that if the instructional plans are adapted to the needs of the students, they can learn better (Woolfolk Hoy, Hoy, & Kurz, 2008). Woolfolk Hoy et al. (2008) also claimed that teachers who believe in student-centered teaching must trust either own teaching abilities to support student learning or their students to cooperate in teaching and learning process. Meece, Herman, and McCombs (2003) claimed that if teachers use learner-centered practices, their students reported stronger mastery and performance goals. Ames & Archer (1988), Meece et al. (2003), and Middleton & Midgley (1997) found that mastery and performance goals were in relationships with students' self-efficacy and strategy use. These findings may be an indicator of relationships of teachers' student-centered beliefs and practices with students self-efficacy and strategy use. Thus, this study was a new attempt to investigate direct or indirect effects of student-centered beliefs and practices on students’ science achievements, self-regulation components, epistemological beliefs, and their perception of learning environment. In this study, it is expected that student-centered beliefs and practices are positively linked to students’ achievement, their perception of learning environment, epistemological beliefs, and self-regulation.

CHAPTER III

METHOD

This chapter presents the major characteristics of the population and sample; describes the instruments, procedures, and data analysis; and discusses the assumptions and limitations of the study. Finally, the chapter ends with an examination of the internal and external validity issues of the study.

3.1 Design of the Study

In this study, the direct and indirect relationships among (1) teachers' achievement goal orientation, self-efficacy, epistemological beliefs, epistemological world view, student-centered beliefs and practice, and individual citizenship behavior and (2) students' achievement goal orientation, self-efficacy, epistemological beliefs, classroom environment perception, task value, metacognitive self-regulated learning, and science achievement were investigated. The data were gathered from participants' self-reports and analyzed by conducting two-level Hierarchical Linear Modeling (HLM). The level-1 was formed with student-based variables, whereas the level-2 was formed with teacher-based variables.

3.2 Population and Sample

All science teachers working in public schools in Ankara, the capital city of Turkey, who teach 7^{th} grade public elementary school students and their 7^{th} grade students, were identified as the target population of the study. Because it is difficult to reach this large target population, all science teachers who teach to 7th grade public elementary school students and their 7th grade students in Çankaya and Yenimahalle districts of Ankara were identified as the accessible population. Therefore, the results of the study will be generalized to this population.

A random sampling method was used to reach the representative sample of the study: The district of Çankaya has 103 public elementary schools and the district of Yenimahalle has 87 public elementary schools. A total of 113 elementary schools that were from different parts of each districts were randomly selected for the present study. Among these schools 56 were from the Çankaya district and 57 were from the Yenimahalle district. Almost all schools had one science teacher who worked with 7th grade students. However, some schools in the district of Yenimahalle had two or more science teachers, but there were only one or two teachers that taught the 7th grade students in that schools. As a result, overall, 56 science teachers from the Çankaya district participated in the study while there were 81 science teachers from the Yenimahalle district.

To select students for the study, one class was identified for each teacher based on the most appropriate and convenient dates and times for data collection. Data were gathered from only 7th grade student because research in the literature revealed that there were some differences in motivational beliefs of different grade students (Güngören, 2009; Senler & Sungur, 2009). According to the research, the lower level graders are, the higher level motivational beliefs have. Thereby, it is considered that sixth grade students have more motivational beliefs, whereas eighth graders have lower level of motivational beliefs among the middle school graders. Accordingly, when a teachers had only a seventh grade class, this class was selected for participation. If a teacher had a more than one seventh grade class, one of them was randomly selected for the sample.

3.2.1 Teacher Sample

A total of 137 science teachers (56 teachers from Çankaya district, 81 teachers from Yenimahalle district) participated in the study. About one-quarter of the science teachers (24.1%) were male and 70.8% were female. The teachers ranged in age from 26 years to 62 years. Additionally, their teaching experience ranged from 3 years to 32 years. Table 3.1 provides detailed information about the characteristics of the teacher sample.

Table 3.1 General characteristics of the teacher sample.

		Frequency (*f*)	Percentage (%)
District	Çankaya	56	40.9
	Yenimahalle	81	59.1
Gender	Male	33	24.1
	Female	97	70.8
	Missing	7	5.1
Age (year-old)	26-35	26	19.0
	36-45	67	48.9
	46-55	39	28.5
	56-65	2	1.5
	Missing	3	2.2
Experience (year)	1-10	21	15.3
	11-20	75	54.7
	21-30	32	23.4
	31-40	4	2.9
	Missing	5	3.6

3.2.2 Student Sample

A total of 3281 seventh grade students from 113 schools participated in the study. Because some teachers misfiled or did not complete their questionnaires, the data from 116 students were excluded from the inferential data analyses.

Accordingly, 39.8% of the students were from the Çankaya district and 60.2% of the students were from the Yenimahalle district. The number of female and male students was almost same. A majority of students were at the age of 13 with a mean age of 13.07. Their average of their science grade of previous semester was 3.58 out of 5 (SD = 1.16). While almost one-third of the students had a science grade point average of 4 (31.0 %) in the previous year, the percentages of students having grades of 1 and 2 were quite low (6.2 % and 11.0%, respectively) (see Table 3.2).

Table 3.2 Background characteristics of the student sample.

		Frequency (*f*)	Percentage (%)
District	Çankaya	1307	39.8
	Yenimahalle	1974	60.2
Gender	Male	1650	50.3
	Female	1588	48.4
	Missing	43	1.3
Age (year-old)	12	117	3.6
	13	2805	85.5
	14	339	10.3
	15	14	.4
	16	3	.1
	Missing	3	.1
Science GPA	1	204	6.2
	2	360	11.0
	3	813	24.8
	4	1018	31.0
	5	806	24.6
	Missing	80	2.4
Number of Siblings	1	863	26.3
	2	1240	37.8
	3	710	21.6
	4	226	6.9
	5 and above	115	3.5
	Missing	127	3,9
Separate Study Room	Yes	2603	79.3
	No	6603	18.4
	Missing	75	2.3
Computer at Home	Yes	2709	82.6
	No	557	17.0
	Missing	15	.4
Internet Access	Yes	2174	66.3
	No	1072	32.7
	Missing	35	1.0
Daily Newspaper	Never	254	7.7
	Sometimes	2033	62.0
	Always	973	29.7
	Missing	21	.6
Books at Home	Any or few (0-10)	203	6.2
	11-25	789	24.0
	26-100	1119	34.1
	101-200	605	18.4
	Over 200	539	16.4
	Missing	26	.8

Table 3.2 Continued

		Mother		Father	
		f	%	*f*	%
Parents' Educational Level	Illiterate	98	3.0	16	.5
	Primary School	1101	33.6	650	19.8
	Middle School	609	18.6	685	20.9
	Secondary School	857	26.1	916	27.9
	Bachelor Degree	483	14.7	709	21.6
	Master	72	2.2	179	5.5
	Doctorate	15	0.5	42	1.3
	Missing	46	1.4	84	2.6
Parents' Occupation	Employed	845	25.8	2776	84.6
	Not Employed	2217	67.6	106	3.2
	Not a regular job	85	2.6	137	4.2
	Retired	103	3.1	200	6.1
	Missing	31	.9	62	1.9

A majority of the fathers were employed (84.6%), whereas a majority of the mothers were unemployed (67.6%). About one-quarter of the fathers (27.9 %) and mothers (26.1) graduated from secondary school. In addition, most of students had a separate study room (79.3%), a computer (82.6), and an Internet access (66.3%).

3.3 Data Collection Instruments

In the present study, data were collected from teachers and students in 7th grade science classrooms via two major types of instruments: one designed specifically for teachers and the other designed for students.

3.3.1 Teacher Data Collection Instruments

Teacher data collection instruments included (1) a demographical questionnaire with items that investigated science teachers' gender, age, and teaching experience and (2) five instruments namely, Teachers' Sense of Efficacy Scale (TSES), Teacher Achievement Goal Orientations Scale (TAGOS), and Individual Citizenship Behaviors Scale (CBS), Student-Centered Beliefs and Practices Scale (SCBS), and Teacher Epistemological Beliefs Questionnaire (TEBQ) (see Table 3.3).

Table 3.3. Data Collection Instruments and Variables for Teacher Sample.

Instruments	Variables
Demographics Questionnaire	Gender Age Experience University
Teachers' Sense of Efficacy Scale (TSES) *Developed by Tschannen-Moran & Woolfolk-Hoy (2001)* *Translated to Turkish by Çapa, Çakıroğlu, & Sarıkaya (2005)*	Classroom Management Student Engagement Instructional Strategies
Achievement Goal Orientation Scale (TAGOS) *Developed by Butler (2007)* *Translated to Turkish by the researcher*	Ability Approach Ability Avoidance Work Avoidance Task
Individual Citizenship Behavior (CBS) *Developed by Woolfolk Hoy, Hoy, & Kurz (2008)* *Translated to Turkish by the researcher*	Citizenship Behavior
Student-Centered Beliefs and Practices Scale (SCBS) *Developed by Woolley, Benjamin, & Woolley (2004)* *Translated to Turkish by the researcher*	Student-Centered Beliefs and Practices
(Teacher) Epistemological Beliefs Questionnaire (TEBQ) *Developed by Conley, Pintrich, Vekiri, & Harrison (2004)* *Translated to Turkish by Özkan (2008)*	Source Certainty Justification Development

3.3.1.1 Demographic Questionnaire

The Demographic Questionnaire consists of items that ask information about gender, age, experience, and their university graduated of teachers.

3.3.1.2 The Teachers' Sense of Efficacy Scale (TSES)

The Teachers' Sense of Efficacy Scale which is a 9-point Likert scale ranging from "1 = nothing" to "9 = a great deal", was used to assess science teachers' self-efficacy beliefs. It was originally developed by Tschannen-Moran and Woolfolk-Hoy (2001). While developing the TSES, they worked with two teachers and eight graduate students in a seminar on self-efficacy in teaching and learning. All participants explored several possible formats for a new efficacy measure and decided on a measure based on Bandura's teacher self-efficacy scale. Each member of the seminar prepared 8-10 items and in total over 100 items were produced to develop the new efficacy scale. After a nomination, discussion, and revision approach, the members of the seminar decided on 52 items to assess teaching tasks and capabilities. New items were tested in three separate studies and the number of the items was reduced from 52 to 32 in the first study as a result of principal-axis factoring with varimax rotation. Then, second study was conducted and the number of the items was reduced to 18 items because some of omitted items had low factor loadings and some of them seemed as redundant by researchers. In the third study, the 18 items were modified and new 18 items were added to the instrument. As a result, the final instrument included 36 items. Based on results of a factor analysis, 24 items that had higher factor loadings were selected from the instrument by Tschannen-Moran and Woolfolk-Hoy (2001). The final instrument included 24 items under three subscales, namely Classroom Management, Student Engagement, and Instructional Strategies. Test results indicated reliabilities .90 for Classroom Management, .87 for Student Engagement, and .91 for Instructional Strategies. Tschannen-Moran and Woolfolk Hoy also selected 4 items that had the highest factor loadings for each subscale and prepared short version of the instruments (12 items). Reliabilities for the short version were .86 for Classroom Management, .81 for Student Engagement, and .86 for Instructional Strategies.

Table 3.4. The subscales of the TSES with sample items.

Subscales	Sample Item	Number of Items
Efficacy for Instructional Strategies	How well can you implement alternative strategies in your classroom?	4
Efficacy for Classroom Management	How well can you establish a classroom management system with each group of students?	4
Efficacy for Student Engagement	How much can you do to motivate students who show low interest in schoolwork?	4

The long form of the TSES with 24 items was translated into Turkish by Çapa, Çakıroğlu, and Sarıkaya (2005). They administered the translated version to 628 preservice teachers. Confirmatory factor analysis revealed a good model fit for proposed factor structures (TLI = .99, CFI = .99, RMSEA = .065). Internal consistency reliability for full scale was .93 and the subscale reliabilities were .84 for Classroom Management, .82 for Student Engagement, and .86 for Instructional Strategies. In present study, short version of TSES was used and tested. The reliability scores for the present study were .85 for the whole test, .78 for Classroom Management subscale, .68 for Student Engagement subscale, and .75 for Instructional Strategies subscale.

In the current study, short version of the TSES with 12 items was used. In order to validate the factor structure of the instrument for the present study, a CFA was conducted. The results of the CFA were interpreted with respect to four indices. The first index examined was the Normed Fit Index (NFI) and the second index is Comparative Fit Index (CFI). These values greater than .90 are indicative of a good fit. Third one is Standardized Root Mean Square Residuals (SRMR) and below .05 is accepted as a good fit. The last index was Goodness of Fit Index (GFI). The GFI values greater than .90 are considered an indication of a good fit (Kelloway, 1998).

Table 3.5 The results of confirmatory factor analysis for each subscale of the TSES.

	χ^2 *(p value)*	χ^2/df	*NFI*	*CFI*	*SRMR*	*GFI*
Classroom Management	.01	4.29	.83	.85	.07	.97
Student Engagement	.01	4.38	.96	.91	.07	.97
Instructional Strategies	.16	1.86	.89	.98	.04	.99

According to the CFAs' results, the fit statistics almost indicated a good data fit for all sub-scales, some others were reasonable. Lambda-ksi estimates for the latent factors of TSES were the other results of the CFAs. Those were presented in Table 3.6.

Table 3.6. Lambda-X Estimates for TSES.

	Indicator	*Present study LX estimates*
Classroom Management	q1	.75
	q6	.72
	q7	.82
	q8	.54
Student Engagement	q2	.56
	q3	.76
	q4	.63
	q11	.49
Instructional Strategies	q5	.54
	q9	.76
	q10	.57
	q12	.76

3.3.1.3 Teachers' Achievement Goal Orientations Scale (TAGOS)

The Teachers' Achievement Goal Orientations Scale (TAGOS) is a 5-point Likert scale ranging from "5 = strongly agree" to "1 = strongly disagree". The original version of the TAGOS developed by Butler (2007) had 28 items in four subscales, namely mastery goals (7 items), ability-approach goals (7 items), ability-avoidance goals (7 items), and work-avoidance goals (7 items). Butler (2007) tested the TAGOS with 100 teachers and results revealed sufficient internal consistencies for all sub-scales except for the work avoidance sub-scale: Cronbach's alpha coefficients were found as .74, .78, .70, and .45, for mastery, ability-approach, ability-avoidance, and work-avoidance orientations sub-scales, respectively. Because the work-avoidance subscale had a low reliability score, two problematic items were replaced with new ones. Then, Butler (2007) tested the instrument with a sample of 320 teachers. Responses to the items and analysis of the results showed that internal consistency reliabilities were .76 for the mastery goal, .82 for the ability-approach goal, .71 for the ability-avoidance goal, and .78 for the work avoidance goal.

The TAGOS was translated and adapted into Turkish by the researcher. Six items were deleted from the original instruments because these items were not suitable to be used with Turkish sample considering Turkish educational system and school culture in elementary level. For example, the item of "I was assigned an advanced class that only the best teachers get to teach" was deleted because there are not any distinguished classes among others in Turkish elementary schools. Also, the item of "in a meeting my lesson plan was singled out as better than that of any of my colleagues" was deleted because the Ministry of Education in Turkey predefines the lesson plans. Remaining four items such as "the principal led me to understand that s/he considers me to be one of the best teachers in the school" and "a meeting was cancelled, and I got home at a reasonable hour for a change" were also omitted because there was not any system or situation to evaluate and identify the best teachers in the schools of Turkey and there are few meetings in schools so teachers have limited chances to display these behaviors. After omitting these items, the remaining 22 items were translated into Turkish. The final instrument had four subscales: ability-approach goals (4 items), ability-avoidance goals (5 items), work-avoidance goals (6 items), and mastery goals (7 items).

During the translation procedure, the items were reviewed by (1) two academicians from the elementary science education department of the faculty of education for content validity, (2) an academician studying on English Language Teaching from the faculty of education for adaptation to Turkish language structure, and (3) a science teacher to assure that the items were clear and easily understandable. After the translation and adaptation procedures, the TAGOS was pilot tested with 104 elementary science teachers. The obtained data were analyzed with SPSS for reliability analysis and LISREL for confirmatory factor analysis.

Table 3.7. Reliability Coefficients of the subscales of the TAGOS for pilot study.

	Original Version (Butler, 2007)		*Pilot Study*	
	Number of Items	*Cronbach alphas*	*Number of Items*	*Cronbach alphas*
Ability-Approach	7	.82	4	.63
Ability-Avoidance	7	.71	5	.66
Work-Avoidance	7	.78	6	.75
Task	7	.76	7	.79

The factor structure of the TAGOS was tested through confirmatory factor analyses. Confirmatory factor analysis for each subscale after item deletion Table 3.8 showed the results.

Table 3.8. The results of confirmatory factor analysis for the pilot study after omitted items.

	χ^2 *(p value)*	χ^2/df	*NFI*	*CFI*	*SRMR*	*GFI*
Ability-Approach	.05	3.00	.94	.96	.06	.97
Ability-Avoidance	.00	4.07	.86	.89	.08	.93
Work-Avoidance	.00	4.45	.90	.92	.08	.87
Task	.00	7.76	.85	.86	.08	.80

Results of confirmatory factor analyses for the pilot studies yielded indices indicating that for all subscales of ability-approach, ability-avoidance, work-avoidance, and mastery, the fit indices were reasonable. Table 3.9 indicated the subscales of the TAGOS with sample items.

Table 3.9. The subscale of the TAGOS with sample items.

Subscales	Sample Item	Number of Items
	I would feel that I had a good and successful day in school if:	
Ability-Approach Goals	My classes are more advanced in the curriculum than those of other teachers.	4
Ability-Avoidance Goals	Pupils did not ask any questions that I could not answer.	5
Work-Avoidance Goals	The material was easy and I didn't have to prepare lessons.	6
Mastery Goals	I saw that I am developing professionally and teaching more effectively than in the past.	7

For the main study, confirmatory factor analyses and reliability analyses were also conducted for the TAGOS to validate factor structure and assess internal consistency, respectively. Table 3.10 and 3.11 indicated the results of those analyses for the main study.

Table 3.10. Reliability Coefficients Scores of the subscales of the TAGOS for the main study.

	Original Version (Butler, 2007)		*The present Study*	
	Number of Items	*Cronbach alphas*	*Number of Items*	*Cronbach alphas*
Ability-Approach	7	.82	4	.69
Ability-Avoidance	7	.71	5	.67
Work-Avoidance	7	.78	6	.79
Task	7	.76	7	.90

Table 3.11 The results of confirmatory factor analysis for the main study.

	χ^2 *(p value)*	χ^2/df	*NFI*	*CFI*	*SRMR*	*GFI*
Ability-Approach	.17	1.86	.97	.99	.04	.99
Ability-Avoidance	.09	1.74	.92	.96	.05	.98
Work-Avoidance	.00	5.82	.92	.93	.07	.85
Task	.00	4.80	.86	.89	.08	.91

Results of CFA for the main studies yielded fit indices indicating that there was no any serious problem to be a good model for the TAGOS. Table 3.12 indicates Lambda-ksi estimates for the latent factors of the TAGOS in this study.

Table 3.12 Lambda-X Estimates for the TAGOS.

	Indicator	*Present study LX estimate*
Ability Approach	q1	.30
	q2	.70
	q3	.74
	q4	.67
Ability Avoidance	q5	.54
	q6	.47
	q7	.54
	q8	.59
	q9	.59
Work Avoidance	q10	.73
	q11	.78
	q12	.72
	q13	.55
	q14	.51
	q15	.39
Task	q16	.64
	q17	.68
	q18	.73
	q19	.94
	q20	.82
	q21	.91
	q22	.48

3.3.1.4 Individual Citizenship Behavior Scale for Teachers (CBS)

Woolfolk Hoy, Hoy, and Kurz (2008) developed the Individual Citizenship Behavior Scale (CBS) by modifying the Organizational Citizenship Behavior (OCB: DiPaola & Hoy, 2005a, 2005b; DiPaola & Tschannen-Moran, 2001, as cited in Woolfolk Hoy, Hoy, & Kurz, 2008). It is a 5-point Likert scale ranging from “5 = strongly agree” to “1 = strongly disagree” to assess teachers’ citizenship behaviors. The CBS has 7 items and its reliability score for original version was 0.69 (Woolfolk Hoy, Hoy, & Kurz, 2008). Table 3.13 shows two sample items for the CBS.

Table 3.13. The sample items of the Individual Citizenship Behavior Scale (CBS).

Scale	*Sample Item*	*Number of Items*
Individual Citizenship Behavior Scale	I help students during my own time I make it easy for parents to contact me at school or home	7

The CBS was translated and adapted into Turkish by the researcher. The translation procedure used for the TAGOS was followed exactly for the CBS. After the translation and adaptation process, the CBS was tested with 104 elementary science teachers. The data obtained were analyzed with SPSS for reliability analysis and LISREL for confirmatory factor analysis. After the analysis, the items that were determined as problematic were revised. The confirmatory factor analysis results of the main study revealed that the revision of items were positively resulted.

Table 3.14. Reliability Coefficients Score of the Individual Citizenship Behavior Scale (CBS) (translated version vs. original version)

		Original Version (Woolfolk Hoy, Hoy, & Kurz, 2008)	Pilot Study	*The present Study*
	Number of Items	*Cronbach alphas*	*Cronbach alphas*	*Cronbach alphas*
Citizenship Behavior	7	0.69	0.73	0.77

As shown in Table 3.14, the scores of 0.73 for the pilot study and 0.77 for the main study indicate that there were no reliability problems for the CBS. Table 3.15 presents the results of confirmatory factor analysis for the CBS.

Table 3.15. The results of confirmatory factor analysis for each subscale of the Individual Citizenship Behavior Scale (CBS).

Citizenship Behavior	χ^2 *(p value)*	χ^2/df	*NFI*	*CFI*	*SRMR*	*GFI*
Pilot Study	.00	2.91	.87	.91	.08	.90
Main Study	.06	1.72	.93	.97	.05	.95

Results of confirmatory factor analyses for the pilot and the main studies yielded indices indicating that there was a good model to data fit for the Individual Citizenship Behavior Scale. Lambda-ksi estimates for the latent factors of the CBS in this study are presented in Table 3.16.

Table 3.16. Lambda-X Estimates for the CBS.

	Indicator	*Present study LX estimate*
Citizenship Behavior	q1	.49
	q2	.62
	q3	.54
	q4	.60
	q5	.30
	q6	.67
	q7	.69

3.3.1.5 Epistemological Beliefs Questionnaire (TEBQ)

Epistemological Belief Questionnaire is a 26-item 5-point Likert scale (1= strongly disagree; 5= strongly agree) developed by Conley et al., (2004). The scale was developed to determine the individuals' beliefs about the nature of knowledge (i.e. certainty of knowledge and simplicity of knowledge) and the nature of knowing (i.e. source of knowledge and justification for knowing) (Hofer & Pintrich, 1997). The dimensions of the scale are (1) *source* (5 items) measures beliefs about knowledge residing in external authorities, (2) *certainty* (6 items) referring to a belief in a right answer, (3) *development* (6 items) concerning beliefs about science as an evolving and changing subject, and (4) *justification* (9 items) related with role of experiments and how individuals justify knowledge. Conley *et al.* (2004) tested the scale two times (Time1 and Time-2) on the same sample. Thus, they reported two Cronbach Alpha scores for all dimensions. Table 3.18 presents the results of both Time -1 and Time-2 for Conley *et al.* (2004)'s study. Since the higher scores represented the more sophisticated beliefs, the items of the source and certainty dimensions were reversed. The Epistemological Belief Questionnaire was used with both teacher sample and student sample. For the sake of clarity, the scale used with teacher sample was abbreviated as TEBQ and the scale used with student sample was abbreviated as SEBQ. Epistemological Belief Questionnaire was translated and adapted into Turkish by Özkan (2008). According to Özkan, reliability coefficient for the whole scale was .78.

Table 3.17. The sample items of the TEBQ.

Scale	*Sample Item*	*Number of Items*
Certainty	Once scientists have a result from an experiment that is the only answer	6
Development	Some ideas in science today are different than what scientists used to think	6
Source	Everybody has to believe what scientists say	5
Justification	A good way to know if something is true is to do an experiment	9

Table 3.18 presents alpha coefficient found by Ozkan (2008) for the whole scale and coefficients found for whole scale and sub-scales in the current study. As shown in the table, in the present study, reliability coefficient for development subscale was somewhat low, but acceptable for educational studies (Hatcher & Stepanski, 1994; Pomeroy, 1993).

Table 3.18. Reliability Coefficients Scores of the subscales of the TEBQ and whole test.

		Original Version (Conley et al., 2004)	*Turkish version (Ozkan, 2008)*	*The present Study*
	Number of Items	*Cronbach alphas (Time-1-Time-2)*	*Cronbach alphas*	*Cronbach alphas*
Whole Test	26		.78	.78
Source	5	.81-.82		.75
Certainty	6	.78-.79		.70
Development	6	.57-.66		.50
Justification	9	.65-.76		.72

In order to validate the factor structure of the TEBQ for the present study, a CFA was conducted. The CFAs' results showed that the fit statistics almost were good for all sub-scales.

Table 3.19. The results of confirmatory factor analysis for the main study.

	χ^2 *(p value)*	χ^2/df	*NFI*	*CFI*	*SRMR*	*GFI*
Certainty	.02	2.25	.90	.94	.06	.95
Development	.11	1.59	.83	.93	.06	.97
Source	.10	1.83	.95	.98	.05	.97
Justification	.33	1.10	.88	.98	.05	.95

Lambda-ksi estimates for the latent factors of TEBQ were the other results of the CFAs. Those were presented in Table 3.20.

Table 3.20. Lambda-X Estimates for the TEBQ.

	Indicator	*Present study LX estimate*
Certainty	q2	.46
	q7	.50
	q12	.50
	q16	.49
	q20	.70
	q23	.61
Development	q4	.10
	q8	.43
	q13	.42
	q17	.62
	q21	.46
	q25	.42
Justification	q3	.43
	q5	.42
	q9	.41
	q11	.48
	q14	.55
	q18	.66
	q22	.37
	q24	.47
	q26	.50
Source	q1	.74
	q6	.80
	q10	.57
	q15	.45
	q19	.50

3.3.1.6 Student-Centered Beliefs and Practices Scale for Teachers (SCBS)

Teachers' student-centered beliefs and practices will be assessed by conducting 7-items that is a part of Constructivist Teaching scale. It is the subscale of the Teacher's Belief Survey (TBS: Woolley, Benjamin, & Woolley, 2004, cited in Woolfolk-Hoy *et al.* 2008). It is a 6-point Likert type scale ranged from "strongly disagree" to "strongly agree". Higher scores refer to more student-centered beliefs and practices. In Woolfolk-Hoy et al. (2008), the reliability score was found as .72.

Table 3.21. The sample items of the Student-Centered Beliefs and Practices Scale for Teachers (SCBS).

Scale	*Sample Item*	*Number of Items*
Student-Centered Beliefs and Practices	I involve students in evaluating their own work and setting their own goals I make it a priority in my classroom to give students time to work together when I am not directing them.	7

The SCB was translated and adapted into Turkish by the researcher. The translation procedure used for the TAGOS and the CBS was followed exactly for the SCBS. Original version of the SCBS had 6-point range for scaling, but in the present study 5-point range was used due to reliability concerning between other scales. After the translation and adaptation process, the CBS was tested with 104 elementary science teachers. And also, the data obtained from them was analyzed with SPSS for reliability analysis and LISREL for confirmatory factor analysis. After the analysis, some items that showed problematic results were revised for the main study. Table 3.22 indicates the Cronbach Alpha scores for the original version scale, the pilot study, and the main study.

Table 3.22. Reliability Coefficients Score of the Student-Centered Beliefs and Practices Scale for Teachers (SCBS) (translated version vs. original version)

		Original Version (Woolfolk-Hoy et al., 2008)	*Pilot Study*	*The present Study*
	Number of Items	*Cronbach alpha*		
Student-Centered Beliefs and Practices	7	0.72	0.70	0.77

Accordingly, the scores of 0.70 for the pilot study and 0.77 for the main study revealed that there were no reliability problems for the SCBS. Table 3.23 presents the results of confirmatory factor analysis for the SCBS.

Table 3.23. The results of confirmatory factor analysis for each subscale of the Student-Centered Beliefs and Practices Scale for Teachers (SCBS).

	χ^2 (p value)	*χ^2/df*	*NFI*	*CFI*	*SRMR*	*GFI*
Pilot Study	.00	4.43	.73	.77	.08	.88
Main Study	.05	1.72	.86	.97	.05	.95

Results of confirmatory factor analyses for the pilot study did not indicate perfect model to data fit for the pilot study, but fit indices were reasonable for main study. This indicated that revision of problematic items were resulted as positively. Lambda-ksi estimates for the latent factors of the SCBS in this study are presented in Table 3.24.

Table 3.24. Lambda-X Estimates for the Student-Centered Beliefs and Practices Scale for Teachers (SCBS).

	Indicator	*Present study LX estimate*
Student-Centered Beliefs and Practices	q1	.58
	q2	.60
	q3	.51
	q4	.59
	q5	.52
	q6	.51
	q7	.70

3.3.2 Student Data Collection Instruments

Data from students were collected using: (1) a demographic questionnaire that included items concerning students' background characteristics such as gender, age, and last semester science grade; (2) six self-report instruments including the Self-Efficacy Scale, Task Value, and Metacognitive Self-Regulated Learning Scale (taken from the Motivated Strategies for Learning Questionnaire or MSLQ), the Students' Achievement Goal Questionnaire (AGQ), Constructivist Learning Environment Scale (CLES), and Epistemological Beliefs Questionnaire (EBQ); and (3) the Science Achievement Test (SAT) (see Table 3.25).

Table 3.25. Data Collection Instruments and Variables for Student Sample.

Instruments	Variables
Demographics Questionnaire	Gender Number of Siblings Age Science GPA Parents' Occupation Parents' Educational Level Number of Books at Home Separate Study Room at Home Daily News Paper Computer at Home Internet Access
Motivated Strategies For Learning Questionnaire (MSLQ) *Developed by Pintrich, Garcia, & McKeachie (1993)* *Translated to Turkish by Sungur (2004)*	Self-Efficacy Metacognitive Self-Regulated Learning Task Value
Achievement Goal Questionnaire (AGQ) *Developed by Elliot & McGregor (2001)* *Translated to Turkish by Senler & Sungur (2007)*	Mastery Approach Performance Approach Mastery Avoidance Performance Avoidance
Constructivist Learning Environment Scale (CLES) *Developed by Taylor, Fraser, & Fisher (1997)* *Translated to Turkish by Yılmaz-Tüzün, Çakıroğlu, & Boone (2006)*	Personal Relevance Uncertainty Critical Voice Shared Control Student Negotiation
Epistemological Beliefs Questionnaire (SEBQ) *Developed by Conley, Pintrich, Vekiri, & Harrison (2004)* *Translated to Turksih by Özkan (2008)*	Source Certainty Justification Development

3.3.2.1 Demographic Questionnaire for Students

The Demographic Questionnaire was developed to gather information about students' background characteristics including gender, age, science GPA, parents' occupation, parents' educational level, number of siblings at home, number of books at home, presence of a separate study room at home, frequency of buying a daily newspaper, presence of a computer and internet access at home.

3.3.2.2 Self-Efficacy, Task Value and Metacognitive Self-Regulated Learning from the Motivated Strategies for Learning Questionnaire (MSLQ)

The Motivated Strategies for Learning Questionnaire (MSLQ) was originally developed by Pintrich, Smith, Garcia, and McKeachie (1991) to assess students' motivation for learning, confidence in gaining success, test anxiety, and ability to use various learning strategies. It is a 7-point Likert scale ranging from "1 = not at all true of me" to "= very true of me". Fifteen subscales are included in the MSLQ under two main sections, "motivation", which has 6 sub-scales, and "learning strategies", which has 9 sub-scales. In the present study, self-efficacy, task value, and metacognitive self-regulation subscales were used to assess students' self-efficacy beliefs for learning, students' evaluation of tasks, and metacognitive self-regulated learning, respectively. The MSLQ was tested in Pintrich, Smith, Garcia, and McKeachie (1991)'s study. They found .93 alpha value for self-efficacy subscale, .90 alpha value for task value subscale, and .79 alpha value for metacognitive self-regulation subscale.

Table 3.26. The subscales of the MSLQ with sample items that used in the present study.

Subscales	Sample Item	Number of Items
Self-Efficacy	I'm certain I can understand the most difficult material presented in the readings for this course	8
Task Value	Understanding the subject matter of this course is very important to me	6
Metacognitive Self-Regulation	When reading for this course, I make up questions to help focus my reading	12

Sungur (2004) translated and adapted the MSLQ was into Turkish. In Sungur's study, reliability coefficients were .89 for the self-efficacy subscale, .87 for the task value subscale and .81 for the metacognitive self-regulation subscale. These values for the present study were .88 for the self-efficacy subscale, .81 for the task value subscale and .79 for the metacognitive self-regulation subscale (Table 3.27).

Table 3.27. Reliability Coefficients Scores for self-efficacy, task value, and metacognitive self-regulation subscales of the MSLQ

		Original Version (Pintrich et al., 1991)	*Turkish version (Sungur, 2004)*	*The present Study*
	Number of Items		*Cronbach alphas*	
Self-Efficacy	8	.93	.89	.88
Task Value	6	.90	.87	.81
Metacognitive Self-Regulation	12	.79	.81	.79

Table 3.28 presents the confirmatory factor analysis results for these three subscales of the MSLQ.

Table 3.28. The results of confirmatory factor analysis for self-efficacy, task value, and metacognitive self-regulation subscales of the MSLQ.

	χ^2 *(p value)*	χ^2/df	*NFI*	*CFI*	*SRMR*	*GFI*
Self-Efficacy	.00	11.84	.99	.99	.02	.98
Task Value	.00	19.02	.98	.98	.03	.98
Metacognitive Self-Regulation	.00	18.35	.96	.96	.06	.95

The CFAs results showed that fit indices almost indicate a good model for these three subscales except for χ^2/df ratio. Lambda-ksi estimates for the latent factors of the subscales of the MSLQ were the other results of the CFAs. Those were presented in Table 3.31.

Table 3.29. Lambda-X Estimates for the subscales of the MSLQ.

	Indicator	*Present study LX estimate*
Self-Efficacy	q2	.71
	q3	.67
	q5	.69
	q6	.68
	q8	.69
	q9	.71
	q13	.72
	q14	.66
Task Value	q1	.51
	q4	.68
	q7	.61
	q10	.72
	q11	.63
	q12	.74
Metacognitive Self-Regulated Learning	q15	.08
	q16	.52
	q17	.62
	q18	.59
	q19	.60
	q20	.66
	q21	.61
	q22	.05
	q23	.67
	q24	.67
	q25	.67
	q26	.57

3.3.2.3 Achievement Goal Questionnaire (AGQ)

The Achievement Goal Questionnaire was originally developed by Elliot and McGregor (2001) to assess students' achievement goals. It is 5-point Likert-scale that ranges from "1 = never" to "5 = always." The AGQ includes 4 subscales: mastery approach goals (3 items), performance approach goals (3 items), mastery avoidance goals (3 items), and performance avoidance goals (6 items). Elliot and McGregor (2001) found high reliability scores for the AGQ subscales: .87 for mastery approach, .92 for performance approach, .89 for mastery avoidance, and .83 for performance avoidance sub-scales. Similarly, confirmatory factor analysis scores indicated good fit results for the scale (RMSEA = .04, TLI = .99, and CFI = .99). Sample items for the AGQ sub-scales were presented in Table 3.30.

Table 3.30. The subscale of the AGQ with sample items.

Subscales	Sample Item	Number of Items
Mastery Approach Goals	It is important for me to understand the content of this course as thoroughly as possible.	3
Performance Avoidance Goals	It is important for me to do better than other students.	3
Mastery Avoidance Goals	I worry that I may not learn all that I possibly could in this class.	3
Performance Avoidance Goals	My goal for this class is to avoid performing poorly compared to the rest of the class.	6

Şenler and Sungur (2007) translated and adapted the AGQ into Turkish. They reported Cronbach's alpha scores of 81 for mastery approach, .69 for performance approach, .65 for mastery avoidance, and .64 for performance avoidance. Moreover, the confirmatory factor analysis supported four-factor structure of Turkish version of the (RMSEA = .06, GFI = .92, CFI = .90, and SRMR = .07).

In the present study, the AGQ was tested with reliability analysis and confirmatory factor analysis. The results revealed alpha coefficient scores of .71 for mastery approach, .71 for performance approach, .65 for mastery avoidance, and .76 for performance avoidance. Table 3.31 shows the reliability scores for the original version, the Turkish version of the AGQ, and the results of the present study.

Table 3.31. Reliability Coefficients Scores for the AGQ

	Original Version (Elliot and McGregor, 2001)	*The Turkish Version (Şenler and Sungur, 2007)*	*The present Study*
		Cronbach Alphas	
Mastery Approach	.87	.81	.71
Performance Approach	.92	.69	.71
Mastery Avoidance	.99	.65	.65
Performance Avoidance	.83	.64	.76

The confirmatory factor analysis results showed good fits for all subscales. For the three subscales of mastery approach, performance approach, and mastery avoidance, the model was saturated and the fits were perfect. For the performance avoidance subscale, the results were good ($\chi 2$ p-value = .00, $\chi 2/df$ = 22.55, NFI = .97, CFI = .97, SRMR = .04, and GFI = .98). Lambda-ksi estimates for the latent factors of the SAGOS in this study are presented in Table 3.32.

Table 3.32. Lambda-X Estimates for the the AGQ.

	Indicator	*Present study LX estimate*
Mastery Approach	q1	.62
	q6	.67
	q8	.72
Mastery Avoidance	q11	.59
	q14	.66
	q17	.62
Performance Approach	q4	.66
	q10	.66
	q16	.69
Performance Avoidance	q2	.55
	q7	.61
	q13	.59
	q19	.53
	q20	.64
	q21	.61

3.3.2.4 Constructivist Learning Environment Scale (CLES)

Constructivist Learning Environment Scale (CLES) was developed to measure students' perceptions of their constructivist-oriented learning environment. It was originally developed by Taylor and Fraser (1991) and revised by (Taylor, Dawson & Fraser, 1995; Taylor, Fraser & Fisher, 1997, Johnson & McClure, 2003). After revision of original one, the final scale had 20 items under 5 sub-scales that are Personal Relevance, Uncertainty, Critical Voice, Shared Control, and Student Negotiation. Table 3.33 presents the sub-scales, sample items and the number of items for each sub-scale.

Table 3.33. The subscale of the CLES with sample items.

Subscales	Sample Item	Number of Items
Personal Relevance	In this science class, I learn about the world inside and outside of school.	4
Uncertainty	In this science class, I learn the views of science have changed over time.	4
Critical Voice	In this science class, I feel safe questioning what or how I am being taught.	4
Shared Control	In this science class, I help the teacher to plan what I am going to learn.	4
Student Negotiation	In this science class, I ask other students to explain their ideas.	4

Johnson and McClure (2003) found the alpha coefficients as .90 for Personal Relevance, .81 for Uncertainty, .88 for Critical Voice, .76 for Shared Control, and .81 for Student Negotiation. The CLES was translated and adapted to Turkish language by Yılmaz-Tüzün, Çakıroğlu, and Bone (2006). Their results revealed the reliabilities as .72 for personal relevance, .73 for uncertainty, .73 for critical voice, .83 for shared control, and .77 for student negotiation. In the present study, the reliabilities were .72 for personal relevance, .59 for uncertainty, .68 for critical voice, .75 for shared control, and .67 for student negotiation.

Table 3.34. Reliability Coefficients Scores of the original version, the Turkish version, and the present study.

	Original Version (Johnson & McClure, 2003)	*Turkish Version (Yılmaz-Tüzün, Çakıroğlu, & Bone, 2006)*	*The present Study*
		Cronbach Alphas	
Personal Relevance	.90	.72	.72
Uncertainty	.81	.73	.75
Critical Voice	.88	.73	.68
Shared Control	.76	.83	.75
Student Negotiation	.81	.77	.67

In order to validate the factor structure of the CLES for the present study, a CFA was conducted. The CFAs' results showed that the fit statistics almost were good for all sub-scales.

Table 3.35. The results of confirmatory factor analysis for the main study.

	χ^2 *(p value)*	χ^2/df	*NFI*	*CFI*	*SRMR*	*GFI*
Personal Relevance	.05	3.01	1.00	1.00	.01	1.00
Uncertainty	.00	7.84	.99	.99	.02	1.00
Critical Voice	.00	15.55	.99	.99	.02	1.00
Shared Control	.00	32.62	.98	.99	.03	.99
Student Negotiation	.33	1.11	1.00	1.00	.01	1.00

Lambda-ksi estimates for the latent factors of CLES were the other results of the CFAs. Those were presented in Table 3.36.

Table 3.36. Lambda-X Estimates for the CLES.

	Indicator	Present study LX estimate
Personal Relevance	q1	.55
	q7	.67
	q11	.64
	q16	.66
Uncertainty	q2	.27
	q9	.58
	q13	.66
	q19	.63
Critical Voice	q3	.60
	q8	.59
	q15	.59
	q18	.59
Shared Control	q4	.71
	q6	.72
	q12	.69
	q20	.52
Student Negotiation	q5	.54
	q10	.58
	q14	.70
	q17	.49

3.3.2.5 Epistemological Beliefs Questionnaire (SEBQ)

Epistemological Belief Questionnaire (Conley et al. 2004) was used to measure students' epistemological beliefs. As mentioned in the "Teacher Data Collection Instruments", this instrument was also used with teacher sample to assess teachers' epistemological beliefs. Because detailed information about the instrument was provided in Teacher Data Collection Instruments section, a brief summary about the Epistemological Beliefs Questionnaire was presented here: it is a 26-item likert type scale in four dimensions namely, certainty, development, source, and justification. It was translated and adapted into Turkish by Özkan (2008). Özkan found the total reliability of the questionnaire as .78. It was .82 for students' sample in the present study.

Table 3.37. The sample items of the SEBQ.

Scale	*Sample Item*	*Number of Items*
Certainty	Once scientists have a result from an experiment that is the only answer	6
Development	Some ideas in science today are different than what scientists used to think	6
Source	Everybody has to believe what scientists say	5
Justification	A good way to know if something is true is to do an experiment	9

Reliability coefficients of sub-subscales were somewhat low (.82 for whole test, .72 for source, .66 for certainty, .64 for development, and .79 for justification), but acceptable for educational studies (Hatcher & Stepanski, 1994; Pomeroy, 1993).

In the present study, in order to validate the factor structure of the Epistemological Beliefs Questionnaire for student sample, a CFA was conducted. The CFAs' results showed that there was a good model fit for all sub-scales.

Table 3.38. The results of confirmatory factor analysis for the main study.

	χ^2 *(p value)*	χ^2/df	*NFI*	*CFI*	*SRMR*	*GFI*
Certainty	.00	17.54	.96	.96	.04	.98
Development	.01	2.57	.99	1.00	.01	1.00
Source	.00	10.23	.99	.99	.02	.99
Justification	.00	4.99	.99	.99	.02	.99

Lambda-ksi estimates for the latent factors of SEBQ were presented in Table 3.39.

Table 3.39. Lambda-X Estimates for the SEBQ.

	Indicator	*Present study LX estimate*
Certainty	q2	.39
	q7	.18
	q12	.56
	q16	.58
	q20	.66
	q23	.57
Development	q4	.43
	q8	.54
	q13	.38
	q17	.55
	q21	.47
	q25	.49
Justification	q3	.57
	q5	.54
	q9	.52
	q11	.52
	q14	.60
	q18	.57
	q22	.51
	q24	.52
	q26	.58
Source	q1	.59
	q6	.64
	q10	.56
	q15	.50
	q19	.60

3.3.2.6 The Science Achievement Test (SAT)

A 14-item multiple choice test was used to assess students' science achievement. The SAT was prepared by choosing items from the national exams (e. g. Secondary Education Entrance Examination and Government Complimentary Boarder and Scholar Examination to transition to high schools) that were conducted by the Turkish Ministry of Education in 2008 and 2009 (MEB, 2008-2009). Seven items were selected from the SBS 2008 and seven from the SBS 2009. Each item had four alternatives: an answer and three distracters. The SAT covered the 7th grade's topics from the fall semester, which included electricity (4 items), force-motion-energy (4 items), sense organs (3 items), and digestive system (3 items). Academicians and science teachers evaluated all 14 items in terms of content validity. The reliability coefficient by KR-20 (Kuder Richardson 20) was computed as .49.

Reliability coefficient was somewhat low, but acceptable for educational studies (Hatcher & Stepanski, 1994; Pomeroy, 1993).

3.4 Data Collection Procedure

The Ministry of Education granted permission to administer the questionnaires in the participant schools that were selected using the random sampling method. The permissions covered the two semesters of 2009-2010 education year. During the first semester a pilot study was conducted with 104 science teachers to validate Teachers Achievement Goal Orientations Scale, Teachers' Individual Citizenship Behaviors, and Teachers' Student-Centered Beliefs and Practices Scale for Turkish science teachers. The main study was conducted during the second semester. The teachers' and students' questionnaires were administrated during the same time period and took about 40 minutes to complete. The students completed their questionnaires in the classroom while their teacher filled out the questionnaire in a different place. The researchers read the directions to the teachers and students before they completed the questionnaires. Any information about students and teachers names or any other information were not asked from them. Participants were also reminded that there was no right or wrong answer except for achievement test and any information about the students, teachers, classes, and schools would not be connected to their responses. All questionnaires and answers will be kept confidential and only used for research purposes. Also to protect confidentiality, after filling the questionnaires, each teacher's and his/her classes' questionnaires were sealed in an envelope prepared for the class and viewed only by the researchers.

3.5 Analysis of Data

In the present study, data analyses include preliminary analysis, descriptive statistical analysis, and inferential statistical analysis. As part of preliminary analysis, data were examined concerning missing values, outliers, and univariate and multivariate normality. Descriptive statistical analyses were conducted to examine mean, standard deviation, skewness, and kurtosis values of the teacher and student related variables. Hierarchical Linear Modelling (HLM) was used as an inferential statistical procedure to investigate the relations between teacher and student related variables.

3.5.1 Hierarchical Linear Modeling (HLM)

In this study, Hierarchical Linear Modeling (HLM) technique was conducted to explain how the teacher variables (Level-2 variables) and student variables (Level-1 variables) are interrelated and how both variables affect students' science achievement. In this case, the data gathered from teachers and their students might have a nested structure. In other words, the students who are taught by same teacher might be more similar than the students who are taught by another teacher. All the students who are taught by a teacher might be affected by their teacher's beliefs, goals, or practices. Thus, the students who are taught by different teachers can be independent and a cluster effect is occurred. Analysis of such nested data with classical linear model is not reasonable, because assumptions related with the independence of observation is violated due to this clustering effect. Thus, the biasing of estimating the coefficient causes computing smaller standard errors compared to HLM. Considering the clustering effect in nested data provides an advantage of predicting outcome variable to HLM.

Nested structure of the sample was the main reason to select HLM as a statistical technique for the present study. HLM provides a different regression model for each students' group (Level-1). These regression models in each level draw an outline by using structural relations and residual variability at that level. As a result, it can be examined how students' variables interrelated in their level and how teachers' level variables (Level-2) mediate students' level variables. Teachers' variables represent level-2 predictors. Accordingly, the outcome variables were determined among students' variables for all models. Level-1 predictors were also determined among students' variables for each model. Then, level-2 predictiors were determined among teachers' variables. This reveals a hierarchical structure for the sample of the present study. Raudenbush and Bryk (2002) recommend HLM to examine the relations for a hierarchical-structure data just like the data from the present study.

3.6 Variables and Their Descriptions

The variables of the study can be grouped as Level-1 and Level-2 variables. These are the predictors of the outcome variables. Science Achievement and other variables of students are also labeled as outcome. Table 3.40 presents all of these variables, their descriptions, and their types.

Table 3.40 The descriptions and types of the variables of the study.

Name	Description	Type
Student Level Variables (Level-1)		
ACHIEVEM	Science Achievement Students' Science Achievement Scores. The test included 14 science questions. Each true answer coded as 1, incorrect one coded as 0. Thus, possible total scores for each student could be within range between 0 and 14.	Outcome
CLE_PER	Constructivist Learning Environment - Personal Relevance The sub-dimension of Constructivist Learning Environment and it was a composite variable that was constructed by computing average score of Q1, Q7, Q11, and Q16. Possible mean scores of it could be within range between 1 and 5.	Outcome, Predictor

Table 3.40 Continued

CLE_UNC	Constructivist Learning Environment – Uncertainty The sub-dimension of Constructivist Learning Environment and it was a composite variable that was constructed by computing average score of Q2, Q9, Q13, and Q19. Possible mean scores of it could be within range between 1 and 5.	Outcome, Predictor
CLE_CRI	Constructivist Learning Environment - Critical Voice The sub-dimension of Constructivist Learning Environment and it was a composite variable that was constructed by computing average score of Q3, Q8, Q15, and Q18. Possible mean scores of it could be within range between 1 and 5.	Outcome, Predictor
CLE_SHA	Constructivist Learning Environment - Shared Control The sub-dimension of Constructivist Learning Environment and it was a composite variable that was constructed by computing average score of Q4, Q6, Q12, and Q20. Possible mean scores of it could be within range between 1 and 5.	Outcome, Predictor
CLE_NEG	Constructivist Learning Environment - Student Negotiation The sub-dimension of Constructivist Learning Environment and it was a composite variable that was constructed by computing average score of Q5, Q10, Q14, and Q17. Possible mean scores of it could be within range between 1 and 5.	Outcome, Predictor
TASK	Task Value The part of the Motivated Strategies for Learning Questionnaire (MSLQ) and it was a composite variable that was constructed by computing average score of Q1, Q4, Q7, Q10, Q11, and Q12. Possible mean scores of it could be within range between 1 and 7.	Outcome, Predictor
SELF_EFF	Self-Efficacy The part of the Motivated Strategies for Learning Questionnaire (MSLQ) and it was a composite variable that was constructed by computing average score of Q2, Q3, Q5, Q6, Q8, Q9, Q13, and Q14. Possible mean scores of it could be within range between 1 and 7.	Outcome, Predictor

Table 3.40 Continued

MC_SR	Metacognitive Self-Regulated Learning The part of the Motivated Strategies for Learning Questionnaire (MSLQ) and it was a composite variable that was constructed by computing average score of Q15, Q16, Q17, Q18, Q19, Q20, Q21, Q22, Q23, Q24, Q25, and Q26. Possible mean scores of it could be within range between 1 and 7.	Outcome, Predictor
EP_CER	Epistemological Beliefs – Certainty The sub-dimension of Epistemological Beliefs Questionnaire and it was a composite variable that was constructed by computing average score of Q2, Q7, Q12, Q16, Q20, and Q23. Possible mean scores of it could be within range between 1 and 5.	Outcome, Predictor
EP_DEV	Epistemological Beliefs –Development The sub-dimension of Epistemological Beliefs Questionnaire and it was a composite variable that was constructed by computing average score of Q4, Q8, Q13, Q17, Q21, and Q25. Possible mean scores of it could be within range between 1 and 5.	Outcome, Predictor
EP_JUS	Epistemological Beliefs – Justification The sub-dimension of Epistemological Beliefs Questionnaire and it was a composite variable that was constructed by computing average score of Q3, Q5, Q9, Q11, Q14, Q18, Q22, Q24, and Q26. Possible mean scores of it could be within range between 1 and 5.	Outcome, Predictor
EP_SOU	Epistemological Beliefs – Source The sub-dimension of Epistemological Beliefs Questionnaire and it was a composite variable that was constructed by computing average score of Q1, Q6, Q10, Q15, and Q19. Possible mean scores of it could be within range between 1 and 5.	Outcome, Predictor
GOAL_MA	Goals - Mastery Approach The sub-dimension of Achievement Goal Questionnaire and it was a composite variable that was constructed by computing average score of Q1, Q6, and Q8. Possible mean scores of it could be within range between 1 and 5.	Outcome, Predictor

Table 3.40 Continued

GOAL_PA	Goals - Performance Approach The sub-dimension of Achievement Goal Questionnaire and it was a composite variable that was constructed by computing average score of Q4, Q10, and Q16. Possible mean scores of it could be within range between 1 and 5.	Outcome, Predictor
GOAL_MAV	Goals - Mastery Avoidance The sub-dimension of Achievement Goal Questionnaire and it was a composite variable that was constructed by computing average score of Q11, Q14, and Q17. Possible mean scores of it could be within range between 1 and 5.	Outcome, Predictor
GOAL_PAV	Goals - Performance Avoidance The sub-dimension of Achievement Goal Questionnaire and it was a composite variable that was constructed by computing average score of Q2, Q7, Q13, Q19, Q20, and Q21. Possible mean scores of it could be within range between 1 and 5.	Outcome, Predictor
Teacher Variables (Level-2)		
TGOALAAP	Achievement Goal Orientations - Ability Approach The sub-dimension of the Teachers' Achievement Goal Orientations Scale and it was a composite variable that was constructed by computing average score of Q1, Q2, Q3, and Q4. Possible mean scores of it could be within range between 1 and 5.	Predictor
TGOALAAV	Achievement Goal Orientations -Ability Avoidance The sub-dimension of the Teachers' Achievement Goal Orientations Scale and it was a composite variable that was constructed by computing average score of Q5, Q6, Q7, Q8, and Q9. Possible mean scores of it could be within range between 1 and 5.	Predictor
TGOALWAV	Achievement Goal Orientations - Work Avoidance The sub-dimension of the Teachers' Achievement Goal Orientations Scale and it was a composite variable that was constructed by computing average score of Q10, Q11, Q12, Q13, Q14, and Q15. Possible mean scores of it could be within range between 1 and 5.	Predictor

Table 3.40 Continued

TGOALTAS	Achievement Goal Orientations – Task The sub-dimension of the Teachers' Achievement Goal Orientations Scale and it was a composite variable that was constructed by computing average score of Q16, Q17, Q18, Q19, Q20, Q21, and Q22. Possible mean scores of it could be within range between 1 and 5.	Predictor
TSELF_CM	Self-Efficacy - Classroom Management The sub-dimension of the Teachers' Achievement Goal Orientations Scale and it was a composite variable that was constructed by computing average score of Q1, Q6, Q7, and Q8. Possible mean scores of it could be within range between 1 and 9.	Predictor
TSELF_SE	Self-Efficacy - Student Engagement The sub-dimension of the Teachers' Achievement Goal Orientations Scale and it was a composite variable that was constructed by computing average score of Q2, Q3, Q4, and Q11. Possible mean scores of it could be within range between 1 and 9.	Predictor
TSELF_IS	Self-Efficacy - Instructional Strategies The sub-dimension of the Teachers' Achievement Goal Orientations Scale and it was a composite variable that was constructed by computing average score of Q5, Q9, Q10, and Q12. Possible mean scores of it could be within range between 1 and 9.	Predictor
TCITIZEN	Individual Citizenship Behavior It was a composite variable that was constructed by computing average score of the whole scale. Possible mean scores of it could be within range between 1 and 5.	Predictor
TSTU_CEN	Student-Centered Beliefs and Practices It was a composite variable that was constructed by computing average score of the whole scale. Possible mean scores of it could be within range between 1 and 6.	Predictor

Table 3.40 Continued

TEP_CER	Epistemological Beliefs – Certainty The sub-dimension of Epistemological Beliefs Questionnaire and it was a composite variable that was constructed by computing average score of Q2, Q7, Q12, Q16, Q20, and Q23. Possible mean scores of it could be within range between 1 and 5.	Predictor
TEP_DEV	Epistemological Beliefs –Development The sub-dimension of Epistemological Beliefs Questionnaire and it was a composite variable that was constructed by computing average score of Q4, Q8, Q13, Q17, Q21, and Q25. Possible mean scores of it could be within range between 1 and 5.	Predictor
TEP_JUS	Epistemological Beliefs – Justification The sub-dimension of Epistemological Beliefs Questionnaire and it was a composite variable that was constructed by computing average score of Q3, Q5, Q9, Q11, Q14, Q18, Q22, Q24, and Q26. Possible mean scores of it could be within range between 1 and 5.	Predictor
TEP_SOU	Epistemological Beliefs – Source The sub-dimension of Epistemological Beliefs Questionnaire and it was a composite variable that was constructed by computing average score of Q1, Q6, Q10, Q15, and Q19. Possible mean scores of it could be within range between 1 and 5.	Predictor

The data collected by using the Constructivist Learning Environment Scale were also used to examine students' group perceptions about their learning environment. To do it, the students' data gathered from the CLES were aggregated for the HLM analyses. Table 3.41 presents that the abbreviations of the aggregate variables.

Table 3.41 The abbreviations and their meanings for aggregate' variables

Aggregate Variables (Level-2)		
Name	*Description*	*Type*
CLE_P_AG	Constructivist Learning Environment - Personal Relevance It was an aggregate variable that was constructed by aggregating the mean scores of students that were in each teacher's group. Possible mean scores of it could be within range between 1 and 5.	Predictor
CLE_U_AG	Constructivist Learning Environment – Uncertainty It was an aggregate variable that was constructed by aggregating the mean scores of students that were in each teacher's group. Possible mean scores of it could be within range between 1 and 5.	Predictor
CLE_C_AG	Constructivist Learning Environment - Critical Voice It was an aggregate variable that was constructed by aggregating the mean scores of students that were in each teacher's group. Possible mean scores of it could be within range between 1 and 5.	Predictor
CLE_S_AG	Constructivist Learning Environment - Shared Control It was an aggregate variable that was constructed by aggregating the mean scores of students that were in each teacher's group. Possible mean scores of it could be within range between 1 and 5.	Predictor
CLE_N_AG	Constructivist Learning Environment - Student Negotiation It was an aggregate variable that was constructed by aggregating the mean scores of students that were in each teacher's group. Possible mean scores of it could be within range between 1 and 5.	Predictor

3.7 Threats to Validity of the Study

3.7.1 Threats to Internal Validity of the Study

Fraenkel and Wallen (2006) stated that some other variables or factors may impact any relationship observed among two or three variables in unintended ways. They are labelled as threats to internal validity. These possible threats should be considered, controlled, eliminated, or minimized at least systematically.

Subject characteristics can be considered as a potential threat to internal validity: In the present study, the sample was selected from different parts of two huge districts of Ankara. Also, selection of schools was done randomly. These two districts are in the city center and considered as reflecting the general characteristics of the students and teachers city center. Some information about the subjects such as their age, gender, socio-economic status, etc. were gathered. Concerning student sample, some characteristics such as age was aimed to be controlled by collecting data only from seventh grade students. However, subject characteristics can pose a threat in this study, because it was not possible to control all teacher and student characteristics.

Mortality (loss of subjects) was not considered as a threat to internal validity for the present study because while the samples of the study were selected, loss of subject or absenteeism, were taken into consideration. In addition, since the instruments of the current study were administrated to the participants in their public schools and their classes had similar testing condition, *location* was not considered as a threat for this study. *Instrumentation* which can be examined under the headings of *Instrument Decay*, *Data Collector Characteristics*, and *Data Collector Bias* is also not considered as a serious threat to internal validity: in the present study both teacher and students responded to likert type scales and multiple choice items. They filled out optical forms. Thus, scoring was objective and instrument decay did not pose a threat to internal validity. To avoid data collector characteristics and bias threats, the data were collected by one data collector who administrated the scales to all participants and he behaved in a standard way throughout the all procedures. Moreover, *maturity* are not expected to be threats to internal validity because , data collection period which took about two months can be considered as too short to cause maturity threat considering variables of the study.

However, *testing* can be a threat to internal validity because participants' response to one instrument may be influenced by their responses to previous instruments.

3.7.2 Threats to External Validity of the Study

Franenkel and Wallen (2006) defined the external validity as the generalizability of the findings of a research study. The present study was administered in two large districts of Ankara, Turkey. Çankaya district has 103 public elementary schools and Yenimahalle district has 87 public elementary schools in total. The data were gathered from 56 schools in Çankaya district and 57 schools in Yenimahalle district. In other words, half of the schools randomly selected from the two districts were used for the sample of the study. Therefore, it can be considered that the sample of the study was enough to generalize the findings of the study to population.

Moreover, all the administration procedure of the study took place in public schools' classrooms during regular class hours. Hence, most environmental conditions were under similar conditions and it can be considered that external effects were controlled.

3.8 Assumptions of the Study

Assumptions of the Study,

1. During the instruments' administration, all conditions were standard for teachers and students.

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

3.9 Limitations

1. All variables in the study were measured by using self-report questionnaires. It needed careful attention of the participants. Thus it was assumed that the

participants' responses were honest and based on their own personal beliefs and opinions rather than on what they believe to be acceptable.

2. The participants' beliefs and opinions truly measured using the selected self-report questionnaires.

3. Since this is a cross-sectional study, further research that has longitudinal design is needed to investigate changes in students' science achievement in relation to teacher level and student level variables based on cause and effect relationships.

CHAPTER IV

RESULTS

This chapter presents the results of preliminary data analysis and Hierarchical Linear Modeling (HLM) Analyses. Preliminary data analysis covers treatment of missing values and outliers, and the results of some important descriptive analyses about students' data and teachers' data. Second part presents the results of a series of hierarchical linear models that were tested and explained by conducting the HLM.

4.1 Preliminary Data Analysis

4.1.1 Treatment of Missing Values and Outliers

Since the HLM does not allow conducting a parameter estimates analysis with the missing data values, data cleaning procedure for this data was a necessity. The descriptive analysis of students' data revealed that the percent of missing values did not exceed 8.4 for all variables. While conducting HLM, the missing values in students' data were treated with listwise deletion of cases.

In order to determine outliers of the data, Mahalonobis distance values were checked for the students' data. Accordingly, about 100 students were determined as cases that had high Mahalonobis distance value. Therefore, these students' data were removed from the data to get more reliable results from HLM analysis. Based on this procedure, the number of students for some teachers became less than ten. Hox (2010) stated that increasing sample sizes provides more accurate estimates and standard errors. Therefore, he suggested a 100/10 rule for two-level models. This means that if the sample has about 100 groups, each group need at least about 10 individuals. Accordingly, 7 teachers that had less 10 students and their students were removed from the data.

Considering teacher data, one teacher did not fill their questionnaire completely. This teacher were removed from the data. On the other hands, 5 teachers' questionnaire returned empty due to some causes that were said by those teachers. Thereby, the students of those teachers were removed from students' data. It was inevitable, because the HLM analysis does not let parameter estimates with missing values.

After treatment of missing values and outliers, the data from 137 teachers and their 3281 were used in the HLM analyses.

Assumptions of HLM analyses were tested on the current data. The test results confirmed that assumptions are defensible. The results of assumption tests are presented in Appendix D.

4.1.2 Descriptive Statistics

Some main descriptive results about all variables of the students and the teachers such as minimum and maximum scores of the scales, average scores, standard deviations, variances, skewness, and kurtosis values were presented in the Table 4.1 and 4.2.

Table 4.1 Descriptive Statistics for the Student Variables

Student Variables (Level-1)	*Min.*	*Max.*	*M*	*SD*	*Variance*	*Skewness*	*Kurtosis*
CLE-Personal Relevance	1.00	5.00	4.10	.78	.61	-.89	.34
CLE-Uncertainty	1.00	5.00	3.75	.88	.60	-.46	-.16
CLE-Critical Voice	1.00	5.00	3.84	.84	.71	-.57	-.21
CLE-Shared Control	1.00	5.00	3.08	.99	.99	-.10	-.70
CLE-Student Negotiation	1.00	5.00	3.50	.87	.76	-.30	-.47
Task Value	1.00	7.00	5.74	1.14	1.30	-.95	.41
Self-Efficacy	1.00	7.00	5.30	1.21	1.47	-.63	-.08
Metacognitive Self-Regulation	1.00	7.00	4.94	1.02	1.04	-.45	-.09
Epistemological Beliefs-Source	1.00	5.00	2.94	.86	.73	.12	-.46
Epistemological Beliefs-Certainty	1.17	5.00	3.27	.75	.56	-.07	-.39
Epistemological Beliefs-Justification	1.11	5.00	4.09	.62	.39	-.91	.93
Epistemological Beliefs-Development	1.00	5.00	3.80	.62	.38	-.50	.39
Achievement Goals-Mastery Approach	1.00	5.00	4.33	.81	.66	-1.36	1.43
Achievement Goals-Performance Approach	1.00	5.00	4.08	.90	.81	-.98	.53
Achievement Goals-Mastery Avoidance	1.00	5.00	3.57	.97	.95	-.55	-.23
Achievement Goals-Performance Avoidance	1.00	5.00	3.70	1.02	1.04	-.70	-.10
Science Achievement	.00	14	4.68	2.21	4.89	.81	1.71

Concerning the constructivist learning environment perceptions results, the mean scores of all sub-dimensions were above the midpoint 3. Students perceived high level of personal relevance in their science classes (M = 4.10, SD = .78). However, the level of perceived shared control in science classes was the lowest (M = 3.08, SD = .99) relative to the other dimensions of constructivist learning environment perceptions. On the other hand, students perceived relatively high level of uncertainty (M = 3.75, SD = .88), critical voice (M = 3.84, SD = .84), and student negotiation (M = 3.50, SD = .87).

The mean of 7th grade students' scores on self-efficacy, task value, and metacognitive self-regulation strategies subscales of MSLQ indicated that they had high level of *self-efficacy* (M = 5.30, SD = 1.21), high level of *task value* (M = 5.74, SD = 1.14), and almost high level of *metacognitive self-regulation* in learning science topics (M = 4.94, SD = 1.02).

Regarding epistemological beliefs, mean scores suggested that 7th grade students' tend to have relatively high sophisticated beliefs (Justification, M = 4.09, SD = .62; and Development, M = 3.80, SD = .62) than naïve beliefs (Source, M = 2.94, SD = .86; Certainty, M = 3.27, SD = .75).

Students' response on the subscales of achievement goal questionnaire revealed that while the mean score of mastery approach goals (M = 4.33, SD = .81) was the highest, the mean score of mastery avoidance goals (M = 3.57, SD = .97) was the lowest. Therefore, it can be inferred 7th grade students tend to study for the reasons of learning and mastering the course material in science rather than for avoiding misunderstanding or not learning.

Finally, examination of the mean score on the *science achievement* test revealed that students had low achievement level in science (M = 4.68, SD = 2.21).

Table 4.2 Descriptive Statistics for the Teachers Variables

Teachers and Aggregate Variables (Level-2)	*Min.*	*Max.*	*M*	*SD*	*Variance*	*Skewness*	*Kurtosis*
T. Achievement Goals-Ability Approach	1.25	5.00	3.48	.76	.57	-.52	.58
T. Achievement Goals-Ability Avoidance	1.00	5.00	3.04	.78	.60	-.29	-.08
T. Achievement Goals-Work Avoidance	1.00	4.75	2.39	.83	.68	.41	-.22
T. Achievement Goals-Task	1.00	5.00	4.31	.80	.64	-2.18	5.98
T. Sense of Efficacy-Classroom Management	3.50	9.00	7.07	.91	.83	-.13	.93
T. Sense of Efficacy-Student Engagement	4.00	9.00	6.59	1.01	1.03	-.24	.02
T. Sense of Efficacy-Instructional Strategies	5.00	9.00	7.29	.95	.89	-.24	-.45
T. Citizenship Behavior	1.86	5.00	4.20	.54	.29	-1.23	2.38
T. Student-Centered Beliefs	2.14	5.00	4.02	.52	.27	-.59	.80
T. Epistemological Beliefs-Source	1.00	4.40	2.86	.75	.56	-.06	-.33
T. Epistemological Beliefs-Certainty	1.17	4.83	2.79	.74	.54	.43	.12
T. Epistemological Beliefs-Justification	2.89	5.00	4.32	.36	.13	-.39	.66
T. Epistemological Beliefs-Development	2.67	5.00	4.02	.48	.23	-.20	.44

Regarding teacher variables, descriptive statistics showed that science teachers had the highest score on task goals (*M* = 4.31, *SD* = .80). Moreover, mean scores for ability approach (*M* = 3.48, *SD* = .76) and ability avoidance goals (*M* = 3.04, *SD* = .78) were also above the midpoint 3. However, mean scores for work avoidance goals was below the midpoint 3 (*M* = 2.39, *SD* = .83). These findings suggested that science teachers tend to set goals in science course as becoming proficient at task and showing their performance rather than avoiding from showing poor teaching ability and avoiding from having to work hard.

Concerning science teachers' sense of efficacy the results indicated that science teachers had the highest score on self-efficacy for instructional strategies (*M* = 7.29, *SD* = .95), whereas the lowest one was for student engagement (*M* = 6.59, *SD* = 1.01). It was still above the midpoint 5. Furthermore, mean scores for classroom management was high (*M* = 7.07, *SD* = .91). These results implied that science teachers feel themselves highly self-efficacious in managing classroom efficiently, engaging students in learning science, and using instructional strategies properly.

On the other hand, mean score for individual citizenship behavior scale (M = 4.20, SD = .54) and mean score for student-centered beliefs and practices scale (M = 4.02, SD = .52) were relatively high for 5-point likert scales. These findings showed that science teachers have highly willingness to support their students to be successful in science courses and they believe in centering their teaching on the students to shape the teaching-learning process.

Finally, the mean of science teachers' scores on epistemological beliefs showed their beliefs tend to be relatively high in sophisticated beliefs (Justification, M = 4.32, SD = .36; and Development, M = 4.02, SD = .48) than naïve beliefs (Source, M = 2.86, SD = .75; Certainty, M = 2.79, SD = .74).

4.2 The Results of the Hierarchical Linear Modeling (HLM) Analyses

After the descriptive statistics of the data, all scores of the continuous variables were transformed to standardized score by using z-scores. To compare predictors of outcomes and interpret the results easily, standardized scores have advantages. Therefore, the HLM analyses were conducted based on the standardized scores.

The Hierarchical Linear Modeling (HLM) analyses were presented based on the research questions of this study.

4.2.1 Research Question 1: Students' Perceptions of Constructivist Learning Environment

The first set of HLM analyses were conducted to test the research questions focusing on students' perceptions of constructivist learning environment. In the analyses, the dimensions of the Constructivist Learning Environment Scale (CLES) were assigned as outcome variables.

Research Question 1.a: Are there differences in students' perceptions of constructivist learning environment (i.e., *personal relevance*, *uncertainty*, *critical voice*, *shared control*, and *student negotiation*) among classes?

Research Question 1.b: Which teacher level variables are associated with the differences in students' perceptions of constructivist learning environment (i.e., *personal relevance*, *uncertainty*, *critical voice*, *shared control*, and *student negotiation*)?

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

To test research question 1.a, One-Way Random Effects ANOVA was conducted by using HLM. This model is also named as "empty model" that has no any variable from Level-1 (student level) or Level-2 (teacher level). It focuses on how much variation in the mean of the outcome variable is from within and between classes. Intra-Class Correlation Coefficient (ICC) score gives an answer to this question (Raudenbush & Bryk, 2002). Because, in this study, one teacher teaches only one class, the term "class" was interchangeably used with the term "teacher".

The data were analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

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

Y_{ij} is the outcome variable (*personal relevance*, *uncertainty*, *critical voice*, *shared control*, and *student negotiation*)

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

γ_{00} is the grand mean, that is, the overall average score of an 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.

Five separate One-Way Random Effects ANOVA models were conducted to address research question 1.a, because the CLES has five different sub-scales namely, personal relevance, uncertainty, critical voice, shared control, and student negotiation. Since all scores were standardized before conducting the HLM, the grand-mean for each sub-scale of the CLES, γ_{00}, was not significantly different from zero as expected according to the One-Way Random Effects ANOVAs. Since the main purpose is to compare and interpret the predictors of the outcome variables, standardized scores provide advantages to do this instead of focusing on the grand means.

The intraclass correlation coefficient (ICC) is an important indicator to determine if multilevel models are needed and applicable for these data set and variables. ICC gives information about if there is variation between class means, but no variation within any class (Garson, 2013). Raudenbush and Bryk (2002) and Garson (2013) described the calculation of the ICC as follows:

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

Five separate ICCs were calculated to see the variation between class means in students' perceptions of CLE. The results of the present study revealed that 9% of total variability in *personal relevance*, 5% of total variability in *uncertainty*, 5% of total variability in *critical voice*, 7% of total variability in *shared control*, and 4% of total variability in *student negotiation* can be attributed to the teachers. These variations were justified to continue the multilevel model analysis. On the other hands, by conducting One-Way Random Effects ANOVA models reliability estimates which are obtained by averaging all class reliabilities are calculated. These reliability statistics show 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). The formulation to calculate reliability:

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

The results of the One-Way Random Effects ANOVAs showed that reliability estimates values were not high, but not seriously problematic. It may be attributed to sample size within each group. Table 4.3 presents the final estimation of fixed effects for all dimensions of students' perception of CLE.

Table 4.3 Final estimation of fixed effects for all dimensions of students' perception of Constructivist Learning Environment (CLE).

Fixed Effects	*Coefficient*	*SE*	*ICC (ρ)*	*Reliability (λ)*
Model for CLE-Personal Relevance (β_0)			.09	.69
Intercept (γ_{00})	-.009	.031		
Model for CLE-Uncertainty (β_0)			.05	.55
Intercept (γ_{00})	-.007	.026		
Model for CLE-Critical Voice (β_0)			.05	.53
Intercept (γ_{00})	-.001	.025		
Model for CLE-Shared Control (β_0)			.07	.61
Intercept (γ_{00})	.005	.028		
Model for CLE-Student Negotiation (β_0)			.04	.48
Intercept (γ_{00})	.001	.024		

The results of the One-Way Random Effects ANOVAs indicated that the variances of the all class level (τ_{00}) components were statistically significant. It means that there are significant variation among class means concerning students' perceptions of constructivist learning environment in terms of *personal relevance* (τ_{00} = .088, X^2 = 449.71, df = 136, p<.001), *uncertainty* (τ_{00} = .050, X^2 = 311.96, df = 136, p<.001), *critical voice* (τ_{00} = .046, X^2 = 298.88, df = 136, p<.001), *shared control* (τ_{00} = .065, X^2 = 362.68, df = 136, p<.001), and *student negotiation* (τ_{00} = .038, X^2 = 265.45, df = 136, p<.001). Table 4.4 presents that final estimation of variance components for all dimensions of students' perception of CLE.

Table 4.4 Final estimation of variance components for all dimensions of students' perception of Constructivist Learning Environment (CLE).

Random Effects	*Variance Components*	*df*	X^2
CLE-Personal Relevance			
Class mean, u_{ij}	.088	136	449.71***
Level-1 Effect, r_{ij}	.914		
CLE-Uncertainty			
Class mean, u_{ij}	.050	136	311.96***
Level-1 Effect, r_{ij}	.951		
CLE-Critical Voice			
Class mean, u_{ij}	.046	136	298.88***
Level-1 Effect, r_{ij}	.953		
CLE-Shared Control			
Class mean, u_{ij}	.065	136	362.68***
Level-1 Effect, r_{ij}	.936		
CLE-Student Negotiation			
Class mean, u_{ij}	.038	136	265.45***
Level-1 Effect, r_{ij}	.962		

*** *p <.001*

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

The Means as Outcomes Model were tested for all dimensions of the CLES to investigate the explained variances in each outcome variable due to the Level-2 (teacher or class level) predictors.

The data were analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(TGOALAAP)_j + \gamma_{02}(TGOALAAV)_j + \gamma_{03}(TGOALWAV)_j + \gamma_{04}(TGOALTAS)_j + \gamma_{05}(TSELF\_CM)_j + \gamma_{06}(TSELF\_SE)_j + \gamma_{07}(TSELF\_IS)_j + \gamma_{08}(TCITIZEN)_j + \gamma_{09}(TSU\_CEN)_j + \gamma_{010}(TEP\_SOU)_j + \gamma_{011}(TEP\_CER)_j + \gamma_{012}(TEP\_JUS)_j + \gamma_{013}(TEP\_DEV)_j + u_{0j}$$

In these models,

Y_{ij} is the outcome variable (*personal relevance*, *uncertainty*, *critical voice*, *shared control*, and *student negotiation*)

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

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

γ_{01} is the differentiating effect of *ability approach* dimension of Teacher Achievement Goal Orientations Scale (TAGOS) on class mean of the outcome variable.

γ_{02} is the differentiating effect of *ability avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{03} is the differentiating effect of *work avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{04} is the differentiating effect of *task* dimension of the TAGOS on class mean of the outcome variable.

γ_{05} is the differentiating effect of *classroom management* dimension of the Teacher Sense of Efficacy Scale (TSES) on class mean of the outcome variable.

γ_{06} is the differentiating effect of *student engagement* dimension of the TSES on class mean of the outcome variable.

γ_{07} is the differentiating effect of *instructional strategies* dimension of the TSES on class mean of the outcome variable.

γ_{08} is the differentiating effect of teacher's *individual citizenship behaviors* on class mean of the outcome variable.

γ_{09} is the differentiating effect of teacher's *student-centered beliefs and practices* on class mean of the outcome variable.

γ_{010} is the differentiating effect of *source* dimension of the Teacher Epistemological Beliefs Questionnaire (TEBQ) on class mean of the outcome variable.

γ_{011} is the differentiating effect of *certainty* dimension of the TEBQ on class mean of the outcome variable.

γ_{012} is the differentiating effect of *justification* dimension of the TEBQ on class mean of the outcome variable.

γ_{013} is the differentiating effect of *development* dimension of the TEBQ on class mean of the outcome variable.

r_{ij} is the level-1 residual.

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

To test the model that was presented above and to get final model, all level-2 predictors were included in the model and the analysis was performed. Then, the t-ratio values of all predictors were examined and, based on the t-ratio values, the sequence of the predictors was determined. In the next step, the level-2 predictors were added to the empty model according to their t-ratios. If a predictor was significant after adding it, it was kept in the model. If not, it was removed from the model. Therefore, the final model included only significant predictors.

Results of the Means as Outcomes Models indicated that *personal relevance* was significantly and positively associated with *justification* dimension of the teacher epistemological beliefs (γ = .101, SE = .029, p < .01). *Uncertainty w*as significantly and positively associated with *ability approach* dimension of teacher achievement goals (γ = .073, SE = .025, p < .01) and *justification* dimension of the teacher epistemological beliefs (γ = .074, SE = .025, p < .01). *Critical Voice* was significantly and positively associated with *justification* dimension of the teacher epistemological beliefs (γ = .093, SE = .024, p < .001). *Shared control* was significantly and positively associated with *instructional strategies* dimension of the teachers' sense of efficacy (γ = .058, SE = .027, p < .05). And finally *student negotiation* was significantly and positively associated with *justification* dimension of the teacher epistemological beliefs (γ = .052, SE = .024, p < .05). Table 4.5 presents the final estimation of fixed effects for all dimensions of students' perception of the constructivist learning environment and their level-2 predictors.

Table 4.5 Final estimation of fixed effects for all dimensions of students' perception of Constructivist Learning Environment (CLE).

	Personal Relevance		Uncertainty		Critical Voice		Shared Control		Student Negotiation	
Fixed Effects	*γ*	*SE*	*γ*	*SE*	*γ*	*SE*	*γ*	*SE*	*γ*	*SE*
Model for Class Means[1]										
Intercept	-.007	.029	-.005	.024	.000	.024	.004	.027	.002	.024
T. Ability Approach Goal			.073**	.025						
T. Ability Avoidance Goal										
T. Work Avoidance Goal										
T. Task Goal										
T. Self-Efficacy-Classroom Management										
T. Self-Efficacy-Student Engagement										
T. Self-Efficacy-Instructional Strategies							.058*	.027		
T. Individual Citizenship Behavior										
T. Student-Centered Beliefs										
T. Epistemological Beliefs-Source										
T. Epistemological Beliefs-Certainty										
T. Epistemological Beliefs-Justification	.101**	.029	.074**	.025	.093***	.024			.052*	.024
T. Epistemological Beliefs-Development										

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

These findings implied that students of science teachers with sophisticated epistemological beliefs (*justification*) tend to perceive their learning environments as presenting adequate chances for them to relate science to real world (*Personal Relevance*), to practice the construction of scientific knowledge (*Uncertainty*), to question what is going on in the lesson freely (*Critical Voice*), and to communicate with their teachers in the classroom (*Student Negotiation*). Moreover, science teachers with higher levels of ability approach goals appeared to have students who feel free to practice the construction of scientific knowledge (*Uncertainty*). Finally, students of science teachers with higher levels of self-efficacy for using instructional strategies properly are likely to have a shared role in the class (*Shared Control*). Figure 4.1 indicates the results of the HLM analysis on a model for research question 1b. In the Figure 4.1, the variables in the orange boxes are teacher-level predictors. The blue ones are students' outcome variables. Also, the black arrows refer to positive relationships between teacher-level predictors and students' outcome variables.

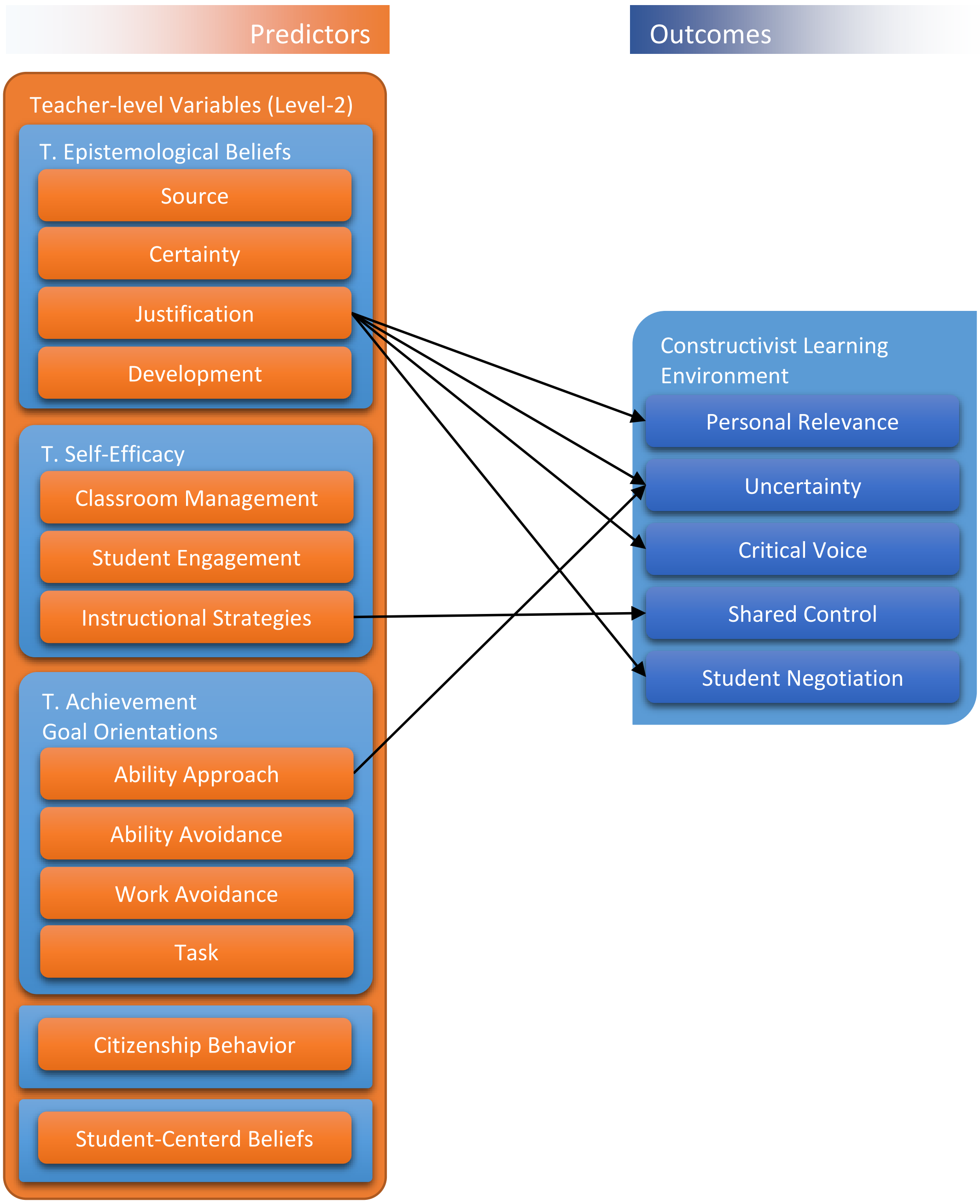


Figure 4.1 The final model based on the results of the HLM analysis for research question 1b.

Since the significantly resulted level-2 (Teacher-Level) predictors were added to the empty model in means as outcomes models, it was expected that the residual variances between classes were decreased compared to the One-Way Random Effects

ANOVA model. To see the reductions of the residual variances between two models, One-Way Random Effects ANOVA model and the Means as Outcomes Model, explained variance (R^2) accounted for teacher variables was computed for each outcome.

It can be formulized as;

$$R^2 = \frac{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA) - \tau_{00}(Means\ as\ Outcome)}{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA)}$$

Computed $R^2$for each two model set (One-Way Random Effects ANOVA Model and Means as Outcomes Model) revealed that 12% of the true between-class variance in the students' perception of *personal relevance* was accounted for *justification* dimension of teachers' epistemological beliefs, 26% of the true between-class variance in the students' perception of *uncertainty* was accounted for teachers' *ability approach* goals and *justification* dimension of teachers' epistemological beliefs, 2% of the true between-class variance in the students' perception of *critical voice* was accounted for *justification* dimension of teachers' epistemological beliefs, 5% of the true between-class variance in the students' perception of *shared control* was accounted for *instructional strategies* dimension of teachers' sense of efficacy, and 6% of the true between-class variance in the students' perception of *student negotiation* was accounted for *justification* dimension of teachers' epistemological beliefs. However, classes still varied significantly in the average means of each outcome (*Personal Relevance*, τ_{00} = .078, X^2 = 413.82, df = 135, p<.001; *Uncertainty*, τ_{00} = .037, X^2 = 268.35, df = 135, p<.001; *Critical Voice*, τ_{00} = .038, X^2 = 270.66, df = 135, p<.001; *Shared Control*, τ_{00} = .062, X^2 = 351.39, df = 135, p<.001; *Student Negotiation*, τ_{00} = .035, X^2 = 256.90, df = 135, p<.001). In other words, these teachers' level factors were not explanation for all the variation in the intercepts, since classes still varied significantly in their average scores on related outcome variables after controlling these class level factors. Table 4.6 presents that final estimation of variance components for all dimensions of students' perception of CLE as the results of the Means as Outcomes Model.

Table 4.6 Final estimation of variance components for all dimensions of students' perception of Constructivist Learning Environment (CLE).

Random Effects	*Variance Components*	*df*	X^2	R^2
CLE-Personal Relevance				
Class mean, u_{ij}	.078	135	413.82***	.117
Level-1 Effect, r_{ij}	.914			
CLE-Uncertainty				
Class mean, u_{ij}	.037	135	268.35***	.258
Level-1 Effect, r_{ij}	.950			
CLE-Critical Voice				
Class mean, u_{ij}	.038	135	270.66***	.017
Level-1 Effect, r_{ij}	.953			
CLE-Shared Control				
Class mean, u_{ij}	.062	135	351.39***	.053
Level-1 Effect, r_{ij}	.936			
CLE-Student Negotiation				
Class mean, u_{ij}	.035	135	256.90***	.064
Level-1 Effect, r_{ij}	.962			

*** *p <.001*

4.2.2 Research Question 2: Students' Epistemological Beliefs

Following sub-questions were constructed based on research question 2 that was related to students' Epistemological Beliefs (EB). To do it, the variable of the Epistemological Belief Questionnaire (SEBQ) was assigned as outcome variable.

Research Question 2.a: Are there differences in the students' epistemological beliefs (i.e., certainty, development, justification, and source) among classes?

Research Question 2.b: Which teacher level variables are associated with the differences in the students' epistemological beliefs?

Research Question 2.c: Which student level variables explain the differences in the students' epistemological beliefs?

Research Question 2.d: Which teacher level variables influence the effect of student level variables on the students' epistemological beliefs?

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

To test research question 2.a, One-Way Random Effects ANOVA was conducted by using HLM.

The data was analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

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

Y_{ij} is the outcome variable (*certainty*, *development*, *justification,* and *source*)

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

γ_{00} is the grand mean, that is, the overall average score of an 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.

Students' epistemological beliefs were measured in four dimensions, namely certainty, development, justification, and source. Thus, four separate One-Way Random Effects ANOVA were conducted to test research question 2.a. All scores were standardized before conducting the HLM.

In order to see the variation between class means in dimensions of students' epistemological beliefs, four separate ICCs were calculated by using the following formula:

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

The results revealed that 8% of total variability in *certainty*, 4% of total variability in *development*, 6% of total variability in *justification*, and 8% of total variability in *source* can be attributed to the teachers.

Table 4.7 Final estimation of fixed effects for all dimensions of students' Epistemological Beliefs (EB).

Fixed Effects	*Coefficient*	*SE*	*ICC (ρ)*	*Reliability (λ)*
Model for Epistemological Beliefs-Certainty (β_0)			.08	.67
Intercept (γ_{00})	.017	.030		
Model for Epistemological Beliefs-Development (β_0)			.04	.47
Intercept (γ_{00})	-.001	.024		
Model for Epistemological Beliefs-Justification (β_0)			.06	.59
Intercept (γ_{00})	-.006	.027		
Model for Epistemological Beliefs-Source (β_0)			.08	.65
Intercept (γ_{00})	.015	.029		

The results of the One-Way Random Effects ANOVAs showed that reliability estimates values were not seriously problematic for all outcomes. Table 4.10 presents the final estimation of fixed effects for all dimensions of the epistemological beliefs. According to the results the variances of the all class level (τ_{00}) components were statistically significant. It means that there are significant variability in students' epistemological beliefs fin terms of *certainty* (τ_{00} = .081, X^2 = 421.61, df = 136, p<.001), *development* (τ_{00} = .036, X^2 = 259.34, df = 136, p<.001), *justification* (τ_{00} = .060, X^2 = 343.52, df = 136, p<.001), and *source* (τ_{00} = .077, X^2 = 404.46, df = 136, p<.001). Table 4.8 presents that final estimation of variance components for all dimensions of students' EB.

Table 4.8 Final estimation of variance components for all dimensions of students' Epistemological Beliefs (EB).

Random Effects	*Variance Components*	*df*	X^2
Epistemological Beliefs-Certainty			
Class mean, u_{ij}	.081	136	421.61***
Level-1 Effect, r_{ij}	.921		
Epistemological Beliefs-Development			
Class mean, u_{ij}	.036	136	259.34***
Level-1 Effect, r_{ij}	.964		
Epistemological Beliefs-Justification			
Class mean, u_{ij}	.060	136	343.52***
Level-1 Effect, r_{ij}	.942		
Epistemological Beliefs-Source			
Class mean, u_{ij}	.077	136	404.46***
Level-1 Effect, r_{ij}	.925		

*** *p <.001*

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

The Means as Outcomes Model were tested for all dimensions of students' Epistemological Beliefs Questionnaire (SEBQ) to investigate the explained variances in each outcome variable due to the Level-2 (teacher or class level) predictors.

The data was analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

$$\begin{aligned}\beta_{0j} = \gamma_{00} + \gamma_{01}(TGOALAAP)_j + \gamma_{02}(TGOALAAV)_j + \gamma_{03}(TGOALWAV)_j \\ + \gamma_{04}(TGOALTAS)_j + \gamma_{05}(TSELF\_CM)_j \\ + \gamma_{06}(TSELF\_SE)_j + \gamma_{07}(TSELF\_IS)_j + \gamma_{08}(TCITIZEN)_j \\ + \gamma_{09}(TSU\_CEN)_j + \gamma_{010}(TEP\_SOU)_j + \gamma_{011}(TEP\_CER)_j \\ + \gamma_{012}(TEP\_JUS)_j + \gamma_{013}(TEP\_DEV)_j + \gamma_{014}(CLE\_P\_AG)_j \\ + \gamma_{015}(CLE\_U\_AG)_j + \gamma_{016}(CLE\_C\_AG)_j \\ + \gamma_{017}(CLE\_S\_AG)_j + \gamma_{018}(CLE\_N\_AG)_j + u_{0j}\end{aligned}$$

In these models,

Y_{ij} is the outcome variable (*certainty*, *development*, *justification*, and *source*)

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

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

γ_{01} is the differentiating effect of *ability approach* dimension of Teacher Achievement Goal Orientations Scale (TAGOS) on class mean of the outcome variable.

γ_{02} is the differentiating effect of *ability avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{03} is the differentiating effect of *work avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{04} is the differentiating effect of *task* dimension of the TAGOS on class mean of the outcome variable.

γ_{05} is the differentiating effect of *classroom management* dimension of the Teacher Sense of Efficacy Scale (TSES) on class mean of the outcome variable.

γ_{06} is the differentiating effect of *student engagement* dimension of the TSES on class mean of the outcome variable.

γ_{07} is the differentiating effect of *instructional strategies* dimension of the TSES on class mean of the outcome variable.

γ_{08} is the differentiating effect of teacher's *individual citizenship behaviors* on class mean of the outcome variable.

γ_{09} is the differentiating effect of teacher's *student-centered beliefs and practices* on class mean of the outcome variable.

γ_{010} is the differentiating effect of *source* dimension of the Teacher Epistemological Beliefs Questionnaire (TEBQ) on class mean of the outcome variable.

γ_{011} is the differentiating effect of *certainty* dimension of the TEBQ on class mean of the outcome variable.

γ_{012} is the differentiating effect of *justification* dimension of the TEBQ on class mean of the outcome variable.

γ_{013} is the differentiating effect of *development* dimension of the TEBQ on class mean of the outcome variable.

γ_{014} is the differentiating effect of *personal relevance* dimension (aggregated) of the Constructivist Learning Environment Scale (CLES) on class mean of the outcome variable.

γ_{015} is the differentiating effect of *uncertainty* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{016} is the differentiating effect of c*ritical voice* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{017} is the differentiating effect of *shared control* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{018} is the differentiating effect of *student negotiation* dimension (aggregated) of the CLES on class mean of the outcome variable.

r_{ij} is the level-1 residual.

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

Results of the Means as Outcomes Models indicated that c*ertainty* was significantly and negatively associated with *student engagement* dimension of the teachers' sense of efficacy (γ = -.072, SE = .027, p < .01) and *personal relevance* dimension (aggregated) of the constructivist learning environment perception (γ = -

.096, SE = .028, $p < .01$). Also, it was significantly and positively associated with *shared control* dimension (aggregated) of the constructivist learning environment perception (γ = .173, SE = .028, $p < .001$). *Development* was significantly and positively associated with *certainty* dimension of the teacher epistemological beliefs (γ = .050, SE = .018, $p < .01$), *personal relevance* dimension (aggregated) of the constructivist learning environment perception (γ = .086, SE = .027, $p < .01$), and *uncertainty* dimension (aggregated) of constructivist learning environment perception (γ = .094, SE = .027, $p < .01$). *Justification* was significantly and positively associated with *source* dimension of the teacher epistemological beliefs (γ = .046, SE = .018, $p < .05$) and *personal relevance* dimension (aggregated) of the constructivist learning environment perception (γ = .224, SE = .018, $p < .001$). And finally, s*ource* was significantly and negatively associated with *personal relevance* dimension (aggregated) of the constructivist learning environment perception (γ = -.116, SE = .028, $p < .001$) and was significantly and positively associated with *shared control* dimension (aggregated) of the constructivist learning environment perception (γ = .161, SE = .028, $p < .001$). Table 4.9 presents the final estimation of fixed effects for all dimensions of students' Epistemological Beliefs and their level-2 predictors.

Table 4.9 Final estimation of fixed effects for all dimensions of students' Epistemological Beliefs (EB).

	Certainty		Development		Justification		Source	
Fixed Effects	*γ*	*SE*	*γ*	*SE*	*γ*	*SE*	*γ*	*SE*
Model for Class Means[1]								
Intercept	.019	.026	-.008	.018	-.009	.018	.017	.026
T. Self-Efficacy-Classroom Management								
T. Self-Efficacy-Student Engagement	-.072**	.027						
T. Self-Efficacy-Instructional Strategies								
T. Individual Citizenship Behavior								
T. Student-Centered Beliefs								
T. Epistemological Beliefs-Source					.046*	.018		
T. Epistemological Beliefs-Certainty			.050**	.018				
T. Epistemological Beliefs-Justification								
T. Epistemological Beliefs-Development								
CLE-Personal Relevance (Aggregated)	-.096**	.028	.086**	.027	.224***	.018	-.116***	.028
CLE-Uncertainty (Aggregated)			.094**	.027				
CLE-Critical Voice (Aggregated)								
CLE-Shared Control (Aggregated)	.173***	.028					.161***	.028
CLE-Student Negotiation (Aggregated)								

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

These findings implied that science teachers with less sophisticated epistemological beliefs tend to have students with the more sophisticated epistemological beliefs. Results also revealed that students of science teachers who feel self-efficacious for student engagement are less likely to hold certainty beliefs. According to the findings regarding students' aggregated perception of constructivist learning environment, if students perceive to have opportunities to relate science to real world (*Personal Relevance*) and to practice the construction of scientific knowledge (*Uncertainty*), their epistemological beliefs tend to be more sophisticated. On the other hand, taking a role in the decision making process of what will go on in the lesson (*shared control*) was positively linked to naïve epistemological beliefs.

Since the significantly resulted level-2 (Teacher-Level) predictors were added to the empty model, it was expected that the residual variances between classes were decreased compared to the One-Way Random Effects ANOVA model. To see the reductions of the residual variances between two models, R^2 was computed by using τ_{00} estimates obtained from two model sets (One-Way Random Effects ANOVA Model and Means as Outcomes Model) with following formula:

$$R^2 = \frac{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA) - \tau_{00}(Means\ as\ Outcome)}{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA)}$$

Computed R^2 for each two model set sets (One-Way Random Effects ANOVA Model and Means as Outcomes Model) revealed that 38% of the true between-class variance in ***certainty*** dimension was accounted for *student engagement* dimension of teachers' sense of efficacy beliefs and *personal relevance* and *shared control* dimensions of constructivist learning environment (aggregated), 91% of the true between-class variance in ***development*** dimension was accounted for *certainty* dimension of teachers' epistemological beliefs and *personal relevance* and *uncertainty* dimensions of constructivist learning environment (aggregated), 94% of the true between-class variance in ***justification*** dimension was accounted for *source* dimension of teachers' epistemological beliefs and *personal relevance* dimension of constructivist learning environment (aggregated), and 34% of the true between-class variance in ***source*** dimension was accounted for *personal relevance* and *shared control* dimensions of constructivist learning environment (aggregated). Even after controlling class level variables, classes still varied significantly in the average means of *certainty* (τ_{00} = .050, X^2 = 316.91, df = 133, p<.001) and *source* (τ_{00} = .051, X^2 = 314.51, df = 134, p<.001). Table 4.10 presents that final estimation of variance components for all dimensions of students' epistemological beliefs as the results of the Means as Outcomes Model.

Table 4.10 Final estimation of variance components for all dimensions of students' Epistemological Beliefs (EB).

Random Effects	*Variance Components*	*df*	X^2	R^2
Epistemological Beliefs-Certainty				
Class mean, u_{ij}	.050	133	316.91***	.38
Level-1 Effect, r_{ij}	.921			
Epistemological Beliefs-Development				
Class mean, u_{ij}	.003	133	150.17	.91
Level-1 Effect, r_{ij}	.964			
Epistemological Beliefs-Justification				
Class mean, u_{ij}	.004	134	161.21	.94
Level-1 Effect, r_{ij}	.944			
Epistemological Beliefs-Source				
Class mean, u_{ij}	.051	134	314.51***	.34
Level-1 Effect, r_{ij}	.926			

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

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

The Random Coefficient Model was tested to investigate the explained variances in students' Epistemological Beliefs (EB) due to the students' perception of Constructivist Learning Environment (CLE) (Level-1 or student level predictor). This model was tried for each dimension of epistemological beliefs which were certainty, development, justification, and source. Each analysis was done by addressing regression equations for each teachers' class, by computing averages of these classes' intercepts-slopes and all variations. Fixing or not fixing of the association between the outcome variable and the predictor variable are an important stage in testing the Random Coefficient Model. Fixed variation means that the degree of the relationship between the outcome variable and predictor variable does not vary through the classes, whereas random variation means that the degree of the relationship between the outcome variable and the predictor variable varies through the classes. To decide to fix or not to fix, a series of HLM models is tested. Based on the result, the final model is constructed.

Accordingly, the Random Coefficient Model was tested based on the following regression equation:

Level-1 (student level) model:

$$Y_{ij} = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3J} * (CLE\_CRI) + \beta_{4J} * (CLE\_SHA) + \beta_{5J} * (CLE\_NEG) + r_{ij}$$

Level-2 (teacher level or class level) model:

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

…

…

…

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

In these models,

Y_{ij} is the outcome variable (*certainty*, *development*, *justification*, and *source*)

β_{0j} is the mean on each epistemological beliefs dimension for each class.

β_{1j} is the differentiating effect of *personal relevance* dimension of the Constructivist Learning Environment Scale (CLES) in class j.

β_{2j} is the differentiating effect of *uncertainty* dimension of the CLES in class j.

β_{3j} is the differentiating effect of c*ritical voice* dimension of the CLES in class j.

β_{4j} is the differentiating effect of *shared control* dimension of the CLES in class j.

β_{5j} is the differentiating effect of *student negotiation* dimension of the CLES in class j.

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.

To get final model, all level-1 predictors was included in the model and analysis was performed. Then, all predictors were examined with respect to the t-ratio values and, the sequence of the predictors was determined considering these values. In the next step, the level-1 predictors were added to the empty model according to their t-ratios. Differently from the Means as Outcomes Model, each level-1 predictor was tested by examining if it was a significant predictor and its variation was random. There are four possibilities in this test. (1) If a predictor was significant and randomly varying, it was hold in the model. (2) If a predictor was significant, but not randomly varying, it was it was hold in the model as a fixed variable. (3) If a predictor was not significant and not randomly varying, it was omitted from the model. And (4) if a predictor was not significant, but randomly varying, it was it was hold in the model as a random variable. This method was named as building strategy that was offered as a choosing predictors method by Bryk and Raudenbush (2002). Similar to the Means as Outcomes Model, the final model included only significant-resulted level-1 predictors.

Certainty

The Random Coefficient Model revealed that c*ertainty* dimension of students' epistemological beliefs was significantly and positively associated with *shared control* dimension (aggregated) of the constructivist learning environment (γ = .175, SE = .022, p < .001). Moreover, the slope of *shared control* significantly varied (X^2= 170.15, p < .05). It was not significantly associated with *critical voice* dimension (aggregated) of the constructivist learning environment, but the slope of *certainty* was significantly varied (X^2= 164.59, p < .05). It means that there was a variability among classes and slopes in some classes were sharper compared to other classes. It can be explained by class differences. Class differences can be sourced from class level variables. Other dimensions of the constructivist learning environment were not found to associate with c*ertainty* dimension of students' epistemological beliefs.

To calculate the proportion of the reduction in residual variance for *certainty* dimension of students' epistemological beliefs, the sigma squared that was obtained from the One-Way Random Effects ANOVA and the sigma squared that was obtained from the Random Coefficient Model were used:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Random\ Coefficient)}{\sigma^2(random\ ANOVA)}$$

Accordingly, when the level-1 variables were added to the model as predictors of ***certainty***, the residual variance was reduced by 5.2%. However, there was still a significant variation among the class means that might be explained adding level-2 variables (X^2= 444.81, *p* < .001).

Development

Development dimension of students' epistemological beliefs was significantly and positively associated with *personal relevance* dimension (aggregated) (γ = .130, SE = .026, p < .001), *uncertainty* dimension (aggregated) (γ = .146, SE = .024, p < .001), *critical voice* dimension (aggregated) (γ = .126, SE = .027, p < .001), *shared control* dimension (aggregated) (γ = .065, SE = .022, p < .01), and *student negotiation* dimension (aggregated) of the constructivist learning environment (γ = .061, SE = .021, p < .01). Moreover, the slope of *personal relevance* (X^2= 194.65, *p* < .01), *uncertainty* (X^2= 170.56, *p* < .05), and *critical voice* (X^2= 174.98, *p* < .05), significantly varied. It means that there was a variability among classes and class differences can be explained by class level variables.

To calculate the proportion of the reduction in residual variance for *development* dimension of students' epistemological beliefs, the sigma squared that was obtained from the One-Way Random Effects ANOVA and the sigma squared that was obtained from the Random Coefficient Model were used:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Random\ Coefficient)}{\sigma^2(random\ ANOVA)}$$

Accordingly, when the level-1 variables were added to the model as predictors of ***development***, the residual variance was decreased by 20.3%. However, there was still a significant variation among the class means that might be explained adding level-2 variables (X^2= 325.26, *p* < .001).

Justification

Justification dimension of students' epistemological beliefs was significantly and positively associated with *personal relevance* dimension (aggregated) (γ = .226, SE = .025, p < .001), *uncertainty* dimension (aggregated) (γ = .170, SE = .023, p <

.001), *critical voice* dimension (aggregated) (γ = .175, SE = .022, p < .001), and *student negotiation* dimension (aggregated) of the constructivist learning environment (γ = .087, SE = .019, p < .001). Moreover, the slope of *personal relevance* (X^2= 207.27, p < .001) and *critical voice* (X^2= 166.91, p < .05) were significantly varied. It means that there was a variability among classes and class differences can be explained by class level variables.

To calculate the proportion of the reduction in residual variance for *justification* dimension of students' epistemological beliefs, the sigma squared that was obtained from the One-Way Random Effects ANOVA and the sigma squared that was obtained from the Random Coefficient Model were used:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Random\ Coefficient)}{\sigma^2(random\ ANOVA)}$$

Accordingly, when the level-1 variables were added to the model as predictors of ***justification***, the residual variance was decreased by 32.5%. However, there was still a significant variation among the class means that might be explained adding level-2 variables (X^2= 509.21, p < .001).

Source

Source dimension of students' epistemological beliefs was significantly and negatively associated with *personal relevance* dimension (aggregated) (γ = -.043, SE = .022, p < .05) and *critical voice* dimension (aggregated) of the constructivist learning environment (γ = -.054, SE = .023, p < .05). Also, it was significantly and positively associated with *shared control* dimension (aggregated) of the constructivist learning environment (γ = .208, SE = .025, p < .001). Moreover, the slope of *shared control* was significantly varied (X^2= 233.50, p < .001). It means that there was a variability among classes for shared control and class differences can be explained by class level variables.

To calculate the proportion of the reduction in residual variance for *source* dimension of students' epistemological beliefs, the sigma squared that was obtained from the One-Way Random Effects ANOVA and the sigma squared that was obtained from the Random Coefficient Model were used:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Random\ Coefficient)}{\sigma^2(random\ ANOVA)}$$

Accordingly, when the level-1 variables were added to the model as predictors of ***source***, the residual variance was decreased by 5.7%. However, there was still a significant variation among the class means that might be explained adding level-2 variables (X^2= 428.93, p < .001).

Table 4.11 presents the results of the Random Coefficient Model that was tested for certainty dimension of the students' epistemological beliefs.

Table 4.11 Final estimation of fixed effects for all dimensions of students' Epistemological Beliefs (EB).

	Certainty		Development		Justification		Source	
Fixed Effects	γ	SE	γ	SE	γ	SE	γ	SE
Model for Class Means[1]								
Intercept	.016	.030	-.002	.024	-.008	.028	.015	.029
CLE-Personal Relevance			.130***	.026	.226***	.025	-.043*	.022
CLE-Uncertainty			.146***	.024	.170***	.023		
CLE-Critical Voice	-.028	.022	.126***	.027	.175***	.022	-.054*	.023
CLE-Shared Control	.175***	.022	.065**	.022			.208***	.025
CLE-Student Negotiation			.061**	.021	.087***	.019		

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

These findings implied that if students feel them to have opportunities to relate science to real world (*Personal Relevance*), to practice the construction of scientific knowledge (*Uncertainty*), to question what is going on in the lesson freely (*Critical Voice*), to take a role in the decision making process of what will go on in the lesson, and to communicate with their teachers in the classroom (*Student Negotiation*), their epistemological beliefs tend to be more sophisticated. On the other hand, the higher the students' perception of shared control (i.e. taking a role in the decision making process of what will go on in the lesson), the more students believe in the existence of more than one right answer than can be constructed by the knower (*Certainty).*

Table 4.12 presents the results of the Random Coefficient Model that was tested for certainty dimension of the students' epistemological beliefs.

Table 4.12 Final estimation of variance components for all dimensions of students' Epistemological Beliefs (EB).

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Epistemological Beliefs-Certainty				.052	
Class mean, u_{ij}	.083	136	444.81***		.683
CLE-Critical Voice (Aggregated), u_{1j}	.008	136	164.59*		.123
CLE-Shared Control (Aggregated), u_{2j}	.012	136	170.15*		.166
Level-1 Effect, r_{ij}	.872				
Epistemological Beliefs-Development				.203	
Class mean, u_{ij}	.045	136	325.26***		.572
CLE-Personal Relevance (Aggregated), u_{1j}	.022	136	194.65**		.219
CLE-Uncertainty (Aggregated), u_{2j}	.018	136	170.56*		.208
CLE-Critical Voice (Aggregated), u_{3j}	.019	136	174.98*		.212
Level-1 Effect, r_{ij}	.769				
Epistemological Beliefs-Justification				.325	
Class mean, u_{ij}	.076	136	509.21***		.729
CLE-Personal Relevance (Aggregated), u_{1j}	.022	136	207.27***		.252
CLE-Uncertainty (Aggregated), u_{2j}	.021	136	186.12**		.268
CLE-Critical Voice (Aggregated), u_{3j}	.008	136	166.91*		.117
Level-1 Effect, r_{ij}	.636				

Table 4.12 Continued

Epistemological Beliefs-Source				.057	
Class mean, u_{ij}	.079	136	428.93***		.673
CLE-Shared Control (Aggregated), u_{3j}	.026	136	233.50***		.376
Level-1 Effect, r_{ij}	.872				

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

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

Intercepts and Slopes as Outcomes Model was tested to investigate which teacher level variables influence the effect of student level variables on the students' epistemological beliefs. For the specified purpose, the variables that were determined by testing the Random Coefficient Models were used as level-1 (student level) predictors. Then, the variables that were determined by testing the Means as Outcomes Models were added to the intercepts and to significantly random varied level-1 predictors as level-2 (teacher or class level) predictors. This was applied for each outcome variable in research question 2.d, which are *certainty*, *development*, *justification*, and *source* dimensions of students' epistemological beliefs. If a level-2 predictor is significantly associated to a level-1 predictor, it means that this level-2 predictor is a moderator between the outcome variable and that level-1 predictor.

Certainty

Accordingly, the Intercepts and Slopes as Outcomes Model was tested based on the following regression equation for the *certainty* dimension of the SEBQ:

Level-1 (student level) model:

$$Certainty\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_CRI) + \beta_{2J} * (CLE\_SHA) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (TSELF\_SE)_j + \gamma_{02} * (CLE\_P\_AG)_j + \gamma_{03} * (CLE\_S\_AG)_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} * (TSELF\_SE)_j + \gamma_{12} * (CLE\_P\_AG)_j + \gamma_{13} * (CLE\_S\_AG)_j + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21} * (TSELF\_SE)_j + \gamma_{22} * (CLE\_P\_AG)_j + \gamma_{23} * (CLE\_S\_AG)_j + u_{2j}$$

To get the final model, non-significant predictors were omitted from the model respectively. After running the final the HLM, it was seemed that following model was significantly resulted for all retained level-1 and level-2 predictors:

Level-1 (student level) model:

$$Certainty\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_CRI) + \beta_{2J} * (CLE\_SHA) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (TSELF\_SE)_j + \gamma_{02} * (CLE\_P\_AG)_j + \gamma_{03} * (CLE\_S\_AG)_j + u_{0j}$$

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

$$\beta_{2j} = \gamma_{20} + \gamma_{21} * (CLE\_P\_AG)_j + \gamma_{22} * (CLE\_S\_AG)_j + u_{2j}$$

As similar to the Means as Outcomes Models, the results (β_{0j}) of the Intercepts and Slopes as Outcomes Model indicated that *certainty* dimension of students' epistemological beliefs was significantly and negatively associated with *student engagement* dimension of the teachers' sense of efficacy (γ = -.063, SE = .026, p < .05) and *personal relevance* dimension (aggregated) of the constructivist learning environment (γ = -.092, SE = .028, p < .01). Also, it was significantly and positively associated with *shared control* dimension (aggregated) of the constructivist learning environment (γ = .170, SE = .027, p < .001).

Testing the equation β_{1j}, the results showed that *critical voice* dimension of the students' perception of constructivist learning environment was not significantly associated with *certainty* dimension of the students' epistemological beliefs (γ = -.033, SE = .022, p = .122). However, still there was a significant variability among the classes (X^2=164.42, p<.05). Thus, it was retained in the final model.

Testing the equation β_{2j}, the results showed that *shared control* dimension of the students' perception of constructivist learning environment was significantly and positively associated with *certainty* dimension of the students' epistemological beliefs (γ = .183, SE = .022, p<.001). Furthermore, *personal relevance* (γ = -.085, SE = .020, p < .001) and *shared control* (γ = .066, SE = .022, p < .01) dimensions (aggregated) of the constructivist learning environment moderated the effect of *shared control* dimension of the students' individual perception of constructivist learning environment on *certainty* dimension of the students' epistemological beliefs.

Table 4.13 presents that final estimation of fixed effects for certainty dimension of students' epistemological beliefs as the results of the Intercepts and Slopes as Outcomes Model.

Table 4.13 Final estimation of fixed effects for certainty dimension of students' Epistemological Beliefs (EB).

Fixed Effects	Coefficient	SE
Model for Class Means[1]		
Intercept, γ_{00}	.018	.026
T. Self-Efficacy-Student Engagement, γ_{01}	-.063*	.026
CLE-Personal Relevance (Aggregated), γ_{02}	-.092**	.028
CLE-Shared Control (Aggregated), γ_{03}	.170***	.027
CLE-Critical Voice, γ_{10}	-.033	.022
CLE-Shared Control, γ_{20}	.183***	.022
CLE-Personal Relevance (Aggregated), γ_{21}	-.085***	.022
CLE-Shared Control (Aggregated), γ_{22}	.066**	.022

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

To see the proportion of variance explained in the slope model with significant resulted level-2 predictors, variance components obtained from the Random Coefficient Model and the Intercepts and Slopes as Outcomes Model were compared:

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

Accordingly, 36.4% of the variance in the between class difference in mean *certainty* was explained by adding level-2 predictors.

Finally, the results of the Intercepts and Slopes as Outcomes Model revealed that a significant variability still seems among the classes (X^2=334.59, p<.001). Table 4.14 presents that final estimation of variance components for certainty dimension of students' epistemological beliefs as the results of the Intercepts and Slopes as Outcomes Model.

Table 4.14 Final estimation of variance components for certainty dimension of students' Epistemological Beliefs (EB).

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Intercept				.364	
Class mean, u_{0j}	.053	133	334.59***		.580
CLE-Critical Voice, u_{1j}	.008	136	164.42*		.114
CLE-Shared Control, u_{2j}	.007	134	156.17***		.100
Level-1 Effect, r_{ij}	.873				

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

Development

The Intercepts and Slopes as Outcomes Model was also tested based on the following regression equation for the *development* dimension of the students' EB:

Level-1 (student level) model:

$$Development\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3j} * (CLE\_CRI) + \beta_{4J} * (CLE\_SHA) + \beta_{5J} * (CLE\_NEG) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (TEP\_CER)_j + \gamma_{02} * (CLE\_P\_AG)_j + \gamma_{03} * (CLE\_U\_AG)_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} * (TEP\_CER)_j + \gamma_{12} * (CLE\_P\_AG)_j + \gamma_{13} * (CLE\_U\_AG)_j + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21} * (TEP\_CER)_j + \gamma_{22} * (CLE\_P\_AG)_j + \gamma_{23} * (CLE\_U\_AG)_j + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31} * (TEP\_CER)_j + \gamma_{32} * (CLE\_P\_AG)_j + \gamma_{33} * (CLE\_U\_AG)_j + u_{3j}$$

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

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

To get the final model, non-significant predictors were omitted from the model respectively. After running the final the HLM, it was seemed that following model was significantly resulted for all retained level-1 and level-2 predictors:

Level-1 (student level) model:

$$Development\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3j} * (CLE\_CRI) + \beta_{4J} * (CLE\_SHA) + \beta_{5J} * (CLE\_NEG) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (TEP\_CER)_j + \gamma_{02} * (CLE\_P\_AG)_j + \gamma_{03} * (CLE\_U\_AG)_j + u_{0j}$$

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

$$\beta_{2j} = \gamma_{20} + \gamma_{21} * (TEP\_CER)_j + u_{2j}$$

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

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

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

As similar to the Means as Outcomes Models, the results (β_{0j}) of the Intercepts and Slopes as Outcomes Model indicated that; *development* dimension of students' epistemological beliefs was significantly and positively associated with *certainty* dimension of the teacher sense of efficacy (γ = .047, SE = .018, p < .05), *personal relevance* dimension (aggregated) of the constructivist learning environment (γ = .089, SE = .026, p < .01), and *uncertainty* dimension (aggregated) of the constructivist learning environment (γ = .092, SE = .026, p < .01).

Testing the equation β_{1j}, the results showed that *personal relevance* dimension of the students' perception of constructivist learning environment was found as significantly and positively associated with *development* dimension of the students' epistemological beliefs (γ = .128, SE = .026, p < .001). However, still there was a significant variability among the classes (X^2=194.27, p<.01).

Testing the equation β_{2j}, the results showed that *uncertainty* dimension of the students' perception of constructivist learning environment was found as significantly and positively associated with *development* dimension of the students' epistemological beliefs (γ = .183, SE = .022, p<.001). Moreover, *certainty* dimensions of the teacher epistemological beliefs moderated the effect of *uncertainty* dimension of the students' constructivist learning environment on *development* dimensions of students' epistemological beliefs (γ = -.047, SE = .024, p < .001).

The equations of β_{3j}, β_{4j}, and β_{5j}were tested in the same HLM analysis. According to the results , *critical voice* dimension of the students' constructivist learning environment perception *was* significantly and positively associated with *development* dimension of the students' epistemological beliefs (γ = .126, SE = .027, p < .001). Also, the slope of *critical voice* was still significantly varied (X^2=174.68, p<.05). *Shared control* dimension of the students' constructivist learning environment (γ = .065, SE = .022, p < .01) and *student negotiation* dimension of the students' constructivist learning environment were found as significantly and positively associated with *development* dimension of the students' epistemological beliefs (γ = .060, SE = .021, p < .01).

Table 4.15 presents that final estimation of fixed effects for development dimension of students' epistemological beliefs as the results of the results of the Intercepts and Slopes as Outcomes Model.

Table 4.15 Final estimation of fixed effects for development dimension of students' Epistemological Beliefs (EB).

Fixed Effects	Coefficient	SE
Model for Class Means[1]		
Intercept, γ_{00}	-.008	.018
T. Epistemological Beliefs-Certainty, γ_{01}	.047**	.018
CLE-Personal Relevance (Aggregated), γ_{02}	.089**	.028
CLE-Shared Control (Aggregated), γ_{03}	.092***	.024
CLE-Personal Relevance, γ_{10}	.128***	.026
CLE-Uncertainty, γ_{20}	.147***	.023
T. Epistemological Beliefs-Certainty, γ_{21}	-.047**	.018
CLE-Critical Voice, γ_{30}	.126***	.027
CLE-Shared Control, γ_{40}	.065**	.022
CLE-Negotiation, γ_{50}	.060**	.021

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

Finally, the results of the Intercepts and Slopes as Outcomes Model revealed that 74% of the variance in the between class difference in mean *development* was explained by adding level-2 predictors, but a significant variability still seems among the classes (X^2=188.14, p<.01). Table 4.16 presents that final estimation of variance components for development dimension of students' epistemological beliefs as the results of the results of the Intercepts and Slopes as Outcomes Model.

Table 4.16 Final estimation of variance components for development dimension of students' Epistemological Beliefs (EB).

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Intercept				.740	
Class mean, u_{0j}	.012	133	188.14**		.263
CLE-Personal Relevance, u_{1j}	.023	136	194.27**		.220
CLE-Uncertainty, u_{2j}	.012	135	163.13		.155
CLE-Critical Voice, u_{3j}	.018	136	174.68*		.208
Level-1 Effect, r_{ij}	.770				

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

Justification

The Intercepts and Slopes as Outcomes Model was also tested based on the following regression equation for the *justification* dimension of the students' EB:

Level-1 (student level) model:

$$Justification\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3j} * (CLE\_CRI) + \beta_{4J} * (CLE\_NEG) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (TEP\_SOU)_j + \gamma_{02} * (CLE\_P\_AG)_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} * (TEP\_SOU)_j + \gamma_{12} * (CLE\_P\_AG)_j + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21} * (TEP\_SOU)_j + \gamma_{22} * (CLE\_P\_AG)_j + \gamma_{23} + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31} * (TEP\_SOU)_j + \gamma_{32} * (CLE\_P\_AG)_j + u_{3j}$$

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

To get the final model, non-significant predictors were omitted from the model respectively. After the final running the HLM, it was seemed that following model was significantly resulted for all retained level-1 and level-2 predictors:

Level-1 (student level) model:

$$Justification\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3j} * (CLE\_CRI) + \beta_{4J} * (CLE\_NEG) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (TEP\_SOU)_j + \gamma_{02} * (CLE\_P\_AG)_j + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + u_{1j}$$
$$\beta_{2j} = \gamma_{20} + u_{2j}$$
$$\beta_{3j} = \gamma_{30} + u_{3j}$$
$$\beta_{4j} = \gamma_{40}$$

As similar to the Means as Outcomes Models, the results (β_{0j}) of the Intercepts and Slopes as Outcomes Model indicated that *source* dimension of the teachers' epistemological beliefs (γ = .044, SE = .018, p < .05) and *personal relevance* dimension (aggregated) of the constructivist learning environment were significantly and positively associated with *justification* dimension of students' epistemological beliefs (γ = .226, SE = .018, p < .001).

Testing the equation β_{1j}, the results showed that *personal relevance* dimension of the students' perception of constructivist learning environment was significantly and positively associated with *justification* dimension of the students' epistemological beliefs (γ = .226, SE = .025, p < .001). However, still there was a significant variability among the classes (X^2=206.67, p<.001).

Testing the equation β_{2j}, the results showed that *uncertainty* dimension of the students' perception of constructivist learning environment was significantly and positively associated with *justification* dimension of the students' epistemological beliefs (γ = .172, SE = .023, p<.001). However, still there was a significant variability among the classes (X^2=185.62, p<.01).

Testing the equation β_{3j}, the results showed that *critical voice* dimension of the students' perception of constructivist learning environment was significantly and positively associated with *justification* dimension of the students' epistemological beliefs (γ = .175, SE = .022, p < .001). However, still there was a significant variability among the classes (X^2=166.43, p<.05).

Testing the equation β_{4j}, the results showed that *student negotiation* dimension of the students' perception of constructivist learning environment was found as significantly and positively associated with *justification* dimension of the students' epistemological beliefs (γ = .087, SE = .019, p < .001).

Table 4.17 presents that final estimation of fixed effects for justification dimension of students' EB as the results of the results of the Intercepts and Slopes as Outcomes Model.

Table 4.17 Final estimation of fixed effects for justification dimension of students' Epistemological Beliefs (EB).

Fixed Effects	Coefficient	SE
Model for Class Means[1]		
Intercept, γ_{00}	-.008	.018
T. Epistemological Beliefs-Source, γ_{01}	.044*	.018
CLE-Personal Relevance (Aggregated), γ_{02}	.226***	.018
CLE-Personal Relevance, γ_{10}	.226***	.025
CLE-Uncertainty, γ_{20}	.172***	.023
CLE-Critical Voice, γ_{30}	.175***	.022
CLE-Student Negotiation, γ_{40}	.087***	.019

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

Finally, the results of the Intercepts and Slopes as Outcomes Model revealed that 76.8% of the variance in the between class difference in mean *justification* was explained by adding level-2 predictors, but a significant variability still seems among the classes (X^2=238.67, p<.001). Table 4.18 presents that final estimation of variance components for justification dimension of students' epistemological beliefs as the results of the results of the Intercepts and Slopes as Outcomes Model.

Table 4.18 Final estimation of variance components for justification dimension of students' Epistemological Beliefs (EB).

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Intercept				.768	
Class mean, u_{0j}	.018	134	238.67***		.392
CLE-Personal Relevance, u_{1j}	.022	136	206.67***		.249
CLE-Uncertainty, u_{2j}	.021	136	185.62**		.269
CLE-Critical Voice, u_{3j}	.007	136	166.43*		.116
Level-1 Effect, r_{ij}	.638				

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

Source

The Intercepts and Slopes as Outcomes Model was also tested based on the following regression equation for the *source* dimension of the students' epistemological beliefs:

Level-1 (student level) model:

$$Source\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_CRI) + \beta_{3j} * (CLE\_SHA) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (CLE\_P\_AG)_j + \gamma_{02} * (CLE\_S\_AG)_j + u_{0j}$$

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

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

$$\beta_{3j} = \gamma_{30} + \gamma_{31} * (CLE\_P\_AG)_j + \gamma_{32} * (CLE\_S\_AG)_j + u_{3j}$$

To get the final model, non-significant predictors were omitted from the model respectively. After the final running the HLM, it was seemed that following model was significantly resulted for all retained level-1 and level-2 predictors:

Level-1 (student level) model:

$$Source\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_CRI) + \beta_{3j} * (CLE\_SHA) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (CLE\_P\_AG)_j + \gamma_{02} * (CLE\_S\_AG)_j + u_{0j}$$
$$\beta_{1j} = \gamma_{10}$$
$$\beta_{2j} = \gamma_{20}$$
$$\beta_{3j} = \gamma_{30} + \gamma_{31} * (CLE\_P\_AG)_j + u_{3j}$$

As similar to the Means as Outcomes Models, the results (β_{0j}) of the Intercepts and Slopes as Outcomes Model indicated that *personal relevance* dimension (aggregated) of the CLES was significantly and negatively associated with *source* dimension of students' EB (γ = -.115, SE = .028, p < .001). Also, *shared control* dimension (aggregated) of the constructivist learning environment was significantly and positively associated with *source* dimension of students' epistemological beliefs (γ = .159, SE = .028, p < .001).

The equations of β_{1j}, and β_{2j}were tested in the same HLM analysis. Accordingly, *personal relevance* dimension of the students' constructivist learning environment *was* found as significantly and negatively associated with *source* dimension of the students' EB (γ = -.046, SE = .022, p < .05). Also, *critical voice* was still significantly varied (X^2=333.29, p<.001). *Critical voice* dimension of the students' constructivist learning environment *was* found as significantly and negatively associated with *development* dimension of the students' epistemological beliefs (γ = -.055, SE = .023, p < .05).

Testing the equation β_{3j}, the results showed that *shared control* dimension of the students' perception of constructivist learning environment was significantly and positively associated with *source* dimension of the students' epistemological beliefs (γ = .213, SE = .022, p < .001). Moreover, *personal relevance* dimensions of the students' perception of constructivist learning environment moderated the effect of *shared control* dimension of the students' individual perception of constructivist learning environment (γ = -.064, SE = .023, p < .01). Also, *shared control* dimension of the students' perception of constructivist learning environment was still significantly varied (X^2=218.90, p<.001).

Table 4.19 presents that final estimation of fixed effects for source dimension of students' epistemological beliefs as the results of the results of the Intercepts and Slopes as Outcomes Model.

Table 4.19 Final estimation of fixed effects for source dimension of students' Epistemological Beliefs (EB).

Fixed Effects	Coefficient	SE
Model for Class Means[1]		
Intercept, γ_{00}	.018	.026
CLE-Personal Relevance (Aggregated), γ_{01}	-.115***	.028
CLE-Shared Control (Aggregated), γ_{02}	.159***	.028
CLE-Personal Relevance, γ_{10}	-.046*	.022
CLE-Critical Voice, γ_{20}	-.055*	.023
CLE-Shared Control, γ_{30}	.213***	.024
CLE- Personal Relevance (Aggregated), γ_{31}	-.064**	.022

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

Finally, the results of the Intercepts and Slopes as Outcomes Model revealed that 32.9% of the variance in the between class difference in mean *source* was explained by adding level-2 predictors, but a significant variability still seems among the classes (X^2=333.29, p<.001). Table 4.20 presents that final estimation of variance components for source dimension of students' epistemological beliefs as the results of the results of the Intercepts and Slopes as Outcomes Model.

Table 4.20 Final estimation of variance components for source dimension of students' Epistemological Beliefs (EB).

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Intercept				.329	
Class mean, u_{0j}	.053	134	333.29***		.582
CLE-Personal Relevance, u_{1j}	.021	135	218.90***		.324
Level-1 Effect, r_{ij}	.873				

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

All of these results implied that, similar to the findings of research question 2b, if teachers have less sophisticated epistemological beliefs, their students tend to have more sophisticated beliefs. Additionally, students of teachers with high self-efficacy for engaging students in learning science effectively appeared to have lower levels of naïve epistemological beliefs (i.e. certainty). As far as class means are concerned regarding students' perception of constructivist learning environment, it was seen that if students have perceptions that they have opportunities to relate science to real world (*Personal Relevance*) and to practice the construction of scientific knowledge (*Uncertainty*), their epistemological beliefs are likely to be more sophisticated. However, to have a shared role in the class (*Shared Control*) was found to be positively linked to both of the naïve epistemological beliefs (i.e. certainty and source). The link between perceived personal relevance and naïve epistemological beliefs were negative.

Additionally, the results with respect to Level-1 predictors indicated similar results with research question 2c. Accordingly, if students feel them to have opportunities to relate science to real world (*Personal Relevance*), to practice the construction of scientific knowledge (*Uncertainty*), to question what is going on in the lesson freely (*Critical Voice*), to have a shared role in the class (*Shared Control*), and to communicate with their teachers in the classroom (*Student Negotiation*), their epistemological beliefs tend to be more sophisticated. On the other hand, the higher students' perception of shared control that related to having a shared role in the class (*Shared Control*), the more students do not believe in the existence of more than one right answer than can be constructed by the knower.

Regarding to the mediation effect of Level-2 variables, the relationship between students' perception of constructivist learning environment (regarding *shared control*) and source and certainty dimensions of epistemological beliefs was weaker in the classroom where students feel them to have opportunities to relate science to real world (*Personal Relevance*) (with respect to class means), but stronger for the students that feel them free to have a shared role in the class (*Shared Control*) (with respect to class means). On the other hand, if teachers have less sophisticated beliefs, the relationship between students' perception of constructivist learning environment (regarding *uncertainty*) and development dimensions of epistemological beliefs was weaker. Figure 4.2 indicates the results of the HLM analysis on a model for research question 2d. In the Figure 4.2, the variables in the orange boxes are student-level predictors and the variables in the blue boxes are teacher-level or Level-2 variables. The others (under the "outcomes" heading) are students' outcome variables. Also, the black arrows refers positive relationships and the red arrows refers negative relationships between student-level predictors and the outcome variables. To indicate the mediation effects, blue arrows were used in the figure. Also, abbreviated variables in a red color like "Personal Relevance" mediated negatively the relationships. Red colors always refers negative relationships.

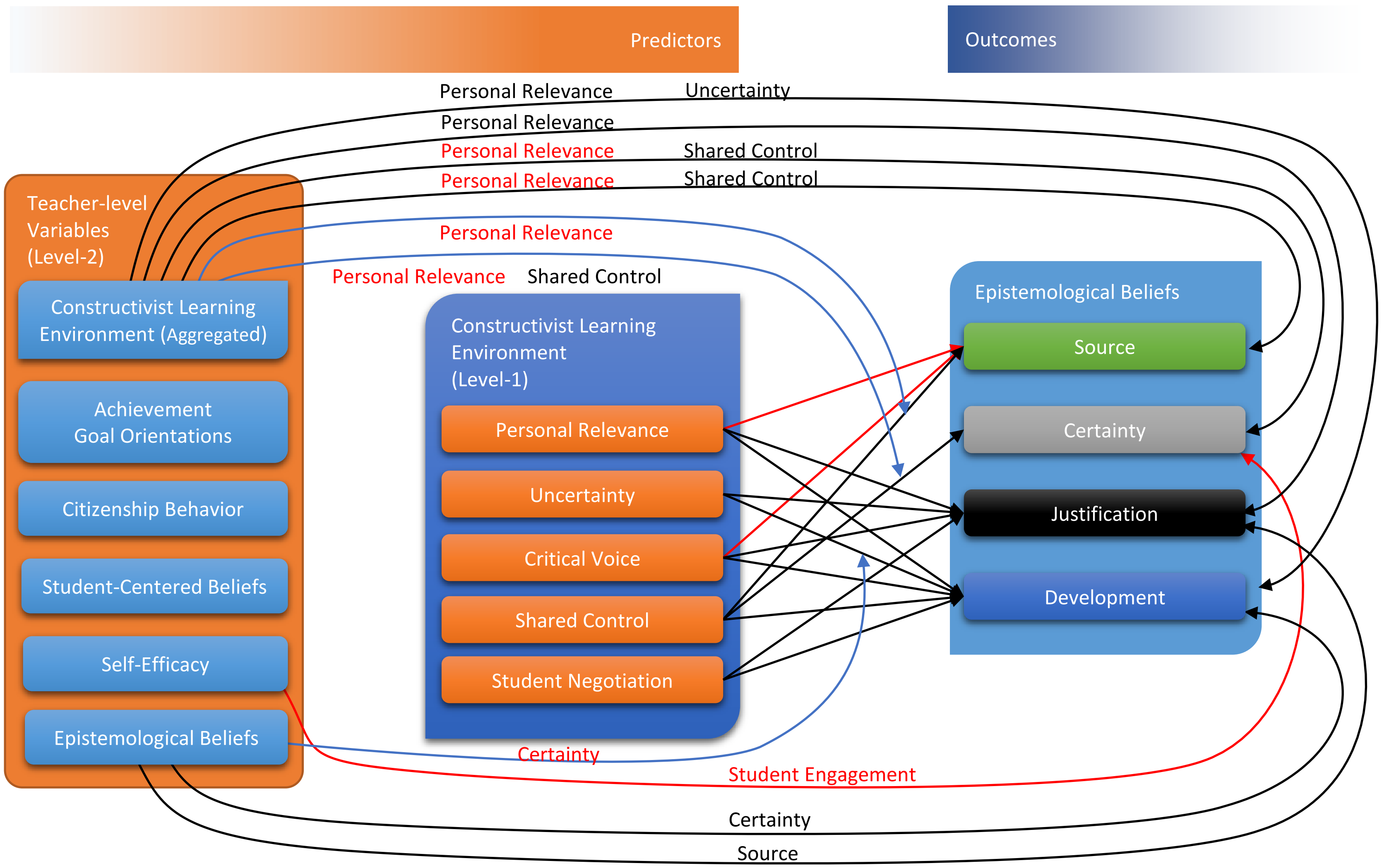


Figure 4.2 The final model based on the results of the HLM analysis for research question 2d.

4.2.3 Research Question 3: Students' Self-Efficacy

Following sub-questions were constructed based on research question 3 that was related to students' self-efficacy (SE). To do it, the variable of the self-efficacy was assigned as outcome variable.

Research Question 3.a: Are there differences in the students' self-efficacy beliefs among classes?

Research Question 3.b: Which teacher level variables are associated with the differences in the students' self-efficacy beliefs?

Research Question 3.c: Which student level variables explain the differences in the students' self-efficacy beliefs?

Research Question 3.d: Which teacher level variables influence the effect of student level variables on the students' self-efficacy beliefs?

4.2.3.1 The Results of the Research Question 3.a: One-Way Random Effects ANOVA Model

To test research question 3.a, One-Way Random Effects ANOVA was conducted by using HLM.

The data were analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

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

Y_{ij} is the outcome variable (*students' self-efficacy*)

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

γ_{00} is the grand mean, that is, the overall average score of an 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.

One-Way Random Effects ANOVA was conducted to test research question 3.a. As done in the analysis of research question 1 and 2a, all scores were standardized before conducting the HLM.

In order to see the variation between class means in dimensions of students' epistemological beliefs, four separate ICCs were calculated by using the following formula:

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

The results of the present study revealed that 6% of total variability in students' self-efficacy beliefs can be attributed to the teachers. Table 4.21 presents the final estimation of fixed effects for students' self-efficacy beliefs.

Table 4.21 Final estimation of fixed effects for students' self-efficacy beliefs.

Fixed Effects	*Coefficient*	*SE*	*ICC (ρ)*	*Reliability (λ)*
Model for Self-Efficacy (β_0)			.06	.58
Intercept (γ_{00})	-.003	.027		

The results of the One-Way Random Effects ANOVA revealed that the variance of the class level (τ_{00}) component was statistically significant. It means that there is a significant variability in students' *self-efficacy* beliefs across classes (τ_{00} = .057, X^2 = 334.58, df = 136, p<.001). Table 4.22 presents that final estimation of variance components for students' self-efficacy beliefs.

Table 4.22 Final estimation of variance components for students' self-efficacy beliefs.

Random Effects	*Variance Components*	*df*	X^2
Self-Efficacy			
Class mean, u_{ij}	.057	136	334.58***
Level-1 Effect, r_{ij}	.944		

*** *p <.001*

4.2.3.2 The Results of the Research Question 3.b: Means as Outcomes Model

The Means as Outcomes Model was tested for the students' self-efficacy beliefs to investigate the explained variances in the outcome variable due to the Level-2 (teacher or class level) predictors.

The data was analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(TGOALAAP)_j + \gamma_{02}(TGOALAAV)_j + \gamma_{03}(TGOALWAV)_j + \gamma_{04}(TGOALTAS)_j + \gamma_{05}(TSELF\_CM)_j + \gamma_{06}(TSELF\_SE)_j + \gamma_{07}(TSELF\_IS)_j + \gamma_{08}(TCITIZEN)_j + \gamma_{09}(TSU\_CEN)_j + \gamma_{010}(TEP\_SOU)_j + \gamma_{011}(TEP\_CER)_j + \gamma_{012}(TEP\_JUS)_j + \gamma_{013}(TEP\_DEV)_j + \gamma_{014}(CLE\_P\_AG)_j + \gamma_{015}(CLE\_U\_AG)_j + \gamma_{016}(CLE\_C\_AG)_j + \gamma_{017}(CLE\_S\_AG)_j + \gamma_{018}(CLE\_N\_AG)_j + u_{0j}$$

In these models,

Y_{ij} is the outcome variable (*self-efficacy*)

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

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

γ_{01} is the differentiating effect of *ability approach* dimension of Teacher Achievement Goal Orientations Scale (TAGOS) on class mean of the outcome variable.

γ_{02} is the differentiating effect of *ability avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{03} is the differentiating effect of *work avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{04} is the differentiating effect of *task* dimension of the TAGOS on class mean of the outcome variable.

γ_{05} is the differentiating effect of *classroom management* dimension of the Teacher Sense of Efficacy Scale (TSES) on class mean of the outcome variable.

γ_{06} is the differentiating effect of *student engagement* dimension of the TSES on class mean of the outcome variable.

γ_{07} is the differentiating effect of *instructional strategies* dimension of the TSES on class mean of the outcome variable.

γ_{08} is the differentiating effect of teacher's *individual citizenship behaviors* on class mean of the outcome variable.

γ_{09} is the differentiating effect of teacher's *student-centered beliefs and practices* on class mean of the outcome variable.

γ_{010} is the differentiating effect of *source* dimension of the Teacher Epistemological Beliefs Questionnaire (TEBQ) on class mean of the outcome variable.

γ_{011} is the differentiating effect of *certainty* dimension of the TEBQ on class mean of the outcome variable.

γ_{012} is the differentiating effect of *justification* dimension of the TEBQ on class mean of the outcome variable.

γ_{013} is the differentiating effect of *development* dimension of the TEBQ on class mean of the outcome variable.

γ_{014} is the differentiating effect of *personal relevance* dimension (aggregated) of the Constructivist Learning Environment Scale (CLES) on class mean of the outcome variable.

γ_{015} is the differentiating effect of *uncertainty* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{016} is the differentiating effect of c*ritical voice* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{017} is the differentiating effect of *shared control* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{018} is the differentiating effect of *student negotiation* dimension (aggregated) of the CLES on class mean of the outcome variable.

r_{ij} is the level-1 residual.

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

Results of the Means as Outcomes Models indicated that students' *self-efficacy* was significantly and negatively associated with *classroom management* dimension of the teachers' sense of efficacy (γ = -.035, SE = .018, p < .05). Moreover, it was significantly and positively associated with *certainty* dimension of teachers' epistemological beliefs (γ = .048, SE = .017, p < .01), *personal relevance* dimension (aggregated) of the constructivist learning environment (γ = .072, SE = .026, p < .01), and *critical voice* dimension (aggregated) of the constructivist learning environment (γ = .171, SE = .026, p < .001). Table 4.23 presents the final estimation of fixed effects for students' self-efficacy beliefs and their level-2 predictors.

Table 4.23 Final estimation of fixed effects for all dimensions of students' self-efficacy beliefs.

	Self-Efficacy	
Fixed Effects	γ	*SE*
Model for Class Means[1]		
Intercept	-.005	.017
T. Achievement Goals-Ability Approach		
T. Achievement Goals-Ability Avoidance		
T. Achievement Goals-Work Avoidance		
T. Achievement Goals-Task		
T. Sense of Efficacy-Classroom Management	-.035*	.018
T. Sense of Efficacy-Student Engagement		
T. Sense of Efficacy-Instructional Strategies		
T. Individual Citizenship Behavior		
T. Student-Centered Beliefs and Practices		
T. Epistemological Beliefs-Source		
T. Epistemological Beliefs-Certainty	.048**	.017
T. Epistemological Beliefs-Justification		
T. Epistemological Beliefs-Development		
CLE-Personal Relevance (Aggregated)	.072**	.026
CLE-Uncertainty (Aggregated)		
CLE-Critical Voice (Aggregated)	.171***	.026
CLE-Shared Control (Aggregated)		
CLE-Student Negotiation (Aggregated)		

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
$*p< .05$, $**p<.01$, $***p<.001$

These findings implied some interesting conclusions. For instance, science teachers with the less beliefs in the existence of more than one right answer than can be constructed by the knower (*Certainty*) appeared to have students with higher self-efficacy beliefs in science. In addition, students of teachers who feel self-efficacious for classroom management in science classes were found to have lower level of science self-efficacy. As far as class means are concerned regarding students' perception of constructivist learning environment, students who perceive to have opportunities to relate science to real world (*Personal Relevance*) and to question what is going on in the lesson freely (*Critical Voice*) tend to be self-efficacious in science.

Since the significantly resulted level-2 (Teacher-Level) predictors were added to the empty model, it was expected that the residual variances between classes were decreased compared to the One-Way Random Effects ANOVA model. To see the reductions of the residual variances between two models, R^2 was computed by using τ_{00} estimates obtained from two model sets (One-Way Random Effects ANOVA Model and Means as Outcomes Model) with following formula:

$$R^2 = \frac{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA) - \tau_{00}(Means\ as\ Outcome)}{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA)}$$

Computed R^2 for each two model set sets (One-Way Random Effects ANOVA Model and Means as Outcomes Model) revealed that 99% of the true between-class variance in ***self-efficacy beliefs*** was accounted for *classroom management* dimension of teachers' sense of efficacy beliefs, *certainty* dimension of teachers' epistemological beliefs, and *personal relevance* and *critical voice* dimensions of constructivist learning environment (aggregated). Table 4.24 presents that final estimation of variance components for self-efficacy beliefs as the results of the Means as Outcomes Model.

Table 4.24 Final estimation of variance components for students' self-efficacy beliefs.

Random Effects	*Variance Components*	*df*	X^2	R^2
Self-Efficacy				
Class mean, u_{ij}	.001	132	139.37	.038
Level-1 Effect, r_{ij}	.943			

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

4.2.3.3 The Results of the Research Question 3.c: Random Coefficient Model

To investigate the research question 3.c that was "Which student level variables explain the differences in the students' self-efficacy beliefs?", the Random Coefficient Model was tested based on the following regression equation:

Level-1 (student level) model:

$$Y_{ij} = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3J} * (CLE\_CRI)$$
$$+ \beta_{4J} * (CLE\_SHA) + \beta_{5J} * (CLE\_NEG) + \beta_{6J} * (EP\_SOU)$$
$$+ \beta_{7J} * (EP\_CER) + \beta_{8J} * (EP\_JUS) + \beta_{9J} * (EP\_DEV)$$
$$+ r_{ij}$$

Level-2 (teacher level or class level) model:

$$\beta_{0j} = \gamma_{00} + u_{oj}$$
$$\ldots$$
$$\ldots$$
$$\ldots$$
$$\beta_{qj} = \gamma_{q0} + u_{qj}$$

In these models,

Y_{ij} is the outcome variable (*self-efficacy*)

β_{0j} is the mean on self-efficacy beliefs for each class.

β_{1j} is the differentiating effect of *personal* dimension of the Constructivist Learning Environment Scale (CLES) in class j.

β_{2j} is the differentiating effect of *uncertainty* dimension of the CLES in class j.

β_{3j} is the differentiating effect of c*ritical voice* dimension of the CLES in class j.

β_{4j} is the differentiating effect of *shared control* dimension of the CLES in class j.

β_{5j} is the differentiating effect of *student negotiation* dimension of the CLES in class j.

β_{6j} is the differentiating effect of *source* dimension of students' Epistemological Beliefs Questionnaire (SEBQ) in class j.

β_{7j} is the differentiating effect of *certainty* dimension of students' SEBQ in class j.

β_{8j} is the differentiating effect of *justification* dimension of students' SEBQ in class j.

β_{9j} is the differentiating effect of *development* dimension of students' SEBQ in class j.

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.

The Random Coefficient Model revealed that students' *self-efficacy beliefs* was significantly and positively associated with *personal relevance* (γ = .164, SE = .019, p < .001), *critical voice* (γ = .225, SE = .025, p < .001), *shared control* (γ = .056, SE = .018, p < .01), *student negotiation* dimension of the constructivist learning environment (γ = .072, SE = .023, p < .01), *justification* dimension of students' epistemological beliefs (γ = .225, SE = .025, p < .001), and *development* dimension of students' epistemological beliefs (γ = .052, SE = .018, p < .01). Moreover, the slope of *critical voice* (X^2= 213.67, *p* < .001) and *student negotiation* (X^2= 219.50, *p* < .001) were significantly varied.

To calculate the proportion of the reduction in residual variance for *self-efficacy* beliefs, the sigma squared that was obtained from the One-Way Random Effects ANOVA and the sigma squared that was obtained from the Random Coefficient Model were used:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Random\ Coefficient)}{\sigma^2(random\ ANOVA)}$$

When the level-1 variables were added to the model as predictors of ***self-efficacy***, residual variance was decreased by 35.5%. However, there was still a significant variation among the class means that might be explained adding level-2 variables (X^2= 245.63, *p* < .001). It means that there was a variability among classes and slopes in some classes were sharper compared to other classes. It can be explained by class differences. Class differences can be sourced from class level variables.

Table 4.25 presents the results of the Random Coefficient Model that was tested for the students' self-efficacy beliefs.

Table 4.25 Final estimation of fixed effects for all dimensions of students' self-efficacy beliefs.

Fixed Effects	Self-Efficacy γ	SE
Model for Class Means[1]		
Intercept	.005	.019
CLE-Personal Relevance	.164***	.019
CLE-Uncertainty		
CLE-Critical Voice	.225***	.025
CLE-Shared Control	.056**	.018
CLE-Student Negotiation	.072**	.023
Epistemological Beliefs-Source		
Epistemological Beliefs-Certainty		
Epistemological Beliefs-Justification	.193***	.019
Epistemological Beliefs-Development	.053**	.018

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

These findings implied that students who perceive to have opportunities to relate science to real world (*Personal Relevance*), to practice the construction of scientific knowledge (*Uncertainty*), to question what is going on in the lesson freely (*Critical Voice*), to have a shared role in the class (*Shared Control*), and to communicate with their teachers in the classroom (*Student Negotiation*) tend to be self-efficacious in science. On the other hand, the students with more sophisticated epistemological beliefs appeared to have higher levels of science self-efficacy.

Table 4.26 presents the results of the Random Coefficient Model that was tested for the students' self-efficacy beliefs.

Table 4.26 Final estimation of variance components for students' self-efficacy beliefs.

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Self-Efficacy				.355	
Class mean, u_{ij}	.020	136	245.63***		.384
CLE-Critical Voice, u_{2j}	.024	136	213.67***		.330
CLE-Student Negotiation, u_{4j}	.019	136	219.50***		.292
Level-1 Effect, r_{ij}	.609				

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

4.2.3.4 The Results of the Research Question 3.d: Intercepts and Slopes as Outcomes Model

Intercepts and Slopes as Outcomes Model was tested to investigate the research question 3.d that was “Which teacher level variables influence the effect of student level variables on the students’ self-efficacy beliefs?” Accordingly, the Intercepts and Slopes as Outcomes Model was tested based on the following regression equation for the students’ self-efficacy beliefs:

Level-1 (student level) model:

$$(Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_CRI) + \beta_{3J} * (CLE\_SHA) + \beta_{4J} * (CLE\_NEG) + \beta_{5J} * (EP\_JUS) + \beta_{6J} * (EP\_DEV) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (TSELF\_CM)_j + \gamma_{02} * (TEP\_CER)_j + \gamma_{03} * (CLE\_P\_AG)_j + \gamma_{04} * (CLE\_C\_AG)_j + u_{0j}$$

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

$$\beta_{2j} = \gamma_{20} + \gamma_{21} * (TSELF\_CM)_j + \gamma_{22} * (TEP\_CER)_j + \gamma_{23} * (CLE\_P\_AG)_j + \gamma_{24} * (CLE\_C\_AG)_j + u_{2j}$$

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

$$\beta_{4j} = \gamma_{40} + \gamma_{41} * (TSELF\_CM)_j + \gamma_{42} * (TEP\_CER)_j + \gamma_{43} * (CLE\_P\_AG)_j + \gamma_{44} * (CLE\_C\_AG)_j + u_{4j}$$

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

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

To get the final model, non-significant predictors were omitted from the model respectively. After the final running the HLM, it was seemed that following model was significantly resulted for all retained level-1 and level-2 predictors:

Level-1 (student level) model:

$$(Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_CRI) + \beta_{3J} * (CLE\_SHA) + \beta_{4J} * (CLE\_NEG) + \beta_{5J} * (EP\_JUS) + \beta_{6J} * (EP\_DEV) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (TSELF\_CM)_j + \gamma_{02} * (CLE\_C\_AG)_j + u_{0j}$$
$$\beta_{1j} = \gamma_{10}$$
$$\beta_{2j} = \gamma_{20} + \gamma_{21} * (CLE\_C\_AG)_j + u_{2j}$$
$$\beta_{3j} = \gamma_{30}$$
$$\beta_{4j} = \gamma_{40} + \gamma_{41} * (CLE\_P\_AG)_j + u_{4j}$$
$$\beta_{5j} = \gamma_{50}$$
$$\beta_{6j} = \gamma_{60}$$

As similar to the Means as Outcomes Models, the results (β_{0j}) of the Intercepts and Slopes as Outcomes Model indicated that *classroom management* dimension of the teachers' sense of efficacy (γ = -.033, SE = .017, p < .05) and *critical voice* (γ = .185, SE = .018, p < .001) dimension (aggregated) of the constructivist learning environment were significantly associated with the students' *self-efficacy beliefs* which was tested with the equation β_{0j}.

Testing the equation β_{1j}, the results showed that *personal relevance* dimension of the students' perception of constructivist learning environment was significantly associated with the students' *self-efficacy beliefs* (γ = .165, SE = .019, p < .001).

Testing the equation β_{2j}, the results showed that *critical voice* dimension of the students' perception of constructivist learning environment was significantly associated with the students' *self-efficacy beliefs* (γ = .221, SE = .025, p<.001).

Another result of the Intercepts and Slopes as Outcomes Model indicated that *critical voice* dimensions (aggregated) of constructivist learning environment scale moderated the effect of *critical voice* dimension of the students' individual perception of constructivist learning environment on students' *self-efficacy beliefs* (γ = -.046, SE = .021, p < .05).

Testing the equation β_{3j}, *shared control* dimension of the students' perception of constructivist learning environment was found as significantly associated with the students' *self-efficacy beliefs* (γ = .053, SE = .018, p < .01).

Testing the equation β_{4j}, the results showed that *student negotiation* dimension of the students' perception of constructivist learning environment was significantly associated with the students' *self-efficacy beliefs* (γ = .065, SE = .023, p<.01). Another result of the Intercepts and Slopes as Outcomes Model indicated that *personal relevance* dimensions (aggregated) of constructivist learning environment scale moderated the effect of *student negotiation* dimension of the students' individual perception of constructivist learning environment on students' *self-efficacy beliefs* (γ = .047, SE = .019, p < .05).

Testing the equation β_{5j}, the results showed that *justification* dimension of the students' epistemological beliefs B was significantly associated with the students' *self-efficacy beliefs* (γ = .194, SE = .019, p < .001).

Testing the equation β_{6j}, the results showed that *development* dimension of the students' epistemological beliefs was significantly associated with the students' *self-efficacy beliefs* (γ = .051, SE = .018, p < .01).

Table 4.27 presents that final estimation of fixed effects for the students' self-efficacy beliefs as the results of the results of the Intercepts and Slopes as Outcomes Model.

Table 4.27 Final estimation of fixed effects for the students' self-efficacy beliefs.

Fixed Effects	Coefficient	SE
Model for Class Means[1]		
Intercept, γ_{00}	-.003	.018
T. Sense of Efficacy-Classroom Management, γ_{01}	-.033*	.017
CLE-Critical Voice (Aggregated), γ_{02}	.185***	.018
CLE-Personal Relevance, γ_{10}	.165***	.018
CLE-Critical Voice, γ_{20}	.221***	.025
CLE-Critical Voice (Aggregated), γ_{21}	-.046*	.021
CLE-Shared Control, γ_{30}	.053**	.018
CLE-Student Negotiation, γ_{40}	.065**	.023
CLE-Personal Relevance (Aggregated), γ_{41}	.047*	.019
Epistemological Beliefs-Justification, γ_{50}	.194***	.019
Epistemological Beliefs-Development, γ_{60}	.051**	.018

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
*$p < .05$, **$p<.01$, ***$p<.001$*

All of these results implied that, similar to the results of research question 3b, science teachers with higher levels of self-efficacy for classroom management tend to have students who are less self-efficacious in science. Again similar to the findings of research question 2b, regarding students' perception of constructivist learning environment results revealed that students who perceive to question what is going on in the science lesson freely are likely to have higher levels of science self-efficacy. However, different from the results of research question 3b, *certainty* dimension of teachers' epistemological beliefs and *personal* relevance dimension of students' constructivist learning environment (aggregated) were not found to be related to students' science self-efficacy.

Additionally, the results with respect to Level-1 predictors indicated similar results with research question 3c. Accordingly students with perception that they have opportunities to relate science to real world (*Personal Relevance*), to question what is going on in the lesson freely (*Critical Voice*), to have a shared role in the class (*Shared Control*), and to communicate with their teachers in the classroom (*Student Negotiation*) appeared to be self-efficacious in science. Moreover, the students who have more sophisticated epistemological beliefs were found to have higher levels of science self-efficacy.

Regarding to the mediation effect of Level-2 variables, the relationship between students' perception of constructivist learning environment (regarding *critical voice*) and source and self-efficacy beliefs was weaker in the science classrooms where students perceive to have opportunities to relate science to real world (*Personal Relevance*) (with respect to class means), but stronger for the students who perceive to have opportunity to question what is going on in the science lesson freely (*critical voice*) (with respect to class means). On the other hand, the relationship between students' perception of constructivist learning environment (regarding *student negotiation*) and self-efficacy beliefs was stronger in the science classrooms where students perceive to have opportunities to relate science to real world (*Personal Relevance*) (with respect to class means). Figure 4.3 indicates the results of the HLM analysis on a model for research question 3d. In the Figure 4.3, the variables in the orange boxes are student-level predictors and the variables in the blue boxes are teacher-level or Level-2 variables. The right one (under the "outcomes" heading) is students' outcome variable (Self-Efficacy). Also, the black arrows refer to positive relationships and the red arrows refers negative relationships between student-level predictors and the outcome variables. To indicate the mediation effects, blue arrows were used in the figure. Also, abbreviated variables in a red color like "Critical Voice" mediated negatively the relationships. Red colors always refers negative relationships.

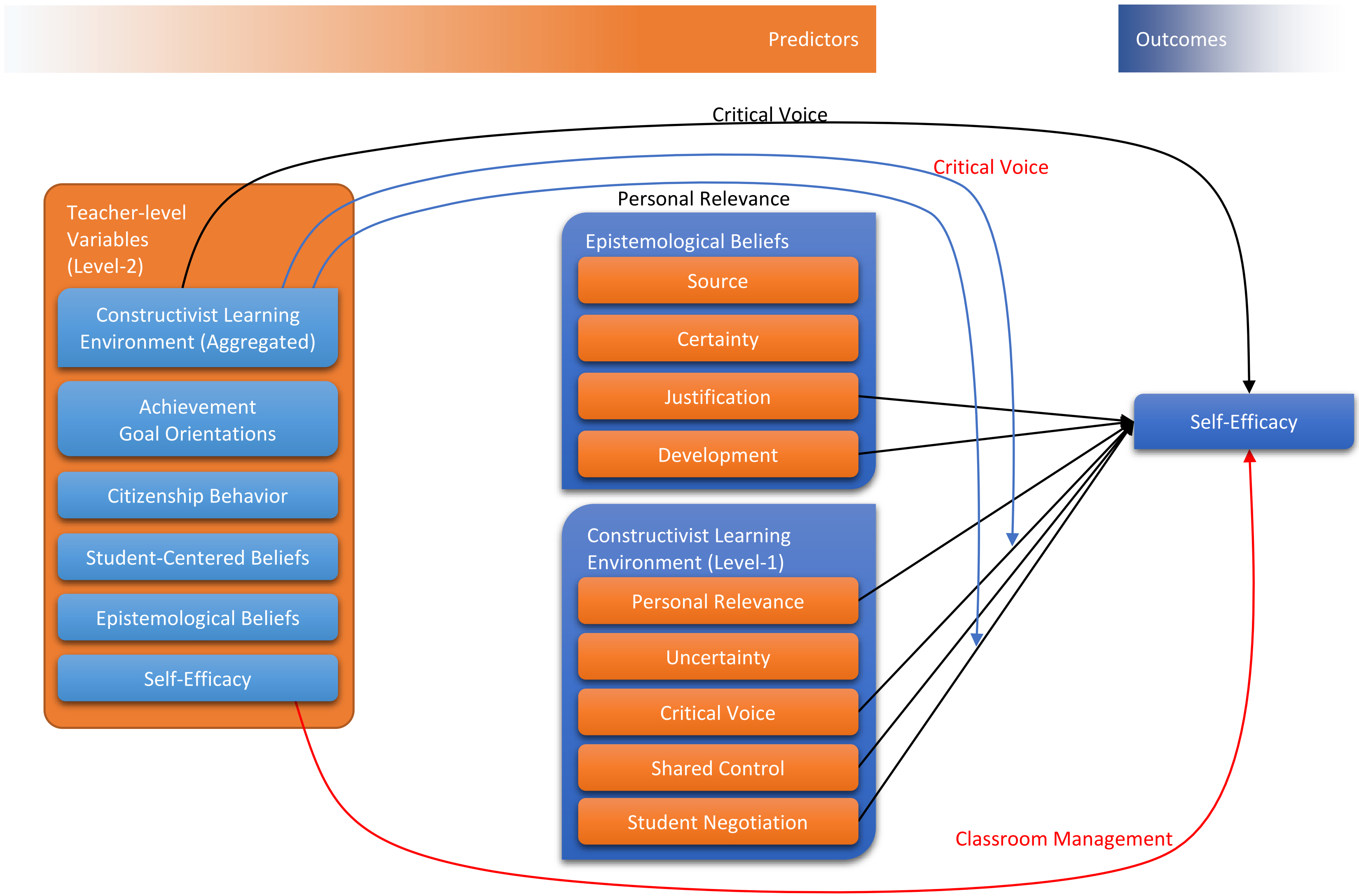


Figure 4.3 The final model based on the results of the HLM analysis for research question 3d.

Finally, the results of the Intercepts and Slopes as Outcomes Model revealed that 13.9% of the variance in the between class difference in mean *self-efficacy* was explained by adding level-2 predictors, but a significant variability still seems among the classes (X^2=229.65, p<.001). Table 4.28 presents that final estimation of variance components for the students' self-efficacy beliefs as the results of the results of the Intercepts and Slopes as Outcomes Model.

Table 4.28 Final estimation of variance components for the students' self-efficacy beliefs.

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Intercept				.139	
Class mean, u_{0j}	.017	134	229.65***		.391
CLE-Critical Voice, u_{2j}	.022	135	210.63***		.318
CLE-Student Negotiation, u_{4j}	.021	135	214.95***		.315
Level-1 Effect, r_{ij}	.607				

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

4.2.4 Research Question 4: Students' Achievement Goal Orientations

Following sub-questions were constructed based on research question 4 that was related to students' achievement goal orientations. In order to address these research questions, the dimensions of the Achievement Goal Questionnaire was assigned as outcome variables.

Research Question 4.a: Are there differences in each dimension of the students' achievement goal orientations (i.e., mastery approach, performance approach, mastery avoidance, and performance avoidance) among classes?

Research Question 4.b: Which teacher level variables are associated with the differences in each dimension of the students' achievement goal orientations?

Research Question 4.c: Which student level variables explain the differences in each dimension of the students' achievement goal orientations?

Research Question 4.d: Which teacher level variables influence the effect of student level variables on the students' achievement goal orientations?

4.2.4.1 The Results of the Research Question 4.a: One-Way Random Effects ANOVA Model

To test research question 4.a, One-Way Random Effects ANOVA was conducted by using HLM.

The data was analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

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

Y_{ij} is the outcome variable (*mastery approach*, *performance approach*, *mastery avoidance*, and *performance avoidance*)

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

γ_{00} is the grand mean, that is, the overall average score of an 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.

Four separate One-Way Random Effects ANOVAs were conducted to test research question 4.a, because students' achievement goals were examined in four dimension namely, mastery approach goals, performance approach goals, mastery avoidance goals, and performance avoidance goals. All scores were standardized before conducting the HLM.

In order to see the variation between class means in dimensions of students' epistemological beliefs, four separate ICCs were calculated by using the following formula:

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

Accordingly, four separate ICCs were calculated to see the variation between class means in students' achievement goals. The results of the present study revealed that 8% of total variability in mastery approach goals, 4% of total variability in performance approach goals, 4% of total variability in mastery avoidance goals, and 5% of total variability in mastery avoidance goals can be attributed to the teachers. Table 4.29 presents the final estimation of fixed effects students' achievement goals.

Table 4.29 Final estimation of fixed effects for all dimensions of students' Achievement Goals.

Fixed Effects	*Coefficient*	*SE*	*ICC (ρ)*	*Reliability (λ)*
Model for Achievement Goals-			.08	.65
Mastery Approach (β_0)	-.005	.029		
Intercept (γ_{00})				
Model for Achievement Goals-			.04	.51
Performance Approach (β_0)	.003	.025		
Intercept (γ_{00})				
Achievement Goals-Mastery			.04	.49
Avoidance (β_0)	.009	.024		
Intercept (γ_{00})				
Model for Achievement Goals-			.05	.55
Performance Avoidance (β_0)	.011	.026		
Intercept (γ_{00})				

The results of the One-Way Random Effects ANOVAs also revealed that the variances of the all class level (τ_{00}) components were statistically significant. It means that there are significantly variability in the mastery approach goals (τ_{00} = .077, X^2 = 405.77, df = 136, p<.001), performance approach goals (τ_{00} = .042, X^2 = 281.60, df = 136, p<.001), mastery avoidance (τ_{00} = .040, X^2 = 273.18, df = 136, p<.001), and performance avoidance goals (τ_{00} = .051, X^2 = 314.28, df = 136, p<.001). Table 4.30 presents that final estimation of variance components for all dimensions of students' achievement goals.

Table 4.30 Final estimation of variance components for all dimensions of students' Achievement Goal Orientations (AGO).

Random Effects	*Variance Components*	*df*	X^2
Achievement Goals-Mastery Approach			
Class mean, u_{ij}	.077	136	405.77***
Level-1 Effect, r_{ij}	.924		
Achievement Goals-Performance Approach			
Class mean, u_{ij}	.042	136	281.60***
Level-1 Effect, r_{ij}	.958		
Achievement Goals-Mastery Avoidance			
Class mean, u_{ij}	.040	136	273.18***
Level-1 Effect, r_{ij}	.959		
Achievement Goals-Performance Avoidance			
Class mean, u_{ij}	.051	136	314.28***
Level-1 Effect, r_{ij}	.948		

*** *p <.001*

4.2.4.2 The Results of the Research Question 4.b: Means as Outcomes Model

The Means as Outcomes Model were tested for all dimensions of the students' achievement goals to investigate the explained variances in each outcome variable due to the Level-2 (teacher or class level) predictors.

The data was analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

$$\begin{aligned}\beta_{0j} = \gamma_{00} + \gamma_{01}(TGOALAAP)_j + \gamma_{02}(TGOALAAV)_j + \gamma_{03}(TGOALWAV)_j \\ + \gamma_{04}(TGOALTAS)_j + \gamma_{05}(TSELF\_CM)_j \\ + \gamma_{06}(TSELF\_SE)_j + \gamma_{07}(TSELF\_IS)_j + \gamma_{08}(TCITIZEN)_j \\ + \gamma_{09}(TSU\_CEN)_j + \gamma_{010}(TEP\_SOU)_j + \gamma_{011}(TEP\_CER)_j \\ + \gamma_{012}(TEP\_JUS)_j + \gamma_{013}(TEP\_DEV)_j + \gamma_{014}(CLE\_P\_AG)_j \\ + \gamma_{015}(CLE\_U\_AG)_j + \gamma_{016}(CLE\_C\_AG)_j \\ + \gamma_{017}(CLE\_S\_AG)_j + \gamma_{018}(CLE\_N\_AG)_j + u_{0j}\end{aligned}$$

In these models,

Y_{ij} is the outcome variable (*mastery approach*, *performance approach*, *mastery avoidance*, and *performance avoidance*).

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

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

γ_{01} is the differentiating effect of *ability approach* dimension of Teacher Achievement Goal Orientations Scale (TAGOS) on class mean of the outcome variable.

γ_{02} is the differentiating effect of *ability avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{03} is the differentiating effect of *work avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{04} is the differentiating effect of *task* dimension of the TAGOS on class mean of the outcome variable.

γ_{05} is the differentiating effect of *classroom management* dimension of the Teacher Sense of Efficacy Scale (TSES) on class mean of the outcome variable.

γ_{06} is the differentiating effect of *student engagement* dimension of the TSES on class mean of the outcome variable.

γ_{07} is the differentiating effect of *instructional strategies* dimension of the TSES on class mean of the outcome variable.

γ_{08} is the differentiating effect of teacher's *individual citizenship behaviors* on class mean of the outcome variable.

γ_{09} is the differentiating effect of teacher's *student-centered beliefs and practices* on class mean of the outcome variable.

γ_{010} is the differentiating effect of *source* dimension of the Teacher Epistemological Beliefs Questionnaire (TEBQ) on class mean of the outcome variable.

γ_{011} is the differentiating effect of *certainty* dimension of the TEBQ on class mean of the outcome variable.

γ_{012} is the differentiating effect of *justification* dimension of the TEBQ on class mean of the outcome variable.

γ_{013} is the differentiating effect of *development* dimension of the TEBQ on class mean of the outcome variable.

γ_{014} is the differentiating effect of *personal relevance* dimension (aggregated) of the Constructivist Learning Environment Scale (CLES) on class mean of the outcome variable.

γ_{015} is the differentiating effect of *uncertainty* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{016} is the differentiating effect of c*ritical voice* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{017} is the differentiating effect of *shared control* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{018} is the differentiating effect of *student negotiation* dimension (aggregated) of the CLES on class mean of the outcome variable.

r_{ij} is the level-1 residual.

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

Results of the Means as Outcomes Models indicated that students' *mastery approach goals* were positively associated with *personal relevance* (γ = .242, SE = .023, $p < .001$) and *shared control* (negatively) (γ = -.060, SE = .023, $p < .05$) dimension (aggregated) of the constructivist learning environment. Moreover, *performance approach goals* were found to be positively associated with *critical voice* dimension (aggregated) of the constructivist learning environment (γ = .111, SE = .023, p < .001). *Mastery avoidance* goals were positively associated with *shared control* dimension (aggregated) of the constructivist learning environment (γ = .109, SE = .022, p < .001). And finally, *performance avoidance* goals were found to be negatively associated with *task* dimension of teachers' achievement goals (γ = -.065, SE = .024, p < .01), *justification* dimension of teachers' EB (negatively) (γ = -.057, SE = .024, p < .05), and *shared control* dimension (aggregated) of the constructivist learning environment (positively) (γ = .097, SE = .023, p < .001). Table 4.31 presents the final estimation of fixed effects for all dimensions of students' AGO and their level-2 predictors.

Table 4.31 Final estimation of fixed effects for all dimensions of students' Achievement Goal Orientations (AGO).

	Mastery Approach		Performance Approach		Mastery Avoidance		Performance Avoidance	
Fixed Effects	γ	*SE*	γ	*SE*	γ	*SE*	γ	*SE*
Model for Class Means[1]								
Intercept	-.012	.022	.002	.023	.009	.022	.010	.023
T. Achievement Goals-Ability Approach								
T. Achievement Goals-Ability Avoidance								
T. Achievement Goals-Work Avoidance								
T. Achievement Goals-Task							-.065**	.024
T. Sense of Efficacy-Classroom Management								
T. Sense of Efficacy-Student Engagement								
T. Sense of Efficacy-Instructional Strategies								
T. Individual Citizenship Behavior								
T. Student-Centered Beliefs and Practices								
T. Epistemological Beliefs-Source								
T. Epistemological Beliefs-Certainty								
T. Epistemological Beliefs-Justification							-.057*	.024
T. Epistemological Beliefs-Development								
CLE-Personal Relevance (Aggregated)	.242***	.023						
CLE-Uncertainty (Aggregated)								
CLE-Critical Voice (Aggregated)			.111***	.023				
CLE-Shared Control (Aggregated)	-.060*	.023			.109***	.022	.097***	.023
CLE-Student Negotiation (Aggregated)								

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.

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

According to these findings, as class level perception that students have opportunities to relate science to real world (*Personal Relevance*), but not to have a shared role in the class (*Shared Control*) increases, students tend to adopt mastery approach goals (i.e. studying for the reasons of learning and mastering course material in science classes),. On the other hand, as the class perception that students in science classes have opportunity to question what is going on in the lesson freely (*Critical Voice*) increases, students tend to adopt performance approach goals in learning science. Additionally, the class level perception that students have opportunity to have a shared role in the class (*Shared Control*) was found to be associated with mastery avoidance goals (i.e. studying for the reasons of avoiding misunderstanding and not learning). Finally, results revealed that the students of teachers with task goals and with the beliefs in justification of knowledge are less likely to adopt performance avoidance goals in learning science. However, class level perception that students are let to take a responsibility to participate the decision making process in science classroom was positively associated with performance avoidance goals.

Since the significantly resulted level-2 (Teacher-Level) predictors were added to the empty model, it was expected that the residual variances between classes were decreased compared to the One-Way Random Effects ANOVA model. To see the reductions of the residual variances between two models, R^2 was computed by using τ_{00} estimates obtained from two model sets (One-Way Random Effects ANOVA Model and Means as Outcomes Model) with following formula:

$$R^2 = \frac{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA) - \tau_{00}(Means\ as\ Outcome)}{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA)}$$

Computed R^2 for each two model set sets (One-Way Random Effects ANOVA Model and Means as Outcomes Model) revealed that 69% of the true between-class variance in ***mastery approach*** was accounted for *personal relevance* and *shared control* dimensions of constructivist learning environment (aggregated); 27% of the true between-class variance in ***performance approach*** was accounted for *critical* *voice* dimension of constructivist learning environment (aggregated); 31% of the true between-class variance in ***mastery avoidance*** was accounted for *shared control* dimension of constructivist learning environment (aggregated); and 34% of the true between-class variance in ***performance avoidance*** was accounted for *task* dimension of teachers' achievement goals, *justification* dimension of teachers' epistemological beliefs, and *shared control* dimension of constructivist learning environment (aggregated). However, classes still varied significantly in the average means of each outcome (*Mastery Approach*, τ_{00} = .023, X^2 = 221.69, df = 134, p<.001; *Performance Approach*, τ_{00} = .031, X^2 = 242.56, df = 135, p<.001; *Mastery Avoidance*, τ_{00} = .028, X^2 = 229.91, df = 135, p<.001; *Performance Avoidance*, τ_{00} = .034, X^2 = 254.02, df = 133, p<.001). Table 4.32 presents that final estimation of variance components for all dimensions of students' AGO as the results of the Means as Outcomes Model.

Table 4.32 Final estimation of variance components for all dimensions of students' Achievement Goal Orientations (AGO).

Random Effects	*Variance Components*	*df*	X^2	R^2
Achievement Goals-Mastery Approach				
Class mean, u_{ij}	.023	134	221.69***	.69
Level-1 Effect, r_{ij}	.925			
Achievement Goals-Performance Approach				
Class mean, u_{ij}	.031	135	242.56***	.27
Level-1 Effect, r_{ij}	.957			
Achievement Goals-Mastery Avoidance				
Class mean, u_{ij}	.028	135	229.91***	.31
Level-1 Effect, r_{ij}	.959			
Achievement Goals-Performance Avoidance				
Class mean, u_{ij}	.034	133	254.02***	.34
Level-1 Effect, r_{ij}	.948			

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

4.2.4.3 The Results of the Research Question 4.c: Random Coefficient Model

The Random Coefficient Model was tested to investigate the explained variances in students' achievement goals due to the students' perception of constructivist learning environment and their epistemological beliefs (Level-1 or student level predictor). Accordingly, the Random Coefficient Model was tested based on the following regression equation:

Level-1 (student level) model:

$$Y_{ij} = \beta_{0j} + \beta_{1j} * (CLE_{PER}) + \beta_{2J} * (CLE_{UNC}) + \beta_{3J} * (CLE_{CRI}) + \beta_{4J} * (CLE\_SHA) + \beta_{5J} * (CLE\_NEG) + \beta_{6J} * (EP_{SOU}) + \beta_{7J} * (EP_{CER}) + \beta_{8J} * (EP\_JUS) + \beta_{9J} * (EP\_DEV) + r_{ij}$$

Level-2 (teacher level or class level) model:

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

…

…

…

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

In these models,

Y_{ij} is the outcome variable (*mastery approach*, *performance approach*, *mastery avoidance*, and *performance avoidance*)

β_{0j} is the mean on each achievement goal orientations dimension for each class.

β_{1j} is the differentiating effect of *personal* dimension of the Constructivist Learning Environment Scale (CLES) in class j.

β_{2j} is the differentiating effect of *uncertainty* dimension of the CLES in class j.

β_{3j} is the differentiating effect of c*ritical voice* dimension of the CLES in class j.

β_{4j} is the differentiating effect of *shared control* dimension of the CLES in class j.

β_{5j} is the differentiating effect of *student negotiation* dimension of the CLES in class j.

β_{6j} is the differentiating effect of *source* dimension of students' Epistemological Beliefs Questionnaire (SEBQ) in class j.

β_{7j} is the differentiating effect of *certainty* dimension of students' SEBQ in class j.

β_{8j} is the differentiating effect of *justification* dimension of students' SEBQ in class j.

β_{9j} is the differentiating effect of *development* dimension of students' SEBQ in class j.

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.

Mastery Approach

According to the results, *mastery approach* goals were positively and significantly associated with *personal relevance* (γ = .192, SE = .023, p < .001), *critical voice* (γ = .091, SE = .023, p < .001), and *student negotiation* (γ = .040, SE = .019, p < .05) dimension of the constructivist learning environment. Moreover, it was significantly and positively related with *justification* dimension of students' epistemological beliefs (γ = .391, SE = .021, p < .001). Other results of the Random Coefficient Model revealed that *personal relevance* (X^2= 196.74, *p* < .01), *critical voice* (X^2= 210.86, *p* < .001), and *student negotiation* (X^2= 164.58, *p* < .05) that were the slopes of *mastery approach* and *justification* (X^2= 213.70, *p* < .001) that was the other slope of *mastery approach* were significantly varied. It means that there was a variability among classes and slopes in some classes were sharper compared to other classes. It can be explained by class differences. Class differences can be sourced from class level variables.

To calculate the proportion of the reduction in residual variance for *mastery approach* dimension of students' achievement goals, the sigma squared that was obtained from the One-Way Random Effects ANOVA and the sigma squared that was obtained from the Random Coefficient Model were used:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Random\ Coefficient)}{\sigma^2(random\ ANOVA)}$$

When the level-1 variables were added to the model as predictors of ***mastery approach***, residual variance was decreased by 39.1%. However, there was still a significant variation among the class means that might be explained adding level-2 variables (X^2= 356.33, *p* < .001). It means that there was a variability among classes and slopes in some classes were sharper compared to other classes. It can be explained by class differences. Class differences can be sourced from class level variables.

Performance Approach

Concerning *performance approach goals*, the results indicated that only personal relevance dimension of the constructivist learning environment was significantly associated with the outcome variable (γ = .111, SE = .021, p < .001). Furthermore, *certainty* (γ = .123, SE = .021, p < .001), *justification* (γ = .228, SE = .022, p < .001), and *development* (γ = .055, SE = .022, p < .05) dimensions of students' EB were significantly and positively related with the outcome variable. The Random Coefficient Model for *performance approach* also indicated that *critical voice* (X^2= 189.02, *p* < .01), *shared control* (X^2= 185.54, *p* < .01), *student negotiation* (X^2= 170.33, *p* < .05), *source* (X^2= 176.98, *p* < .05), and *development* (X^2= 183.22, *p* < .01) that were the slopes of *performance approach* were significantly varied. It means that there was a variability among classes and slopes in some classes were sharper compared to other classes. Class differences can be sourced from class level variables.

To calculate the proportion of the reduction in residual variance for *performance approach* dimension of students' achievement goals, the sigma squared that was obtained from the One-Way Random Effects ANOVA and the sigma squared that was obtained from the Random Coefficient Model were used:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Random\ Coefficient)}{\sigma^2(random\ ANOVA)}$$

When the level-1 variables were added to the model as predictors of ***performance approach***, residual variance was decreased by 24.5%. However, there was still a significant variation among the class means that might be explained adding level-2 variables (X^2= 212.32, *p* < .001). It can be explained by class differences. Class differences can be sourced from class level variables.

Mastery Avoidance

Regarding *mastery avoidance goals*, the results indicated that only *Student Negotiation* dimension of the constructivist learning environment ,(γ = .071, SE = .022, p < .01) and all dimensions of students' epistemological beliefs were significantly associated with the outcome variable (*Source*, γ = .094, SE = .023, p < .001; *Certainty,* γ = .158, SE = .023, p < .001; *Justification*, γ = .058, SE = .022, p < .01; *Development*, γ = .074, SE = .021, p < .01). The Random Coefficient Model for *mastery avoidance goals* also indicated that *uncertainty* that was one of the slope of *mastery avoidance* (X^2= 207.45, *p* < .001) and *shared control* that was the other slope of *mastery avoidance* (X^2= 179.61, *p* < .01) were significantly varied. It can be explained by class differences. Class differences can be sourced from class level variables.

To calculate the proportion of the reduction in residual variance for *mastery avoidance* dimension of students' achievement goals, the sigma squared that was obtained from the One-Way Random Effects ANOVA and the sigma squared that was obtained from the Random Coefficient Model were used:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Random\ Coefficient)}{\sigma^2(random\ ANOVA)}$$

When the level-1 variables were added to the model as predictors of ***mastery avoidance***, residual variance was decreased by 12.7%. However, there was still a significant variation among the class means that might be explained adding level-2 variables (X^2= 240.06, *p* < .001). It means that there was a variability among classes and slopes in some classes were sharper compared to other classes. Class differences can be sourced from class level variables.

Performance Avoidance

Performance avoidance goals were found to be positively and significantly associated with *personal relevance* (γ = .056, SE = .022, p < .05), *uncertainty* (γ = .052, SE = .021, p < .05), and *student negotiation* (γ = .057, SE = .020, p < .01) dimension of the constructivist learning environment. Moreover, it was significantly associated with *source* (γ = .083, SE = .025, p < .01), *certainty* (γ = .022, SE = .022, p < .001), *and development* (γ = .086, SE = .018, p < .001) dimensions of students' epistemological beliefs. Other results of the Random Coefficient Model revealed that *source* as one of the slope of *performance avoidance* (X^2= 196.71, p < .01) was significantly varied. These class differences can be sourced from class level variables.

To calculate the proportion of the reduction in residual variance for *performance avoidance* dimension of students' achievement goals, the sigma squared that was obtained from the One-Way Random Effects ANOVA and the sigma squared that was obtained from the Random Coefficient Model were used:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Random\ Coefficient)}{\sigma^2(random\ ANOVA)}$$

When the level-1 variables were added to the model as predictors of ***performance avoidance***, residual variance was decreased by 14.5%. However, there was still a significant variation among the class means that might be explained adding level-2 variables (X^2= 261.14, p < .001). It can be explained by class differences. Class differences can be sourced from class level variables.

Table 4.33 presents the results of the Random Coefficient Model that was tested for all dimension of the students' achievement goals.

Table 4.33 Final estimation of fixed effects for all dimensions of students' achievement goals.

	Mastery Approach		Performance Approach		Mastery Avoidance		Performance Avoidance	
Fixed Effects	γ	SE	γ	SE	γ	SE	γ	SE
Model for Class Means[1]								
Intercept	.007	.022	.004	.021	.007	.022	.013	023
CLE-Personal Relevance	.192***	.023	.111***	.021			.056*	.022
CLE-Uncertainty					.035	.025	.052*	.021
CLE-Critical Voice	.091***	.024	.051	.027				
CLE-Shared Control			.017	.024	.024	.024		
CLE-Student Negotiation	.040*	.019	.038	.023	.071**	.022	.057**	.020
Epistemological Beliefs-Source			-.001	.024	.094***	.023	.083**	.025
Epistemological Beliefs-Certainty			.123***	.021	.158***	.023	.218***	.022
Epistemological Beliefs-Justification	.391***	.021	.228***	.022	.058**	.022		
Epistemological Beliefs-Development			.055*	.022	.074**	.021	.086***	.018

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

These findings implied that students who perceive that they have opportunities in their science classes to relate science to real world (*Personal Relevance*), to question what is going on in the lesson freely (*Critical Voice*), and to communicate with their teachers tend to set goals as mastering a task. Additionally, the students with more sophisticated epistemological beliefs in justification of knowledge reported high levels of mastery goals in science classes.

Concerning performance approach goals, students with sophisticated epistemological beliefs and the belief that scientific knowledge is certain appeared to study for science for the reasons of demonstrating their abilities to others and getting the best grade. In addition, students with the perception that they have opportunities to relate science to real world (*Personal Relevance*) in their science classes, are found to set such performance approach goals.

Regarding avoidance goals, findings revealed that students who are likely to communicate with their teachers in the science classrooms tend to set their goals as avoiding misunderstanding and not mastering the task. Students with tentative epistemological beliefs also appeared to adopt such mastery avoidance goals.

Finally, according to the results, students with the perception that they relate science to real world (*Personal Relevance*), practice the construction of scientific knowledge (*Uncertainty*), and to communicate with their teachers in the science classrooms (*Student Negotiation*) are likely to have performance avoidance goals in learning science. As far as epistemological beliefs are concerned, students with the belief that knowledge is constructed by the authority (e.g., teachers, books) and the beliefs in the evolving and changing nature of science tend to adopt performance avoidance goals.

Table 4.34 presents the results of the Random Coefficient Model that was tested for all dimension of the students' achievement goals.

Table 4.34 Final estimation of variance components for all dimensions of students' goals.

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Achievement Goals-Mastery Approach				.391	
Class mean, u_{ij}	.039	136	356.33***		.567
CLE-Personal Relevance, u_{1j}	.020	136	196.74**		.249
CLE-Critical Voice, u_{2j}	.024	136	210.86***		.272
CLE-Student Negotiation, u_{3j}	.006	136	164.58*		.113
Epistemological Beliefs-Justification, u_{4j}	.022	136	213.70***		.313
Level-1 Effect, r_{ij}	.563				
Achievement Goals-Performance Approach				.245	
Class mean, u_{ij}	.025	136	212.32***		.328
CLE-Critical Voice, u_{2j}	.030	136	189.02**		.276
CLE-Shared Control, u_{3j}	.019	136	185.54**		.213
CLE-Student Negotiation, u_{4j}	.013	136	170.33*		.148
Epistemological Beliefs-Source, u_{5j}	.015	136	176.98*		.234
Epistemological Beliefs-Development, u_{8j}	.012	136	183.22**		.189
Level-1 Effect, r_{ij}	.723				
Achievement Goals-Mastery Avoidance				.127	
Class mean, u_{ij}	.039	136	356.33***		.567
CLE-Personal Relevance, u_{1j}	.020	136	196.74**		.249
CLE-Critical Voice, u_{2j}	.024	136	210.86***		.272
CLE-Student Negotiation, u_{3j}	.006	136	164.58*		.113
Epistemological Beliefs-Justification, u_{4j}	.022	136	213.70***		.313
Level-1 Effect, r_{ij}	.563				
Achievement Goals-Performance Avoidance				.145	
Class mean, u_{ij}	.035	136	261.01***		.470
Epistemological Beliefs-Source, u_{4j}	.019	136	196.71**		.324
Level-1 Effect, r_{ij}	.811				

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

4.2.4.4 The Results of the Research Question 4.d: Intercepts and Slopes as Outcomes Model

Intercepts and Slopes as Outcomes Model was tested for all dimension of students' achievement goals to investigate which teacher level variables influence the effect of student level variables on the students' achievement goals.

4.2.4.4.1 Mastery Approach Goals

Accordingly, the Intercepts and Slopes as Outcomes Model was tested based on the following regression equation for *mastery approach goals* dimension of the students' achievement goals:

Level-1 (student level) model:

$$Mastery\ Approach\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_CRI) + \beta_{3J} * (CLE\_NEG) + \beta_{2J} * (EP\_JUS) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (CLE\_P\_AG)_j + \gamma_{02} * (CLE\_S\_AG)_j + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11} * (CLE\_P\_AG)_j + \gamma_{12} * (CLE\_S\_AG)_j + u_{1j}$$
$$\beta_{2j} = \gamma_{20} + \gamma_{21} * (CLE\_P\_AG)_j + \gamma_{22} * (CLE\_S\_AG)_j + u_{2j}$$
$$\beta_{3j} = \gamma_{30} + \gamma_{31} * (CLE\_P\_AG)_j + \gamma_{32} * (CLE\_S\_AG)_j + u_{3j}$$
$$\beta_{4j} = \gamma_{40} + \gamma_{41} * (CLE\_P\_AG)_j + \gamma_{42} * (CLE\_S\_AG)_j + u_{4j}$$

To get the final model, non-significant predictors were omitted from the model. After the running final the HLM, it was seemed that following model was significant for all retained level-1 and level-2 predictors:

Level-1 (student level) model:

$$Mastery\ Approach\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_CRI) + \beta_{3J} * (CLE\_NEG) + \beta_{2J} * (EP\_JUS) + r_{ij}$$

Class level (level-2) model*:*

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (CLE\_P\_AG)_j + \gamma_{02} * (CLE\_S\_AG)_j + u_{0j}$$

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

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

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

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

As similar to the Means as Outcomes Models, the one of the results of the Intercepts and Slopes as Outcomes Model indicated that *personal relevance* (γ = .144, SE = .022, p < .001) and *shared control* (γ = -.048, SE = .016, p < .01) dimension (aggregated) of the constructivist learning environment were significantly associated with *mastery approach* goals which was tested with the equation β_{0j}.

The equations of β_{2j}, β_{3j}, and β_{4j}were tested in the same HLM analysis. According to the results, *personal relevance* (γ = .202, SE = .023, p < .001), *critical voice* (γ = .096, SE = .024, p < .001), and *student negotiation* (γ = .039, SE = .019, p < .05) dimensions of the students' perception of constructivist learning environment and *justification* (γ = .375, SE = .021, p < .001 dimension of the students' epistemological beliefs were significantly associated with *mastery approach goals.*

Table 4.35 Final estimation of fixed effects for students' mastery approach goals

Fixed Effects	Coefficient	SE
Model for Class Means[1]		
Intercept, γ_{00}	-.002	.019
CLE-Personal Relevance (Aggregated), γ_{01}	.144***	.019
CLE-Shared Control (Aggregated), γ_{02}	-.048*	.018
CLE-Personal Relevance, γ_{10}	.202***	.023
CLE-Critical Voice, γ_{20}	.096***	.024
CLE-Student Negotiation, γ_{30}	.039*	.019
Epistemological Beliefs-Justification, γ_{40}	.375***	.021

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

Finally, the results of the Intercepts and Slopes as Outcomes Model revealed that 39.1% of the variance was explained in the between class difference in mean *mastery approach* goals by adding level-2 predictors, but a significant variability still exists among the classes (X^2=267.94, p<.001). Moreover, all slopes were still randomly varied (*Personal Relevance,* X^2=197.40, p<.01; *Critical Voice,* X^2=211.70, p<.001; *Student Negotiation,* X^2=165.39, p<.05; *Justification,* X^2=211.77, p<.001). Table 4.36 presents that final estimation of variance components for students' *mastery approach* goals as the results of the Intercepts and Slopes as Outcomes Model.

Table 4.36 Final estimation of variance components for students' mastery approach goals

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Intercept				.391	
Class mean, u_{0j}	.024	134	267.94***		.450
CLE-Personal Relevance, u_{1j}	.021	136	197.40**		.257
CLE-Critical Voice, u_{2j}	.022	136	211.70***		.260
CLE-Student Negotiation, u_{3j}	.005	136	165.39*		.093
Epistemological Beliefs-Justification, u_{4j}	.021	136	211.77***		.300
Level-1 Effect, r_{ij}	.560				

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

4.2.4.4.2 Performance Approach Goals

The Intercepts and Slopes as Outcomes Model was also tested based on the following regression equation for the students' *performance approach goals.*

Level-1 (student level) model:

$$Performance\ Approach\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_CRI) + \beta_{3j} * (CLE\_SHA) + \beta_{4J} * (CLE\_NEG) + \beta_{5J} * (EP\_SOU) + \beta_{6J} * (EP\_CER) + \beta_{7J} * (EP\_JUS) + \beta_{8J} * (EP\_DEV) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (CLE\_C\_AG)_j + u_{0j}$$
$$\beta_{1j} = \gamma_{10}$$
$$\beta_{2j} = \gamma_{20} + \gamma_{21} * (CLE\_C\_AG)_j + u_{2j}$$
$$\beta_{3j} = \gamma_{30} + \gamma_{31} * (CLE\_C\_AG)_j + u_{3j}$$
$$\beta_{4j} = \gamma_{40} + \gamma_{41} * (CLE\_C\_AG)_j + u_{4j}$$
$$\beta_{5j} = \gamma_{50} + \gamma_{51} * (CLE\_C\_AG)_j + u_{5j}$$
$$\beta_{6j} = \gamma_{60}$$
$$\beta_{7j} = \gamma_{70}$$
$$\beta_{8j} = \gamma_{80} + \gamma_{81} * (CLE\_C\_AG)_j + u_{8j}$$

To get the final model, non-significant predictors were omitted from the model. After running the final HLM, following model was found to be significant for all retained level-1 and level-2 predictors:

Level-1 (student level) model:

$$Performance\ Approach\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_CRI) + \beta_{3j} * (CLE\_SHA) + \beta_{4J} * (CLE\_NEG) + \beta_{5J} * (EP\_SOU) + \beta_{6J} * (EP\_CER) + \beta_{7J} * (EP\_JUS) + \beta_{8J} * (EP\_DEV) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (CLE\_C\_AG)_j + u_{0j}$$
$$\beta_{1j} = \gamma_{10}$$
$$\beta_{2j} = \gamma_{20} + u_{2j}$$
$$\beta_{3j} = \gamma_{30} + u_{3j}$$
$$\beta_{4j} = \gamma_{40} + u_{4j}$$
$$\beta_{5j} = \gamma_{50} + u_{5j}$$
$$\beta_{6j} = \gamma_{60}$$
$$\beta_{7j} = \gamma_{70}$$
$$\beta_{8j} = \gamma_{80} + u_{8j}$$

As similar to the Means as Outcomes Models, the one of the results of the Intercepts and Slopes as Outcomes Model indicated that *critical voice* (γ = .064, SE = .022, p < .01) dimension (aggregated) of the constructivist learning environment was significantly and positively associated with students' *performance approach goals which* was tested with the equation β_{0j}.

Testing the equation β_{1j}, the results showed that *personal relevance* dimension of the students' perception of constructivist learning environment were significantly associated with *performance approach goals* (γ = .109, SE = .022, p < .001). However, there was no any significant variability among the classes.

Testing the equation β_{2j}, β_{3j}, β_{4j}, and β_{5j} the results showed that *critical voice*, *shared control, student negotiation* dimensions of the students' perception of constructivist learning environment and *source* dimension of students' epistemological beliefs were not significantly related to the outcome variable. However, still there was a significant variability among the classes (*Critical Voice*, X^2=189.12, p<.01; *Shared Control*, X^2=185.19, p<.01; *Student Negotiation*, X^2=170.27, p<.05; *Source*, X^2=176.80, p<.05).

The equations of β_{6j}, β_{7j}, and β_{8j}were tested in the same HLM analysis. Accordingly, *certainty* (γ = .123, SE = .023, p < .001), *justification* (γ = .231, SE = .022, p < .001), and *development* (γ = .052, SE = .023, p < .05) dimensions of the students' epistemological beliefs were found to be significantly linked to students' *performance approach* goals. . However, still there was a significant variability among the classes (X^2=164.42, p<.05). (X^2=183.02, p<.01).

Table 4.37 presents that final estimation of fixed effects for students' performance approach goals as the results of Intercepts and Slopes as Outcomes Model.

Table 4.37 Final estimation of fixed effects for students' performance approach goals

Fixed Effects	Coefficient	SE
Model for Class Means[1]		
Intercept, γ_{00}	.004	.021
CLE-Critical Voice (Aggregated), γ_{01}	.064**	.022
CLE-Personal Relevance, γ_{10}	.109***	.022
Epistemological Beliefs-Certainty, γ_{60}	.123***	.023
Epistemological Beliefs-Justification, γ_{70}	.231***	.022
Epistemological Beliefs-Development, γ_{80}	.052*	.023

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

Finally, the results of the Intercepts and Slopes as Outcomes Model revealed that any variance in the between class difference in mean *performance approach* goals was not explained by adding level-2 predictors, and a significant variability was still observed among the classes (X^2=227.22, p<.001). Moreover, some slopes were still randomly varied (*Critical Voice*, X^2=189.12, p<.01; *Shared Control,* X^2=185.19, p<.01; *Student Negotiation*, X^2=170.27, p<.05; *Source*, X^2=176.80, p<.05; *Development*, X^2=183.02, p<.01). Table 4.38 presents that final estimation of variance components for *performance approach* goals as the results of the Intercepts and Slopes as Outcomes Model.

Table 4.38 Final estimation of variance components for students' performance approach goals

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Intercept				-.004	
Class mean, u_{0j}	.025	135	227.22***		.383
CLE-Critical Voice, u_{2j}	.025	136	189.12**		.246
CLE-Shared Control, u_{3j}	.021	135	185.19**		.224
CLE-Student Negotiation, u_{4j}	.014	136	170.27*		.163
Epistemological Beliefs-Source, u_{5j}	.015	136	176.80*		.231
Epistemological Beliefs-Development, u_{8j}	.013	136	183.02**		.204
Level-1 Effect, r_{ij}	.723				

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

4.2.4.4.3 Mastery Avoidance Goals

The Intercepts and Slopes as Outcomes Model was also tested based on the following regression equation for the *mastery avoidance goals.*

Level-1 (student level) model:

$$Mastery\ Avoidance\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_UNC) + \beta_{2J} * (CLE\_SHA) + \beta_{3j} * (CLE\_NEG) + \beta_{4J} * (EP\_SOU) + \beta_{5J} * (EP\_CER) + \beta_{6J} * (EP\_JUS) + \beta_{7J} * (EP\_DEV) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (CLE\_S\_AG)_j + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11} * (CLE\_S\_AG)_j + u_{1j}$$
$$\beta_{2j} = \gamma_{20} + \gamma_{21} * (CLE\_S\_AG)_j + u_{2j}$$
$$\beta_{3j} = \gamma_{30}$$
$$\beta_{4j} = \gamma_{40}$$
$$\beta_{5j} = \gamma_{50}$$
$$\beta_{6j} = \gamma_{60}$$
$$\beta_{7j} = \gamma_{70}$$

To get the final model, non-significant predictors were omitted from the model. After running the final HLM, it was found that following model was significant for all retained level-1 and level-2 predictors:

Level-1 (student level) model:

$$Mastery\ Avoidance\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_UNC) + \beta_{2J} * (CLE\_SHA) + \beta_{3j} * (CLE\_NEG) + \beta_{4J} * (EP\_SOU) + \beta_{5J} * (EP\_CER) + \beta_{6J} * (EP\_JUS) + \beta_{7J} * (EP\_DEV) + r_{ij}$$

Class level (level-2) model:

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

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

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

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

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

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

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

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

As similar to the Means as Outcomes Models, the one of the results of the Intercepts and Slopes as Outcomes Model indicated that *uncertainty* (γ = .064, SE = .020, p < .01) dimension (aggregated) of the constructivist learning environment was significantly and positively associated with *mastery avoidance* goals which was tested with the equation β_{0j}.

Testing the equation $\beta_{1j}$and β_{2j} the results showed that *uncertainty* and *shared control* dimensions of the students' perception of students' performance approach goals were not significantly related to the outcome variable. However, still there was a significant variability among the classes (*Uncertainty,* X^2=207.63, p<.001; *Shared Control,* X^2=179.62, p<.01).

The equations of β_{3j}, β_{4j}, β_{5j}, β_{6j}, and β_{7j}were tested in the same HLM analysis. According to the results, *student negotiation* (γ = .071, SE = .024, p < .01) dimension of the students' perception of constructivist learning environment and *source* (γ = .092, SE = .024, p < .001), *certainty* (γ = .156, SE = .026, p < .001), *justification* (γ = .057, SE = .025, p < .05), and *development* (γ = .070, SE = .024, p < .01) dimensions of the students' epistemological beliefs were significantly associated with the outcome variable.

Table 4.39 presents that final estimation of fixed effects for mastery avoidance goals as the results of Intercepts and Slopes as Outcomes Model.

Table 4.39 Final estimation of fixed effects for mastery avoidance dimension of the students' Achievement Goal Orientations (AGO).

Fixed Effects	Coefficient	SE
Model for Class Means[1]		
Intercept, γ_{00}	.007	.021
CLE-Shared Control (Aggregated), γ_{01}	.064**	.018
CLE-Student Negotiation, γ_{30}	.071**	.024
Epistemological Beliefs-Source, γ_{40}	.092***	.024
Epistemological Beliefs-Certainty, γ_{50}	.156***	.026
Epistemological Beliefs-Justification, γ_{60}	.057*	.025
Epistemological Beliefs-Development, γ_{70}	.070**	.024

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

Finally, the results of the Intercepts and Slopes as Outcomes Model revealed that 17.1% of the variance in the between class difference in mean *mastery avoidance* was explained by adding level-2 predictors, but a significant variability still exists among the classes (X^2=222.15, p<.001). Moreover, some slopes were still randomly varied (*Uncertainty,* X^2=207.63, p<.001; *Shared Control,* X^2=179.62, p<.01).Table 4.40 presents that final estimation of variance components for *mastery avoidance* goals as the results of the Intercepts and Slopes as Outcomes Model.

Table 4.40 Final estimation of variance components for students' mastery avoidance goals

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Intercept				.171	
Class mean, u_{0j}	.150	135	222.15***		.385
CLE-Uncertainty, u_{1j}	.156	136	207.63***		.312
CLE-Shared Control, u_{2j}	.135	136	179.62**		.256
Level-1 Effect, r_{ij}	.915				

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

4.2.4.4.4 Performance Avoidance Goals

The Intercepts and Slopes as Outcomes Model was also tested based on the following regression equation for the *performance avoidance goals:*

Level-1 (student level) model:

$$Performance\ Avoidance\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3j} * (CLE\_NEG) + \beta_{4J} * (EP\_SOU) + \beta_{5J} * (EP\_CER) + \beta_{6J} * (EP\_DEV) \quad + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (TGOALTAS)_j + \gamma_{02} * (TEP\_JUS)_j + \gamma_{03} * (CLE\_S\_AG)_j + u_{0j}$$

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

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

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

$$\beta_{4j} = \gamma_{40} + \gamma_{41} * (TGOALTAS)_j + \gamma_{42} * (TEP\_JUS)_j + \gamma_{43} * (CLE\_S\_AG)_j + u_{4j}$$

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

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

To get the final model, non-significant predictors were eliminated from the model. After running the final the HLM, following model was found to be significant for all retained level-1 and level-2 predictors:

Level-1 (student level) model:

$$Performance\ Avoidance\ (Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3j} * (CLE\_NEG) + \beta_{4J} * (EP\_SOU) + \beta_{5J} * (EP\_CER) + \beta_{6J} * (EP\_DEV) \quad + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (TGOALTAS)_j + \gamma_{02} * (TEP\_JUS)_j + \gamma_{03} * (CLE\_S\_AG)_j + u_{0j}$$

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

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

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

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

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

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

As similar to the Means as Outcomes Models, the one of the results of the Intercepts and Slopes as Outcomes Model indicated that *task* (γ = -.052, SE = .021, $p < .05$) dimension of the teachers' achievement goals, *justification* (γ = -.041, SE = .020, $p < .05$) dimension of teachers' epistemological beliefs, and *shared control* (γ = .058, SE = .020, $p < .01$) dimension (aggregated) of the constructivist learning environment was significantly associated with *performance avoidance* goals which was tested with the equation β_{0j}.

The equations of β_{1j}, β_{2j}, β_{3j}, β_{4j}, β_{5j},and β_{6j}were tested in the same HLM analysis. Accordingly, *personal relevance* (γ = .056, SE = .022, p < .05), *uncertainty* (γ = .053, SE = .021, p < .05), and *student negotiation* (γ = .057, SE = .020, p < .01) dimensions of the students' perception of constructivist learning environment and *source* (γ = .079, SE = .025, p < .01), *certainty* (γ = .216, SE = .022, p < .001), and *development* (γ = .084, SE = .018, p < .001) dimension of the students' epistemological beliefs were found as significantly associated with *performance avoidance* goals. Moreover, *source* dimension of the students' epistemological beliefs was still significantly varied (X^2=197.27, p<.01).

Table 4.41 presents that final estimation of fixed effects for students' performance avoidance goals obtained from the Intercepts and Slopes as Outcomes Model.

Table 4.41 Final estimation of fixed effects for performance avoidance dimension of students' Achievement Goal Orientations (AGO).

Fixed Effects	Coefficient	SE
Model for Class Means[1]		
Intercept, γ_{00}	.011	.022
T. Achievement Goals-Task, γ_{01}	-.052*	.021
T. Epistemological Beliefs-Justification, γ_{02}	-.041*	.020
CLE-Shared Control (Aggregated), γ_{02}	.058**	.020
CLE-Personal Relevance, γ_{10}	.056*	.022
CLE-Uncertainty, γ_{20}	.053*	.021
CLE-Student Negotiation, γ_{30}	.057**	.020
Epistemological Beliefs-Source, γ_{40}	.079**	.025
Epistemological Beliefs-Certainty, γ_{50}	.216***	.022
Epistemological Beliefs-Development, γ_{60}	.084***	.018

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

Finally, the results of the Intercepts and Slopes as Outcomes Model revealed that 24% of the variance in the between class difference in mean *performance avoidance* goals was explained by adding level-2 predictors, but a significant variability still exists among the classes (X^2=224.19, p<.001). Table 4.42 presents that final estimation of variance components for *performance avoidance goals* as the results Intercepts and Slopes as Outcomes Model.

Table 4.42 Final estimation of variance components for students' performance avoidance goals

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Intercept				.240	
Class mean, u_{0j}	.027	133	224.19***		.406
Epistemological Beliefs-Source, u_{4j}	.020	136	197.27**		.327
Level-1 Effect, r_{ij}	.809				

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

Overall, results of the Intercepts and Slopes as Outcomes Model were consistent with the results of the previous two models namely, Means as Outcomes Model and Random Coefficient Model. More specifically, the abovementioned results implied that, class level perception that students have chances to relate science to real world (*Personal Relevance*), but not to have a shared role in the class (*Shared Control*) is positively associated with mastery approach goals,. On the other hand, class level perception that students have opportunities to question what is going on in the lesson freely (*Critical Voice*) was found to be positively related to performance approach goals in learning science. Furthermore, results indicated that class level perception that students have opportunity to have a shared role in the class (*Shared Control*) was positively linked to both mastery avoidance and mastery avoidance goals. Additionally, students of teachers with task goals and sophisticated epistemological beliefs in justification of knowledge tend to adopt performance avoidance goals.

Moreover, results revealed that students who have the perception that they have opportunities in their science classes to relate science to real world (*Personal Relevance*), to question what is going on in the lesson freely (*Critical Voice*), and to communicate with their teachers in the classroom (*Student Negotiation*) tend to set goals as mastering task. Additionally, the students with more sophisticated epistemological beliefs in justification of knowledge reported high mastery goals in science class. On the other hand, students with the perception that they have opportunities to relate science to real world (*Personal Relevance*) in their science classes appeared to adopt performance approach goals. Students with sophisticated epistemological beliefs, and the naïve belief that scientific knowledge is certain were also found to hold performance approach goals at higher levels. . With respect to mastery avoidance goals, the students who perceive that they are likely to communicate with their teachers in the science classroom and who hold naïve epistemological beliefs appeared to set their goals as avoiding from misunderstanding and not be able to mastering the task. Lastly, students with the perception that they relate science to real world (*Personal Relevance*), practice the construction of scientific knowledge (*Uncertainty*), and communicate with their teachers in the science classroom are found to adopt performance avoidance goals in learning science. Students with naïve epistemological beliefs and the beliefs in the evolving and changing nature of science were also found to adopt performance avoidance goals.

Regarding to the mediation effect of Level-2 variables, the relationship between students-level predictors and outcomes that are dimensions of achievement goals was not mediated by any teacher-level variable. Figure 4.4 indicates the results of the HLM analysis on a model for research question 4d. In the Figure 4.4, the variables in the orange boxes are student-level predictors and the variables in the blue boxes are teacher-level or Level-2 variables. The right one (under the “outcomes” heading) is students’ outcome variables (achievement goals). Also, the black arrows refers positive relationships and the red arrows refers negative relationships between student-level predictors and the outcome variables. Also, to indicate the negative relationships between teacher-level predictors and outcome variables, the dimensions of variables was written in red color. For this figure, *shared control* dimension of constructivist learning environment (aggregated) was written in red color, because it was negatively related with mastery approach goals.

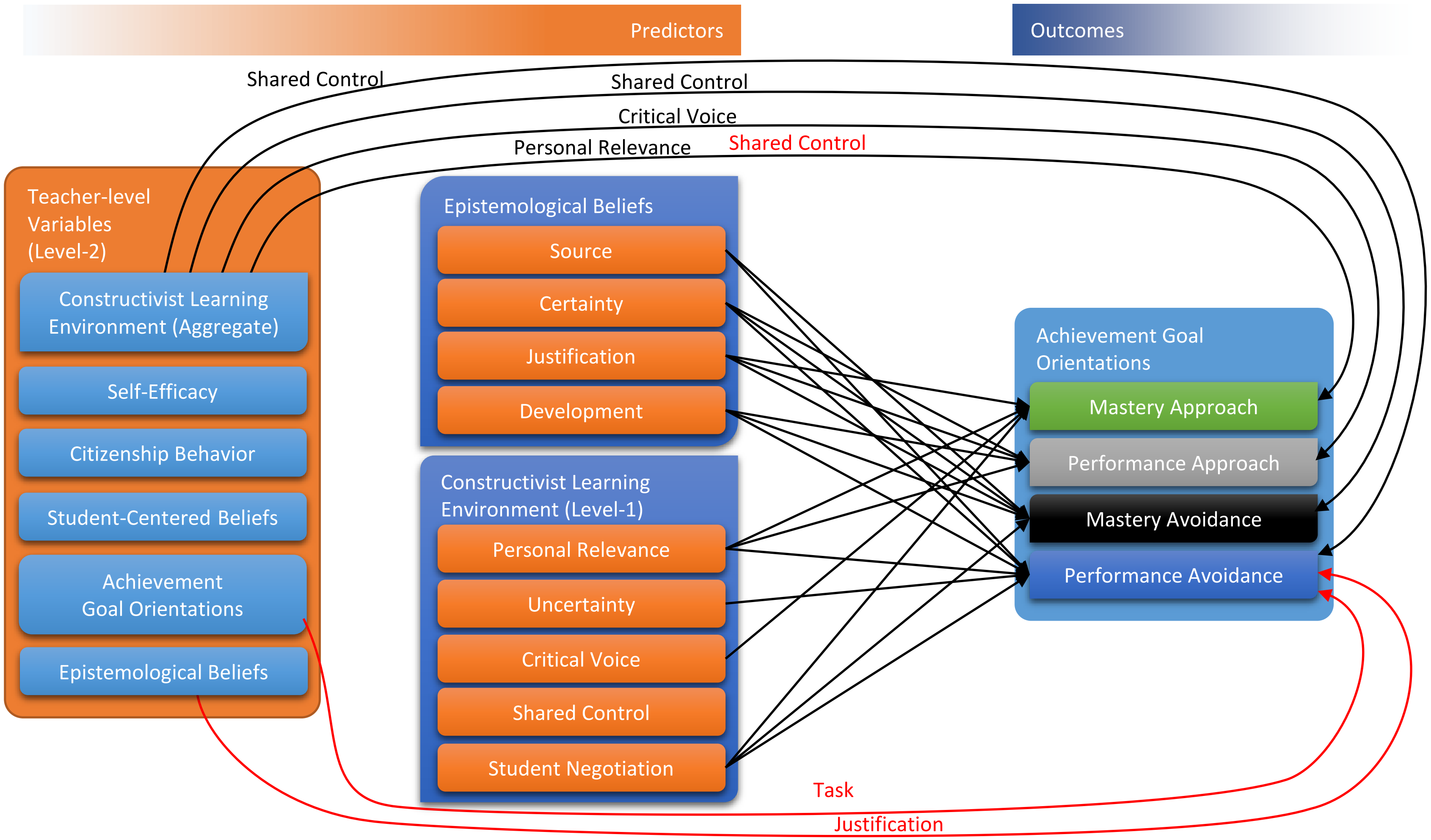


Figure 4.4 The final model based on the results of the HLM analysis for research question 4d.

4.2.5 Research Question 5: Students' Perception of Task Value

Following sub-questions were developed based on the research question 5 which was related to students' perception of Task Value. Task Value was assigned as an outcome variable in the related HLM analyses.

Research Question 5.a: Are there differences in the students' perception of task value beliefs among classes?

Research Question 5.b: Which teacher level variables are associated with the differences in the students' perception of task value?

Research Question 5.c: Which student level variables explain the differences in the students' perception of task value?

Research Question 5.d: Which teacher level variables influence the effect of student level variables on the students' perception of task value?

4.2.5.1 The Results of the Research Question 5.a: One-Way Random Effects ANOVA Model

To test research question 5.a, One-Way Random Effects ANOVA was conducted by using HLM.

The data were analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

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

Y_{ij} is the outcome variable (*students' perception of task value*)

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

γ_{00} is the grand mean, that is, the overall average score of an 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 order to see the variation between class means in dimensions of students' epistemological beliefs, four separate ICCs were calculated by using the following formula:

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

The results of the present study revealed that 6% of total variability in students' perception of *task value* can be attributed to the teachers. Table 4.43 presents the final estimation of fixed effects for students' perception of task value.

Table 4.43 Final estimation of fixed effects for students' perception of Task Value.

Fixed Effects	*Coefficient*	*SE*	*ICC (ρ)*	*Reliability (λ)*
Model for Task Value (β_0)			.06	.57
Intercept (γ_{00})	-.003	.027		

The results of the One-Way Random Effects ANOVA revealed that the variance of the class level (τ_{00}) component was statistically significant. It means that there is a significant variability in students' perception of *task value* among classes (τ_{00} = .056, X^2 = 329.73, df = 136, p<.001). Table 4.44 presents that final estimation of variance components for students' perception of task value.

Table 4.44 Final estimation of variance components for students' perception of Task Value.

Random Effects	*Variance Components*	*df*	X^2
Task Value			
Class mean, u_{ij}	.056	136	329.73***
Level-1 Effect, r_{ij}	.945		

*** *p <.001*

4.2.5.2 The Results of the Research Question 5.b: Means as Outcomes Model

The Means as Outcomes Model was tested for the students' perception of Task Value to investigate the explained variances in the outcome variable due to the Level-2 (teacher or class level) predictors.

The data was analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(TGOALAAP)_j + \gamma_{02}(TGOALAAV)_j + \gamma_{03}(TGOALWAV)_j + \gamma_{04}(TGOALTAS)_j + \gamma_{05}(TSELF\_CM)_j + \gamma_{06}(TSELF\_SE)_j + \gamma_{07}(TSELF\_IS)_j + \gamma_{08}(TCITIZEN)_j + \gamma_{09}(TSU\_CEN)_j + \gamma_{010}(TEP\_SOU)_j + \gamma_{011}(TEP\_CER)_j + \gamma_{012}(TEP\_JUS)_j + \gamma_{013}(TEP\_DEV)_j + \gamma_{014}(CLE\_P\_AG)_j + \gamma_{015}(CLE\_U\_AG)_j + \gamma_{016}(CLE\_C\_AG)_j + \gamma_{017}(CLE\_S\_AG)_j + \gamma_{018}(CLE\_N\_AG)_j + u_{0j}$$

In these models,

Y_{ij} is the outcome variable (*task value*).

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

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

γ_{01} is the differentiating effect of *ability approach* dimension of Teacher Achievement Goal Orientations Scale (TAGOS) on class mean of the outcome variable.

γ_{02} is the differentiating effect of *ability avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{03} is the differentiating effect of *work avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{04} is the differentiating effect of *task* dimension of the TAGOS on class mean of the outcome variable.

γ_{05} is the differentiating effect of *classroom management* dimension of the Teacher Sense of Efficacy Scale (TSES) on class mean of the outcome variable.

γ_{06} is the differentiating effect of *student engagement* dimension of the TSES on class mean of the outcome variable.

γ_{07} is the differentiating effect of *instructional strategies* dimension of the TSES on class mean of the outcome variable.

γ_{08} is the differentiating effect of teacher's *individual citizenship behaviors* on class mean of the outcome variable.

γ_{09} is the differentiating effect of teacher's *student-centered beliefs and practices* on class mean of the outcome variable.

γ_{010} is the differentiating effect of *source* dimension of the Teacher Epistemological Beliefs Questionnaire (TEBQ) on class mean of the outcome variable.

γ_{011} is the differentiating effect of *certainty* dimension of the TEBQ on class mean of the outcome variable.

γ_{012} is the differentiating effect of *justification* dimension of the TEBQ on class mean of the outcome variable.

γ_{013} is the differentiating effect of *development* dimension of the TEBQ on class mean of the outcome variable.

γ_{014} is the differentiating effect of *personal relevance* dimension (aggregated) of the Constructivist Learning Environment Scale (CLES) on class mean of the outcome variable.

γ_{015} is the differentiating effect of *uncertainty* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{016} is the differentiating effect of c*ritical voice* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{017} is the differentiating effect of *shared control* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{018} is the differentiating effect of *student negotiation* dimension (aggregated) of the CLES on class mean of the outcome variable.

r_{ij} is the level-1 residual.

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

Results of the Means as Outcomes Models indicated that *personal relevance* (γ = .192, SE = .021, p < .01) and *student negotiation* (γ = .049, SE = .021, p < .05) dimensions (aggregated) of the constructivist learning environment were significantly and positively associated with students' perception of *task value*. Table 4.45 presents the final estimation of fixed effects for students' perception of task value and their level-2 predictors.

Table 4.45 Final estimation of fixed effects for all dimensions of students' perception of Task Value.

	Task Value	
Fixed Effects	γ	*SE*
Model for Class Means[1]		
Intercept	-.008	.018
T. Achievement Goals-Ability Approach		
T. Achievement Goals-Ability Avoidance		
T. Achievement Goals-Work Avoidance		
T. Achievement Goals-Task		
T. Sense of Efficacy-Classroom Management		
T. Sense of Efficacy-Student Engagement		
T. Sense of Efficacy-Instructional Strategies		
T. Individual Citizenship Behavior		
T. Student-Centered Beliefs and Practices		
T. Epistemological Beliefs-Source		
T. Epistemological Beliefs-Certainty		
T. Epistemological Beliefs-Justification		
T. Epistemological Beliefs-Development		
CLE-Personal Relevance (Aggregated)	.192**	.021
CLE-Uncertainty (Aggregated)		
CLE-Critical Voice (Aggregated)		
CLE-Shared Control (Aggregated)		
CLE-Student Negotiation (Aggregated)	.049*	.021

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

These findings implied that students with a perception as a class that they have opportunities to relate science to real world (*Personal Relevance*) and to communicate with their teachers in the science classroom, tend to find the science classes as important, useful, and interesting.

Since the significantly resulted level-2 (Teacher-Level) predictors were added to the empty model, it was expected that the residual variances between classes were decreased compared to the One-Way Random Effects ANOVA model. To see the reductions of the residual variances between two models, R^2 was computed by using τ_{00} estimates obtained from two model sets (One-Way Random Effects ANOVA Model and Means as Outcomes Model) with following formula:

$$R^2 = \frac{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA) - \tau_{00}(Means\ as\ Outcome)}{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA)}$$

Computed R^2 for each two model set sets (One-Way Random Effects ANOVA Model and Means as Outcomes Model) revealed that 91% of the true between-class variance in ***task value*** was accounted for *personal relevance* and *student negotiation* dimensions of constructivist learning environment (aggregated). Table 4.46 presents that final estimation of variance components for task value obtained from the Means as Outcomes Model.

Table 4.46 Final estimation of variance components for students' perception of Task Value.

Random Effects	*Variance Components*	*df*	X^2	R^2
Task Value				
Class mean, u_{ij}	.073	134	158.17	.905
Level-1 Effect, r_{ij}	.972			

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

4.2.5.3 The Results of the Research Question 5.c: Random Coefficient Model

The Random Coefficient Model was tested to investigate the explained variances in students' perception of Task Value due to the students' perception of constructivist learning environment and epistemological beliefs (Level-1 or student level predictor). Accordingly, the Random Coefficient Model was tested based on the following regression equation:

Level-1 (student level) model:

$$Y_{ij} = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3J} * (CLE\_CRI) + \beta_{4J} * (CLE\_SHA) + \beta_{5J} * (CLE\_NEG) + \beta_{6J} * (EP\_SOU) + \beta_{7J} * (EP\_CER) + \beta_{8J} * (EP\_JUS) + \beta_{9J} * (EP\_DEV) + r_{ij}$$

Level-2 (teacher level or class level) model:

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

…

…

…

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

In these models,

Y_{ij} is the outcome variable (*task value*)

β_{0j} is the mean on task value for each class.

β_{1j} is the differentiating effect of *personal* dimension of the Constructivist Learning Environment Scale (CLES) in class j.

β_{2j} is the differentiating effect of *uncertainty* dimension of the CLES in class j.

β_{3j} is the differentiating effect of c*ritical voice* dimension of the CLES in class j.

β_{4j} is the differentiating effect of *shared control* dimension of the CLES in class j.

β_{5j} is the differentiating effect of *student negotiation* dimension of the CLES in class j.

β_{6j} is the differentiating effect of *source* dimension of students' Epistemological Beliefs Questionnaire (SEBQ) in class j.

β_{7j} is the differentiating effect of *certainty* dimension of students' SEBQ in class j.

β_{8j} is the differentiating effect of *justification* dimension of students' SEBQ in class j.

β_{9j} is the differentiating effect of *development* dimension of students' SEBQ in class j.

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.

According to the results, the students' perception of *task value* was positively and significantly associated with *personal relevance* (γ = .231, SE = .0.22, p < .001), *critical voice* (γ = .159, SE = .020, p < .001), *student negotiation* (γ = .077, SE = .018, p < .001) dimensions of the CLES and *justification* (γ = .289, SE = .021, p < .001) dimension of students' epistemological beliefs. Other results of the Random Coefficient Model revealed that *personal relevance* that was one of the slope of *task vaule* (X^2= 198.28, p < .01) and *justification* that was the other slope of *task value* (X^2= 227.62, p < .001) were significantly varied.

To calculate the proportion of the reduction in residual variance for *task value*, the sigma squared that was obtained from the One-Way Random Effects ANOVA and the sigma squared that was obtained from the Random Coefficient Model were used:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Random\ Coefficient)}{\sigma^2(random\ ANOVA)}$$

When the level-1 variables were added to the model as predictors of ***task value***, residual variance was decreased by 37.9%. However, there was still a significant variation among the class means that might be explained adding level-2 variables (X^2= 337.31, p < .001).

Table 4.47 and 4.48 presents the results of the Random Coefficient Model for the students' perception of task value.

Table 4.47 Final estimation of fixed effects for all dimensions of students' perception of Task Value.

	Task Value	
Fixed Effects	γ	SE
Model for Class Means[1]		
Intercept	.004	.022
CLE-Personal Relevance	.231***	.022
CLE-Uncertainty		
CLE-Critical Voice	.159***	.020
CLE-Shared Control		
CLE-Student Negotiation	.077***	.018
Epistemological Beliefs-Source		
Epistemological Beliefs-Certainty		
Epistemological Beliefs-Justification	.289***	.021
Epistemological Beliefs-Development		

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

These findings implied that students who perceive that they have opportunities in their science classes to relate science to real world (*Personal Relevance*), to question what is going on in the lesson freely (*Critical Voice*), to have a shared role in the class (*Shared Control*), and to communicate with their teachers in the classroom

(*Student Negotiation*), are likely to have higher levels of task value beliefs. Students with more sophisticated beliefs in justification of knowledge were also found to find science classes as interesting, useful, and important.

Table 4.48 Final estimation of variance components for students' perception of Task Value.

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Task Value				.379	
Class mean, u_{ij}	.040	136	337.31		.571
CLE-Personal Relevance, u_{1j}	.016	136	198.28		.275
Epistemological Beliefs-Justification, u_{4j}	.022	136	227.62		.344
Level-1 Effect, r_{ij}	.587				

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

4.2.5.4 The Results of the Research Question 5.d: Intercepts and Slopes as Outcomes Model

Intercepts and Slopes as Outcomes Model was tested based on the following regression equation for the students' perception of task value to examine which teacher level variables influence the effect of student level variables on the students' perception of task value:

Level-1 (student level) model:

$$(Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_CRI) + \beta_{3J} * (CLE\_NEG) + \beta_{4J} * (EP\_JUS) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (CLE\_P\_AG)_j + \gamma_{02} * (CLE\_N\_AG)_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} * (CLE\_P\_AG)_j + \gamma_{12} * (CLE\_N\_AG)_j + u_{1j}$$

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

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

$$\beta_{4j} = \gamma_{40} + \gamma_{41} * (CLE\_P\_AG)_j + \gamma_{42} * (CLE\_N\_AG)_j + u_{4j}$$

To get the final model, non-significant predictors were eliminated from the model. After running the final HLM, it was found that following model was significant for all retained level-1 and level-2 predictors:

Level-1 (student level) model:

$$(Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_CRI) + \beta_{3J} * (CLE\_NEG) + \beta_{4J} * (EP\_JUS) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (CLE\_P\_AG)_j + \gamma_{02} * (CLE\_N\_AG)_j + u_{0j}$$
$$\beta_{1j} = \gamma_{10} + u_{1j}$$
$$\beta_{2j} = \gamma_{20}$$
$$\beta_{3j} = \gamma_{30}$$
$$\beta_{4j} = \gamma_{40} + u_{4j}$$

As similar to the Means as Outcomes Models, the one of the results of the Intercepts and Slopes as Outcomes Model indicated that *personal relevance (*γ = .132, SE = .020, p < .001) and *student negotiation* (γ = .050, SE = .019, p < .05) dimensions (aggregated) of the constructivist learning environment were significantly and positively associated with the students' perception of *task value* which was tested with the equation β_{0j}.

Testing the equation β_{1j}, β_{2j}, β_{3j}, and β_{4j}, the results showed that *personal relevance* (γ = .244, SE = .022, p < .001), *critical voice* (γ = .163, SE = .020, p < .001), *student negotiation* (γ = .079, SE = .018, p < .001) dimensions of the students' perception of constructivist learning environment and *justification* (γ = .269, SE =

.021, p < .001) dimension of the students' epistemological beliefs were significantly and positively related to the students' perception of *task value*.

Table 4.49 presents that final estimation of fixed effects for the students' perception of task value obtained from the Intercepts and Slopes as Outcomes Model.

Table 4.49 Final estimation of fixed effects for the students' perception of Task Value.

Fixed Effects	Coefficient	SE
Model for Class Means[1]		
Intercept, γ_{00}	-.005	.018
CLE-Personal Relevance (Aggregated), γ_{01}	.132***	.020
CLE-Student Negotiation (Aggregated), γ_{02}	.050*	.019
CLE-Personal Relevance, γ_{10}	.244***	.022
CLE-Critical Voice, γ_{20}	.163***	.020
CLE-Student Negotiation, γ_{30}	.079***	.018
Epistemological Beliefs-Justification, γ_{40}	.269***	.021

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

The aforementioned findings of the Intercepts and Slopes as Outcomes Model were consistent with findings of the previous two models namely, Means as Outcomes Model and Random Coefficient Model addressing research questions 5b and 5c, respectively. These findings implied that students with the perception as a class that they have opportunities to relate science to real world (*Personal Relevance*) and to communicate with their teachers in the classroom (*Student Negotiation*), tend to find the task, content, and materials in science classes as important, useful, and interesting.

Additionally, students who perceive that they have opportunities to relate science to real world (*Personal Relevance*), to question what is going on in the lesson freely (*Critical Voice*), to have a shared role in the class (*Shared Control*), and to communicate with their teachers in the classroom (*Student Negotiation*) are likely to have high task value in science classes. Students with the more sophisticated beliefs in justification of knowledge also appeared to have high task value in science classes.

Regarding to the mediation effect of Level-2 variables, the relationship between students-level predictors and outcome was not mediated by any teacher-level variable. Figure 4.5 indicates the results of the HLM analysis on a model for research question 5d. In the Figure 4.5, the variables in the orange boxes are student-level predictors and the variables in the blue boxes are teacher-level or Level-2 variables. The right one (under the "outcomes" heading) is students' outcome variable (task value). Also, the black arrows refer to positive relationships between student-level predictors and the outcome variables.

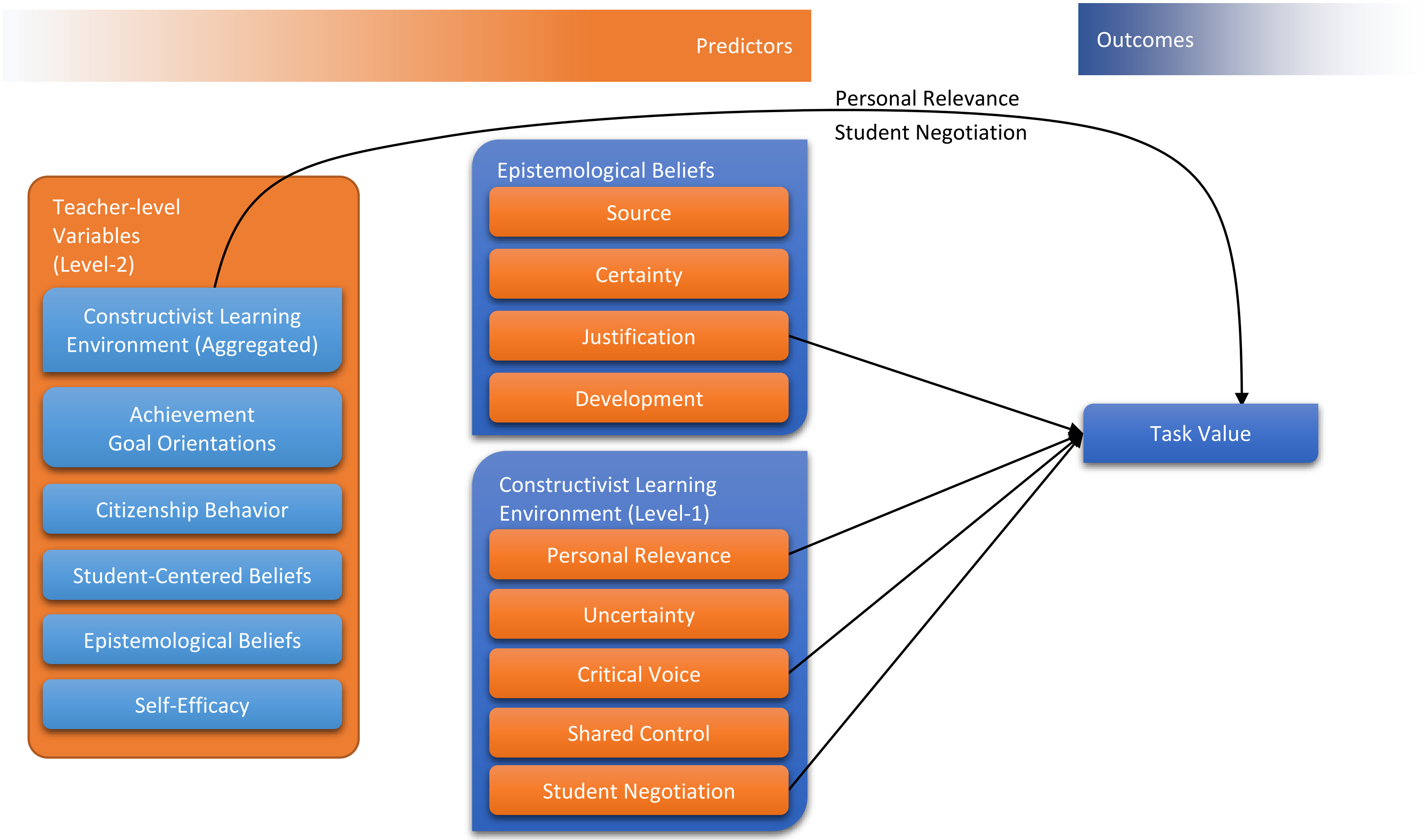


Figure 4.5 The final model based on the results of the HLM analysis for research question 5d.

Finally, the results of the Intercepts and Slopes as Outcomes Model revealed that 55.8% of the variance in the between class difference in mean *task value* was explained by adding level-2 predictors, but a significant variability was still found among the classes (X^2=211.96, p<.001). Table 4.50 presents that final estimation of variance components for the students' perception of task value obtained from the Intercepts and Slopes as Outcomes Model.

Table 4.50 Final estimation of variance components for students' perception of Task Value.

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Intercept				.558	
Class mean, u_{0j}	.018	134	211.96***		.380
CLE-Personal Relevance, u_{1j}	.016	136	198.53**		.280
Epistemological Beliefs-Justification, u_{4j}	.023	136	227.06***		.356
Level-1 Effect, r_{ij}	.581				

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

4.2.6 Research Question 6: Students' Metacognitive Self-Regulation

Following sub-questions were developed based on research question 6 which was related to students' metacognitive self-regulated learning (MCSR). In the analyses, the variable of MCSR was assigned as an outcome variable.

Research Question 6.a: Are there differences in the students' metacognitive self-regulated learning among classes?

Research Question 6.b: Which teacher level variables are associated with the differences in the students' metacognitive self-regulated learning?

Research Question 6.c: Which student level variables explain the differences in the students' metacognitive self-regulated learning?

Research Question 6.d: Which teacher level variables influence the effect of student level variables on the students' metacognitive self-regulated learning?

4.2.6.1 The Results of the Research Question 6.a: One-Way Random Effects ANOVA Model

To test research question 6.a, One-Way Random Effects ANOVA was conducted by using HLM.

The data was analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

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

Y_{ij} is the outcome variable (*students' metacognitive self-regulation)*

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

γ_{00} is the grand mean, that is, the overall average score of an 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.

One-Way Random Effects ANOVA was conducted to test research question 6.a. All scores were standardized before conducting the HLM analysis.

In order to see the variation between class means in dimensions of students' epistemological beliefs, four separate ICCs were calculated by using the following formula:

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

The results of the present study revealed that 6% of total variability in students' *metacognitive self-regulation* scores can be attributed to the teachers. According to the One-Way Random Effects ANOVA results, reliability estimates value was not problematic for the outcome. Table 4.51 presents the final estimation of fixed effects for students' metacognitive self-regulation.

Table 4.51 Final estimation of fixed effects for students' Metacognitive Self-Regulation (MCSR).

Fixed Effects	*Coefficient*	*SE*	*ICC (ρ)*	*Reliability (λ)*
Model for Metacognitive Self-Regulation (β_0)			.06	.58
Intercept (γ_{00})	.003	.027		

The results of the One-Way Random Effects ANOVA revealed that the variance of the class level (τ_{00}) component was statistically significant. It means that there is a significant variability in students' *metacognitive self-regulation* among classes (τ_{00} = .057, X^2 = 333.19, df = 136, p<.001). Table 4.52 presents that final estimation of variance components for students' *metacognitive self-regulation*.

Table 4.52 Final estimation of variance components for students' metacognitive Self-Regulation (MCSR).

Random Effects	*Variance Components*	*df*	X^2
Metacognitive Self-Regulation			
Class mean, u_{ij}	.057	136	333.19***
Level-1 Effect, r_{ij}	.945		

*** *p <.001*

4.2.6.2 The Results of the Research Question 6.b: Means as Outcomes Model

The Means as Outcomes Model was tested for the students' MCSR to investigate the explained variances in the outcome variable due to the Level-2 (teacher or class level) predictors.

The data were analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

$$\begin{aligned}\beta_{0j} = \gamma_{00} &+ \gamma_{01}(TGOALAAP)_j + \gamma_{02}(TGOALAAV)_j + \gamma_{03}(TGOALWAV)_j \\ &+ \gamma_{04}(TGOALTAS)_j + \gamma_{05}(TSELF\_CM)_j \\ &+ \gamma_{06}(TSELF\_SE)_j + \gamma_{07}(TSELF\_IS)_j + \gamma_{08}(TCITIZEN)_j \\ &+ \gamma_{09}(TSU\_CEN)_j + \gamma_{010}(TEP\_SOU)_j + \gamma_{011}(TEP\_CER)_j \\ &+ \gamma_{012}(TEP\_JUS)_j + \gamma_{013}(TEP\_DEV)_j + \gamma_{014}(CLE\_P\_AG)_j \\ &+ \gamma_{015}(CLE\_U\_AG)_j + \gamma_{016}(CLE\_C\_AG)_j \\ &+ \gamma_{017}(CLE\_S\_AG)_j + \gamma_{018}(CLE\_N\_AG)_j + u_{0j}\end{aligned}$$

In these models,

Y_{ij} is the outcome variable (*metacognitive self-regulation*).

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

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

γ_{01} is the differentiating effect of *ability approach* dimension of Teacher Achievement Goal Orientations Scale (TAGOS) on class mean of the outcome variable.

γ_{02} is the differentiating effect of *ability avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{03} is the differentiating effect of *work avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{04} is the differentiating effect of *task* dimension of the TAGOS on class mean of the outcome variable.

γ_{05} is the differentiating effect of *classroom management* dimension of the Teacher Sense of Efficacy Scale (TSES) on class mean of the outcome variable.

γ_{06} is the differentiating effect of *student engagement* dimension of the TSES on class mean of the outcome variable.

γ_{07} is the differentiating effect of *instructional strategies* dimension of the TSES on class mean of the outcome variable.

γ_{08} is the differentiating effect of teacher's *individual citizenship behaviors* on class mean of the outcome variable.

γ_{09} is the differentiating effect of teacher's *student-centered beliefs and practices* on class mean of the outcome variable.

γ_{010} is the differentiating effect of *source* dimension of the Teacher Epistemological Beliefs Questionnaire (TEBQ) on class mean of the outcome variable.

γ_{011} is the differentiating effect of *certainty* dimension of the TEBQ on class mean of the outcome variable.

γ_{012} is the differentiating effect of *justification* dimension of the TEBQ on class mean of the outcome variable.

γ_{013} is the differentiating effect of *development* dimension of the TEBQ on class mean of the outcome variable.

γ_{014} is the differentiating effect of *personal relevance* dimension (aggregated) of the Constructivist Learning Environment Scale (CLES) on class mean of the outcome variable.

γ_{015} is the differentiating effect of *uncertainty* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{016} is the differentiating effect of c*ritical voice* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{017} is the differentiating effect of *shared control* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{018} is the differentiating effect of *student negotiation* dimension (aggregated) of the CLES on class mean of the outcome variable.

r_{ij} is the level-1 residual.

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

Results of the Means as Outcomes Models indicated that *certainty* dimension of the teachers' epistemological beliefs (γ = .045, SE = .019, p < .05) and *critical voice* (γ = .105, SE = .028, p < .001), *shared control* (γ = .062, SE = .027, p < .05), and *student negotiation* (γ = .061, SE = .028, p < .05) dimensions (aggregated) of the constructivist learning environment were significantly and positively associated with students' *metacognitive self-regulation* (see Table 4.53).

Table 4.53 Final estimation of fixed effects for all dimensions of students' Metacognitive Self-Regulation (MCSR).

	Metacognitive Self-Regulation	
Fixed Effects	γ	*SE*
Model for Class Means[1]		
Intercept	.002	.019
T. Achievement Goals-Ability Approach		
T. Achievement Goals-Ability Avoidance		
T. Achievement Goals-Work Avoidance		
T. Achievement Goals-Task		
T. Sense of Efficacy-Classroom Management		
T. Sense of Efficacy-Student Engagement		
T. Sense of Efficacy-Instructional Strategies		
T. Individual Citizenship Behavior		
T. Student-Centered Beliefs and Practices		
T. Epistemological Beliefs-Source		
T. Epistemological Beliefs-Certainty	.045*	.019
T. Epistemological Beliefs-Justification		
T. Epistemological Beliefs-Development		
CLE-Personal Relevance (Aggregated)		
CLE-Uncertainty (Aggregated)		
CLE-Critical Voice (Aggregated)	.105***	.028
CLE-Shared Control (Aggregated)	.062*	.027
CLE-Student Negotiation (Aggregated)	.061*	.028

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

These findings implied students with the perception as a class that they have opportunities to question what is going on in the science lesson freely, to have a shared role in the class (*Shared Control*), and to communicate with their teachers tend use metacognitive learning strategies at higher levels. In addition, students of teachers with the belief that scientific knowledge is certain appeared to be more metacognitively active.

Since the significantly resulted level-2 (Teacher-Level) predictors were added to the empty model, it was expected that the residual variances between classes were decreased compared to the One-Way Random Effects ANOVA model. To see the reductions of the residual variances between two models, R^2 was computed by using τ_{00} estimates obtained from two model sets (One-Way Random Effects ANOVA Model and Means as Outcomes Model) with following formula:

$$R^2 = \frac{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA) - \tau_{00}(Means\ as\ Outcome)}{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA)}$$

Computed R^2 for each two model set sets (One-Way Random Effects ANOVA Model and Means as Outcomes Model) revealed that 82% of the true between-class variance in students' ***metacognitive self-regulation*** was accounted for *certainty* dimension of teachers' epistemological beliefs, and *critical voice* , *shared control* and *student negotiation* dimensions of constructivist learning environment (aggregated). However, classes still varied significantly in the average means of metacognitive self-regulation scores (τ_{00} = .010, X^2 = 178.39, df = 132, p<.001). Table 4.54 presents that final estimation of variance components for metacognitive self-regulation scores as the results of the Means as Outcomes Model.

Table 4.54 Final estimation of variance components for students' Metacognitive Self-Regulation (MCSR).

Random Effects	*Variance Components*	*df*	X^2	R^2
Metacognitive Self-Regulation				
Class mean, u_{ij}	.010	132	178.39**	.819
Level-1 Effect, r_{ij}	.945			

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

4.2.6.3 The Results of the Research Question 6.c: Random Coefficient Model

The Random Coefficient Model was built to investigate the explained variances in students' MCSR due to the students' perception of constructivist learning environment and epistemological beliefs (Level-1 or student level predictor). The Random Coefficient Model was based on the following regression equation:

Level-1 (student level) model:

$$Y_{ij} = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3J} * (CLE\_CRI) + \beta_{4J} * (CLE\_SHA) + \beta_{5J} * (CLE\_NEG) + \beta_{6J} * (EP\_SOU) + \beta_{7J} * (EP\_CER) + \beta_{8J} * (EP\_JUS) + \beta_{9J} * (EP\_DEV) + r_{ij}$$

Level-2 (teacher level or class level) model:

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

…

…

…

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

In these models,

Y_{ij} is the outcome variable (*metacognitive self-regulation*)

β_{0j} is the mean on self-efficacy beliefs for each class.

β_{1j} is the differentiating effect of *personal* dimension of the Constructivist Learning Environment Scale (CLES) in class j.

β_{2j} is the differentiating effect of *uncertainty* dimension of the CLES in class j.

β_{3j} is the differentiating effect of c*ritical voice* dimension of the CLES in class j.

β_{4j} is the differentiating effect of *shared control* dimension of the CLES in class j.

β_{5j} is the differentiating effect of *student negotiation* dimension of the CLES in class j.

β_{6j} is the differentiating effect of *source* dimension of students' Epistemological Beliefs Questionnaire (EBQ) in class j.

β_{7j} is the differentiating effect of *certainty* dimension of students' SEBQ in class j.

β_{8j} is the differentiating effect of *justification* dimension of students' SEBQ in class j.

β_{9j} is the differentiating effect of *development* dimension of students' SEBQ in class j.

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.

Results showed that students' *metacognitive self-regulation* was positively and significantly associated with *personal relevance* (γ = .147, SE = .0.21, p < .001), *uncertainty* (γ = .060, SE = .019, p < .01), *critical voice* (γ = .142, SE = .024, p < .001), *shared control* (γ = .128, SE = .019, p < .001), *student negotiation* (γ = .053, SE = .020, p < .01) dimensions of the constructivist learning environment and *certainty* (γ = .092, SE = .020, p < .001), *justification* (γ = .158, SE = .023, p < .001), *development* (γ = .041, SE = .021, p < .05) dimension of students' epistemological beliefs. It was also found that *critical voice* (X^2= 175.61, *p* < .05), *source* (X^2= 192.69, *p* < .01), *justification* (X^2= 186.69, *p* < .01), and *development* (X^2= 175.67, *p* < .05) as slopes of *metacognitive self-regulation* were significantly varied.

To calculate the proportion of the reduction in residual variance for *metacognitive self-regulation*, the sigma squared that was obtained from the One-Way Random Effects ANOVA and the sigma squared that was obtained from the Random Coefficient Model were used:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Random\ Coefficient)}{\sigma^2(random\ ANOVA)}$$

When the level-1 variables were added to the model as predictors of ***metacognitive self-regulation***, residual variance was decreased by 34.4%. However, there was still a significant variation among the class means that might be explained by adding level-2 variables (X^2= 340.20, *p* < .001). Table 4.55 presents the results of the Random Coefficient Model that was constructed for the students' metacognitive self-regulation.

Table 4.55 Final estimation of fixed effects for all dimensions of students' Metacognitive Self-Regulation (MCSR).

	Metacognitive Self-Regulation	
Fixed Effects	γ	SE
Model for Class Means[1]		
Intercept	-.000	.024
CLE-Personal Relevance	.147***	.021
CLE-Uncertainty	.060**	.019
CLE-Critical Voice	.142***	.024
CLE-Shared Control	.128***	.019
CLE-Student Negotiation	.053**	.020
Epistemological Beliefs-Source		
Epistemological Beliefs-Certainty	.092***	.020
Epistemological Beliefs-Justification	.157***	.023
Epistemological Beliefs-Development	.041*	.021

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

These findings suggested that students who perceive in their science classes that they have opportunities to relate science to real world (*Personal Relevance*), to practice the construction of scientific knowledge (*Uncertainty*), to question what is going on in the lesson freely (*Critical Voice*), to have a shared role in the class (*Shared Control*), and to communicate with their teachers in the classroom (*Student Negotiation*), tend to use metacognitive self-regulation strategies at higher levels. Students with more sophisticated epistemological beliefs and the belief that scientific knowledge is certain are also found to use metacognitive self-regulation strategies more.

Table 4.56 presents the results of the Random Coefficient Model that was constructed for the students' metacognitive self-regulation.

Table 4.56 Final estimation of variance components for students' Metacognitive Self-Regulation (MCSR).

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Metacognitive Self-Regulation				.344	
Class mean, u_{ij}	.222	136	340.20***		.550
CLE-Critical Voice, u_{3j}	.123	136	175.61*		.250
Epistemological Beliefs-Source, u_{6j}	.085	136	192.69**		.163
Epistemological Beliefs-Justification, u_{8j}	.137	136	186.69**		.227
Epistemological Beliefs-Development, u_{9j}	.106	136	175.67*		.166
Level-1 Effect, r_{ij}	.787				

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

4.2.6.4 The Results of the Research Question 6.d: Intercepts and Slopes as Outcomes Model

Intercepts and Slopes as Outcomes Model was constructed based on the following regression equation to investigate which teacher level variables influence the effect of student level variables on the students' metacognitive self-regulation:

Level-1 (student level) model:

$$(Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3J} * (CLE\_CRI) + \beta_{4J} * (CLE\_SHA) + \beta_{5J} * (CLE\_NEG) + \beta_{6J} * (EP\_SOU) + \beta_{7J} * (EP\_CER) + \beta_{8J} * (EP\_JUS) + \beta_{9J} * (EP\_DEV) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (TEP\_CER)_j + \gamma_{02} * (CLE\_C\_AG)_j + \gamma_{03} * (CLE\_S\_AG)_j + \gamma_{04} * (CLE\_N\_AG)_j + u_{0j}$$

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

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

$$\beta_{3j} = \gamma_{30} + \gamma_{31} * (TEP\_CER)_j + \gamma_{32} * (CLE\_C\_AG)_j + \gamma_{33} * (CLE\_S\_AG)_j + \gamma_{34} * (CLE\_N\_AG)_j + u_{3j}$$

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

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

$$\beta_{6j} = \gamma_{60} + \gamma_{61} * (TEP\_CER)_j + \gamma_{62} * (CLE\_C\_AG)_j + \gamma_{63} * (CLE\_S\_AG)_j + \gamma_{64} * (CLE\_N\_AG)_j + u_{6j}$$

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

$$\beta_{8j} = \gamma_{80} + \gamma_{81} * (TEP\_CER)_j + \gamma_{82} * (CLE\_C\_AG)_j + \gamma_{83} * (CLE\_S\_AG)_j + \gamma_{84} * (CLE\_N\_AG)_j + u_{8j}$$

$$\beta_{9j} = \gamma_{90} + \gamma_{91} * (TEP\_CER)_j + \gamma_{92} * (CLE\_C\_AG)_j + \gamma_{93} * (CLE\_S\_AG)_j + \gamma_{94} * (CLE\_N\_AG)_j + u_{9j}$$

To get the final model, non-significant predictors were eliminated from the model. After running the final HLM, it was found that following model was significant for all retained level-1 and level-2 predictors:

Level-1 (student level) model:

$$(Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3J} * (CLE\_CRI) + \beta_{4J} * (CLE\_SHA) + \beta_{5J} * (CLE\_NEG) + \beta_{6J} * (EP\_SOU) + \beta_{7J} * (EP\_CER) + \beta_{8J} * (EP\_JUS) + \beta_{9J} * (EP\_DEV) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (CLE\_C\_AG)_j + \gamma_{02} * (CLE\_S\_AG)_j + \gamma_{03} * (CLE\_N\_AG)_j + u_{0j}$$

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

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

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

$$\beta_{4j} = \gamma_{40}$$
$$\beta_{5j} = \gamma_{50}$$
$$\beta_{6j} = \gamma_{60} + u_{6j}$$
$$\beta_{7j} = \gamma_{70}$$
$$\beta_{8j} = \gamma_{80} + u_{8j}$$
$$\beta_{9j} = \gamma_{90} + \gamma_{91} * (CLE\_C\_AG)_j + \gamma_{92} * (CLE\_N\_AG)_j + u_{9j}$$

Similar to the Means as Outcomes Models, the one of the results of the Intercepts and Slopes as Outcomes Model indicated that *critical voice (*γ = .081, SE = .027, p < .01), *shared control (*γ = .055, SE = .026, p < .05), and *student negotiation* (γ = .054, SE = .027, p < .05) dimensions (aggregated) of the constructivist learning environment were significantly and positively associated with the students' *metacognitive self-regulation* which was tested with the equation β_{0j}.

Testing the equation β_{1j}, β_{2j}, β_{3j}, β_{4j}, β_{5j}, β_{6j}, β_{7j}, β_{8j}, and β_{9j},the results showed that *personal relevance* (γ = .152, SE = .021, p < .001), *uncertainty* (γ = .064, SE = .019, p < .01), *critical voice* (γ = .145, SE = .024, p < .001), *shared control* (γ = .126, SE = .019, p < .001), *student negotiation* (γ = .056, SE = .020, p < .01) dimensions of the students' perception of constructivist learning environment and *certainty* (γ = .091, SE = .020, p < .001), *justification* (γ = .147, SE = .023, p < .001) dimension of the students' epistemological beliefs were significantly and positively associated with the students' *metacognitive self-regulation*. Although, *development* dimension of the students' epistemological beliefs was not found as a significant predictor for the outcome variable, *critical voice (*γ = -.054, SE = .022, p < .05), and *student negotiation* (γ = .066, SE = .022, p < .01) dimensions (aggregated) of the constructivist learning environment were found as mediators for the relationship between *development* and the outcome variable. Table 4.57 presents that final estimation of fixed effects for the students' metacognitive self-regulation obtained from the Intercepts and Slopes as Outcomes Model.

Table 4.57 Final estimation of fixed effects for the students' Metacognitive Self-Regulation (MCSR).

Fixed Effects	Coefficient	SE
Model for Class Means[1]		
Intercept, γ_{00}	.001	.019
CLE-Critical Voice (Aggregated), γ_{01}	.081**	.027
CLE-Shared Control (Aggregated), γ_{02}	.055*	.026
CLE-Student Negotiation (Aggregated), γ_{03}	.054*	.027
CLE-Personal Relevance, γ_{10}	.152***	.021
CLE-Uncertainty, γ_{20}	.064**	.019
CLE-Critical Voice, γ_{30}	.145***	.024
CLE-Shared Control, γ_{40}	.126***	.019
CLE-Student Negotiation, γ_{50}	.056**	.020
Epistemological Beliefs-Certainty, γ_{70}	.091***	.020
Epistemological Beliefs-Justification, γ_{80}	.147***	.023
Epistemological Beliefs-Development, γ_{90}		
CLE-Critical Voice (Aggregated), γ_{91}	-.054*	.022
CLE-Student Negotiation (Aggregated), γ_{92}	.066**	.022

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
*$p< .05$, **$p<.01$, ***$p<.001$*

The abovementioned results suggest that students with the perception as a class that they have opportunity to question what is going on in the lesson freely (*Critical Voice*), to have a shared role in the class (*Shared Control*), and to communicate with their teachers in the classroom (*Student Negotiation*) tend to use metacognitive learning strategies at higher levels. This results was consistent with the results of the Means as Outcomes Model .However, results of the Means as Outcomes Model and that of Intercepts and Slopes as Outcomes Model differed in that *certainty* dimension of teachers' epistemological beliefs was not found in a relationship with students' use of meta-cognitive self-regulation strategies in Intercepts and Slopes as Outcomes Model, which examined the teacher level variables influencing the effect of student level variables on the students' metacognitive self-regulated learning.

Additionally, the results with respect to Level-1 predictors, consistent with the results of Random Coefficient Model, indicated that students who perceive to have opportunities to relate science to real world (*Personal Relevance*), to practice the construction of scientific knowledge (*Uncertainty*), to question what is going on in the lesson freely (*Critical Voice*), to have a shared role in the class (*Shared Control*), and to communicate with their teachers in the classroom (*Student Negotiation*), tend to be more metacognitively active. Moreover, students with the belief that scientific knowledge is certain and the more sophisticated belief in justification of knowledge appeared to use metacognitive strategies at higher levels.

Regarding to the mediation effect of Level-2 variables, the relationship between students' epistemological beliefs (regarding *development*) and metacognitive self-regulation strategy use was weaker in the classrooms where students who perceive to question what is going on in the lesson freely (*Critical Voice*) (with respect to class means), but stronger for the who perceive to be free to communicate with their teachers in the classroom (*Student Negotiation*) (with respect to class means). Figure 4.6 indicates the results of the HLM analysis on a model for research question 6d. In the Figure 4.6, the variables in the orange boxes are student-level predictors and the variables in the blue boxes are teacher-level or Level-2 variables. The right one (under the "outcomes" heading) is students' outcome variable (metacognitive self-regulation). Also, the black arrows refers positive relationships and the red arrows refers negative relationships between student-level predictors and the outcome variables. To indicate the mediation effects, extra arrows were used in the figure. For instance, the mean of "critical voice" above the arrow is that *Critical Voice* dimension of constructivist learning environment (aggregated one) mediated negatively (because of red color) the relationship between *development* dimension of students' epistemological beliefs (individual) and *metacognitive self-regulation* variables.

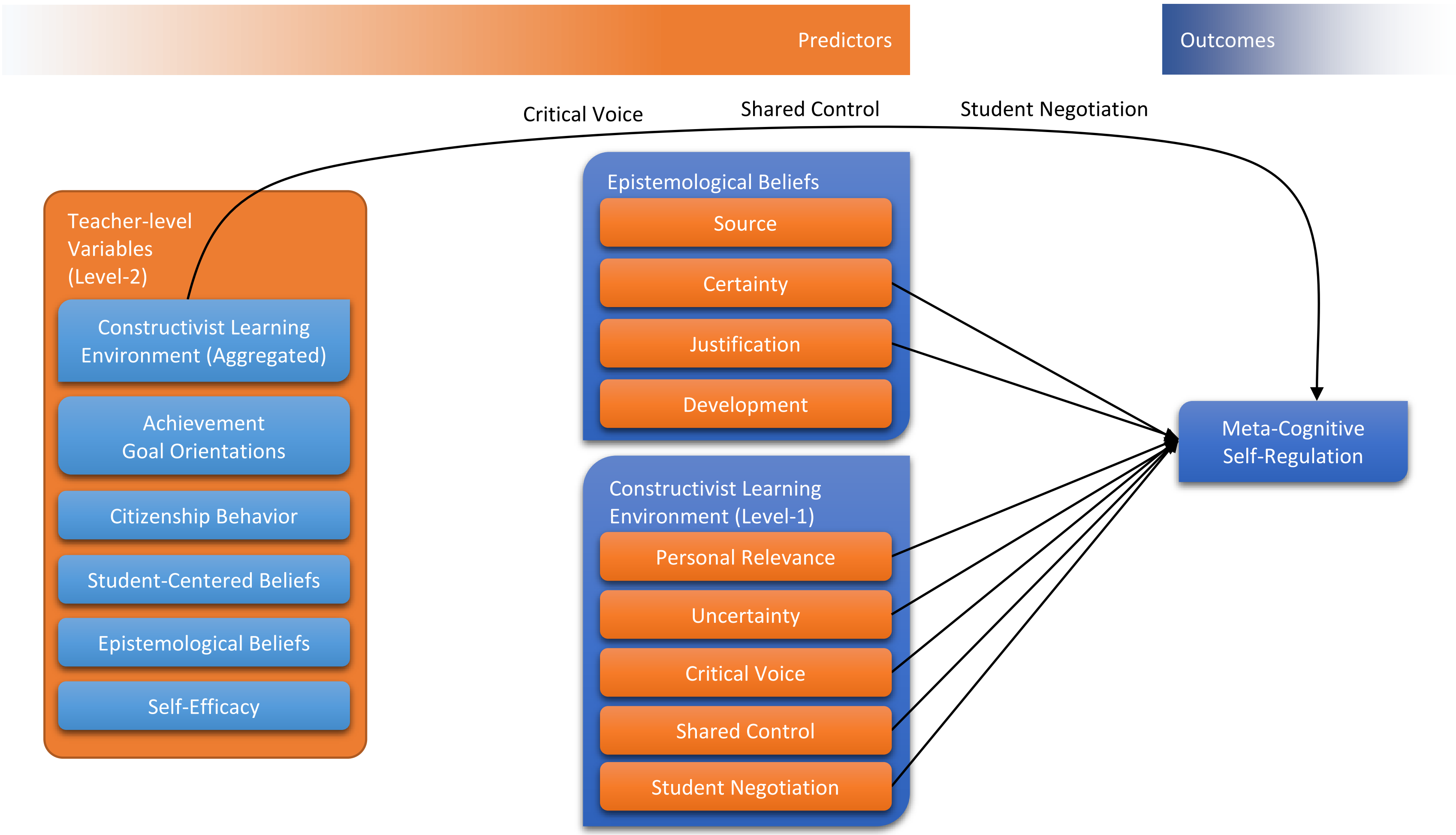


Figure 4.6 The final model based on the results of the HLM analysis for research question 6d.

Finally, the results of the Intercepts and Slopes as Outcomes Model revealed that 58.5% of the variance in the between class difference in mean *metacognitive self-regulation* was explained by adding level-2 predictors, but a significant variability still exists among the classes (X^2=233.67, p<.001). Table 4.58 presents that final estimation of variance components for the students' metacognitive self-regulation as the results of the Intercepts and Slopes as Outcomes Model.

Table 4.58 Final estimation of variance components for students' Metacognitive Self-Regulation (MCSR).

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Intercept				.585	
Class mean, u_{0j}	.020	133	233.97***		.349
CLE-Critical Voice, u_{3j}	.014	136	175.72*		.235
Epistemological Beliefs-Source, u_{6j}	.008	136	192.79**		.168
Epistemological Beliefs-Justification, u_{8j}	.019	136	186.49**		.232
Epistemological Beliefs-Development, u_{9j}	.008	134	166.62*		.128
Level-1 Effect, r_{ij}	.619				

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

4.2.7 Research Question 7: Students' Science Achievement

Following sub-questions were constructed based on research question 7 which was related to students' Science Achievement. In the related HLM analyses, the variable of students' Science Achievement was assigned as outcome variable.

Research Question 7.a: Are there differences in the students' science achievement among classes?

Research Question 7.b: Which teacher level variables are associated with the differences in the students' science achievement?

Research Question 7.c: Which student level variables explain the differences in the students' science achievement?

Research Question 7.d: Which teacher level variables influence the effect of student level variables on the students' science achievement?

4.2.7.1 The Results of the Research Question 7.a: One-Way Random Effects ANOVA Model

In order to examine whether there are differences in the students' science achievement among classes One-Way Random Effects ANOVA was conducted using HLM analysis. All scores were standardized before conducting the HLM.

The data were analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

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

Y_{ij} is the outcome variable (*students' science achievement)*

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

γ_{00} is the grand mean, that is, the overall average score of an 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 order to see the variation between class means in dimensions of students' epistemological beliefs, four separate ICCs were calculated by using the following formula:

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

The results revealed that 37% of total variability in students' *science achievement* scores can be attributed to the teachers. According to the results of the One-Way Random Effects ANOVA reliability estimates value was not problematic for the outcome variable. Table 4.59 presents the final estimation of fixed effects for students' *science achievement*.

Table 4.59 Final estimation of fixed effects for students' science achievement.

Fixed Effects	*Coefficient*	*SE*	*ICC (ρ)*	*Reliability (λ)*
Model for Science Achievement (β_0)			.37	.929
Intercept (γ_{00})	-.028	.054		

The results of the One-Way Random Effects ANOVA revealed that the variance of the class level (τ_{00}) component was statistically significant. It means that there are significant variability in students' *science achievement* among classes (τ_{00} = .368, X^2 = 2177.51, df = 136, p<.001). Table 4.60 presents that final estimation of variance components for students' science achievement.

Table 4.60 Final estimation of variance components for students' Science Achievement.

Random Effects	*Variance Components*	*df*	X^2
Science Achievement			
Class mean, u_{ij}	.368	136	2177.51***
Level-1 Effect, r_{ij}	.617		

*** *p <.001*

4.2.7.2 The Results of the Research Question 7.b: Means as Outcomes Model

The Means as Outcomes Model was tested to investigate the explained variances in students' science achievement due to the Level-2 (teacher or class level) predictors.

The data were analyzed based on the following regression equation:

Level-1 (student level) model:

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

Level-2 (teacher level or class level) model:

$$\begin{aligned}\beta_{0j} = \gamma_{00} + \gamma_{01}(TGOAL\_AAP)_j + \gamma_{02}(TGOAL\_AAV)_j \\ + \gamma_{03}(TGOAL\_WAV)_j + \gamma_{04}(TGOALTAS)_j \\ + \gamma_{05}(TSELF\_CM)_j + \gamma_{06}(TSELF\_SE)_j + \gamma_{07}(TSELF\_IS)_j \\ + \gamma_{08}(TCITIZEN)_j + \gamma_{09}(TSTU\_CEN)_j \\ + \gamma_{010}(TEP\_SOU)_j + \gamma_{011}(TEP\_CER)_j + \gamma_{012}(TEP\_JUS)_j \\ + \gamma_{013}(TEP\_DEV)_j + \gamma_{014}(CLE\_P\_AG)_j \\ + \gamma_{015}(CLE\_U\_AG)_j + \gamma_{016}(CLE\_C\_AG)_j \\ + \gamma_{017}(CLE\_S\_AG)_j + \gamma_{018}(CLE\_N\_AG)_j + u_{0j}\end{aligned}$$

In these models,

Y_{ij} is the outcome variable (*students' science achievement*).

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 *ability approach* dimension of the Teacher Achievement Goal Orientations Scale (TAGOS) on class mean of the outcome variable.

γ_{02} is the differentiating effect of *ability avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{03} is the differentiating effect of *work avoidance* dimension of the TAGOS on class mean of the outcome variable.

γ_{04} is the differentiating effect of *task* dimension of the TAGOS on class mean of the outcome variable.

γ_{05} is the differentiating effect of *classroom management* dimension of the Teacher Sense of Efficacy Scale (TSES) on class mean of the outcome variable.

γ_{06} is the differentiating effect of *student engagement* dimension of the TSES on class mean of the outcome variable.

γ_{07} is the differentiating effect of *instructional strategies* dimension of the TSES on class mean of the outcome variable.

γ_{08} is the differentiating effect of *teachers' individual citizenship behaviors* on class mean of outcome variable.

γ_{09} is the differentiating effect of *teachers' student-centered beliefs and practices* on class mean of outcome variable.

γ_{010} is the differentiating effect of *source* dimension of the Teacher Epistemological Beliefs Questionnaire (TEBQ) on class mean of the outcome variable.

γ_{011} is the differentiating effect of *certainty* dimension of the TEBQ on class mean of the outcome variable.

γ_{012} is the differentiating effect of *justification* dimension of the TEBQ on class mean of the outcome variable.

γ_{013} is the differentiating effect of *development* dimension of the TEBQ on class mean of the outcome variable.

γ_{014} is the differentiating effect of *personal relevance* dimension (aggregated) of the Constructivist Learning Environment Scale (CLES) on class mean of the outcome variable.

γ_{015} is the differentiating effect of *uncertainty* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{016} is the differentiating effect of c*ritical voice* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{017} is the differentiating effect of *shared control* dimension (aggregated) of the CLES on class mean of the outcome variable.

γ_{018} is the differentiating effect of *student negotiation* dimension (aggregated) of the CLES on class mean of the outcome variable.

r_{ij} is the level-1 residual.

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

Results of the Means as Outcomes Models indicated that while *student engagement* dimension of the teachers' sense of self-efficacy (γ = .154, SE = .053, p < .01), and *development* dimension of the teachers' epistemological beliefs (γ = .115, SE = .049, p < .05) were positively associated with students' science achievement, *certainty* dimension of teachers' epistemological beliefs (γ = -.105, SE = .050, p < .05) and, *shared control* dimension of the aggregated constructivist learning environment perceptions (γ = -.112, SE = .048, p < .05) were negatively linked to the outcome variable. Table 4.61 presents the final estimation of fixed effects for students' science achievement and their level-2 predictors.

Table 4.61 Final estimation of fixed effects for all dimensions of students' Science Achievement.

	Science Achievement	
Fixed Effects	γ	*SE*
Model for Class Means[1]		
Intercept	-.029	.050
T. Achievement Goals-Ability Approach		
T. Achievement Goals-Ability Avoidance		
T. Achievement Goals-Work Avoidance		
T. Achievement Goals-Task		
T. Sense of Efficacy-Classroom Management		
T. Sense of Efficacy-Student Engagement	.154**	.053
T. Sense of Efficacy-Instructional Strategies		
T. Individual Citizenship Behavior		
T. Student-Centered Beliefs and Practices		
T. Epistemological Beliefs-Source		
T. Epistemological Beliefs-Certainty	-.105*	.050
T. Epistemological Beliefs-Justification		
T. Epistemological Beliefs-Development	.115*	.049
CLE-Personal Relevance (Aggregated)		
CLE-Uncertainty (Aggregated)		
CLE-Critical Voice (Aggregated)		
CLE-Shared Control (Aggregated)	-.112*	.048
CLE-Student Negotiation (Aggregated)		

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

These findings implied that students of science teachers with beliefs in the evolving and changing nature of science and who are self-efficacious for student engagement tend to have higher science achievement scores. On the other hand, according to the results, students of science teachers who believe that scientific knowledge is certain are likely to have lower science achievement scores. A negative association was also found between class level perception that students have opportunities to have a shared role in the class (*Shared Control*) and science achievements.

Since the significantly resulted level-2 (Teacher-Level) predictors were added to the empty model, it was expected that the residual variances between classes were decreased compared to the One-Way Random Effects ANOVA model. To see the reductions of the residual variances between two models, R^2 was computed by using τ_{00} estimates obtained from two model sets (One-Way Random Effects ANOVA Model and Means as Outcomes Model) with following formula:

$$R^2 = \frac{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA) - \tau_{00}(Means\ as\ Outcome)}{\tau_{00}(\text{One} - \text{Way Random Effects } ANOVA)}$$

Computed R^2 for each two model set sets (One-Way Random Effects ANOVA Model and Means as Outcomes Model) revealed that 16% of the true between-class variance in ***science achievement scores*** was accounted for *student engagement* dimension of teachers' sense of efficacy beliefs, *certainty* and *development* dimension of teachers' epistemological beliefs, and *shared control* dimension of constructivist learning environment (aggregated). However, classes still varied significantly in the average means of *science achievement* scores (τ_{00} = .310, X^2 = 1843.97, df = 132, p<.001). Table 4.62 presents that final estimation of variance components for science achievement as the results of the Means as Outcomes Model.

Table 4.62 Final estimation of variance components for students' Science Achievement.

Random Effects	*Variance Components*	*df*	X^2	R^2
Science Achievement				
Class mean, u_{ij}	.310	132	1843.97***	.158
Level-1 Effect, r_{ij}	.617			

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

4.2.7.3 The Results of the Research Question 7.c: Random Coefficient Model

The Random Coefficient Model was constructed to investigate the explained variances in students' science achievement due to the students' perception of constructivist learning environment and epistemological beliefs (Level-1 or student level predictor). The model was tested based on the following regression equation:

Level-1 (student level) model:

$$Y_{ij} = \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3J} * (CLE\_CRI) + \beta_{4J} * (CLE\_SHA) + \beta_{5J} * (CLE\_NEG) + \beta_{6J} * (TASK) + \beta_{7J} * (SELF\_EFF) + \beta_{8J} * (MC\_SR) + \beta_{9J} * (EP\_SOU) + \beta_{10J} * (EP\_CER) + \beta_{11J} * (EP\_JUS) + \beta_{12J} * (EP\_DEV) + \beta_{13J} * (GOAL\_MA) + \beta_{14J} * (GOAL\_PA) + \beta_{15J} * (GOAL\_MAV) + \beta_{16J} * (GOAL\_PAV) + r_{ij}$$

Level-2 (teacher level or class level) model:

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

…

…

…

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

In these models,

Y_{ij} is the outcome variable (*science achievement*)

β_{0j} is the mean on science achievement scores for each class.

β_{1j} is the differentiating effect of *personal* dimension of the Constructivist Learning Environment Scale (CLES) in class j.

β_{2j} is the differentiating effect of *uncertainty* dimension of the CLES in class j.

β_{3j} is the differentiating effect of c*ritical voice* dimension of the CLES in class j.

β_{4j} is the differentiating effect of *shared control* dimension of the CLES in class j.

β_{5j} is the differentiating effect of *student negotiation* dimension of the CLES in class j.

β_{6j} is the differentiating effect of students' perception of *task value* in class j.

β_{7j} is the differentiating effect of students' *self-efficacy beliefs* in class j.

β_{8j} is the differentiating effect of students' *metacognitive self-regulation* in class j.

β_{9j} is the differentiating effect of *source* dimension of students' Epistemological Beliefs Questionnaire (SEBQ) in class j.

β_{10j} is the differentiating effect of *certainty* dimension of students' SEBQ in class j.

β_{11j} is the differentiating effect of *justification* dimension of students' SEBQ in class j.

β_{12j} is the differentiating effect of dimension of students' SEBQ in class j.

β_{13j} is the differentiating effect of *mastery approach* dimension of students' Achievement Goal Orientations (AGO) in class j.

β_{14j} is the differentiating effect of *performance approach* dimension of students' AGO in class j.

β_{15j} is the differentiating effect of *mastery avoidance* dimension of students' AGO in class j.

β_{16j} is the differentiating effect of *performance avoidance* dimension of students' AGO in class j.

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.

Results showed that students' *science achievement* was significantly associated with *student negotiation* (γ = .059, SE = .016, p < .001) dimension of the CLES, students' *self-efficacy* (γ = .049, SE = .019, p < .05), *certainty* (γ = -.065, SE = .015, p < .001) and *justification* (γ = .060, SE = .020, p < .01) dimensions of students' epistemological beliefs, and *performance avoidance goals* dimensions of students' achievement goals (γ = -.037, SE = .015, p < .05). Other results of the Random Coefficient Model revealed that *self-efficacy* (X^2= 186.78, p < .01), *justification* (X^2= 169.70, p < .05) and *mastery approach goals* (X^2= 171.33, p < .05) that were the slope of *science achievement* were significantly varied.

To calculate the proportion of the reduction in residual variance for *science achievement*, the sigma squared that was obtained from the One-Way Random Effects ANOVA and the sigma squared that was obtained from the Random Coefficient Model were used:

$$R^2 = \frac{\sigma^2(random\ ANOVA) - \sigma^2(Random\ Coefficient)}{\sigma^2(random\ ANOVA)}$$

When the level-1 variables were added to the model as predictors of science achievement, explained variance was decreased by 9.5%. However, there was still a significant variation among the class means that might be explained adding level-2 variables (X^2= 1955.10, p < .001). Table 4.63 presents the results of the Random Coefficient Model that was tested for the students' science achievement.

Table 4.63 Final estimation of fixed effects for all dimensions of students' Science Achievement.

Fixed Effects	Science Achievement	
	γ	SE
Model for Class Means		
Intercept	-.018	.054
CLE-Personal Relevance		
CLE-Uncertainty		
CLE-Critical Voice		
CLE-Shared Control		
CLE-Student Negotiation	.059***	.016
Task Value		
Self-Efficacy	.049*	.019
Metacognitive Self-Regulation		
Epistemological Beliefs-Source		
Epistemological Beliefs-Certainty	-.065***	.015
Epistemological Beliefs-Justification	.060**	.020
Epistemological Beliefs-Development		
Achievement Goals-Mastery Approach	-.005	.020
Achievement Goals-Performance Approach		
Achievement Goals-Mastery Avoidance		
Achievement Goals-Performance Avoidance	-.037*	.015

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
$*p< .05$, $**p<.01$, $***p<.001$

These findings suggest that students who perceive to communicate with their science teachers in the classroom, tend to have higher science achievement scores. In addition, students with high science self-efficacy and with the more sophisticated beliefs in justification of knowledge appeared to have higher levels of science achievement. On the other hand, students who believe that scientific knowledge is certain and who study science for the reasons of avoiding performing poorly or looking stupid are found to have lower science achievement scores.

Table 4.64 presents the results of the Random Coefficient Model that was tested for the students' science achievement.

Table 4.64 Final estimation of variance components for students' Science Achievement.

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Science Achievement				.095	
Class mean, u_{ij}	.374	136	1956.27***		.902
Self-Efficacy, u_{2j}	.013	136	186.78**		.236
Epistemological Beliefs-Justification, u_{4j}	.010	136	169.70*		.176
Achievement Goals-Mastery Approach, u_{5j}	.008	136	171.33*		.149
Level-1 Effect, r_{ij}	.558				

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

4.2.7.4 The Results of the Research Question 7.d: Intercepts and Slopes as Outcomes Model

Intercepts and Slopes as Outcomes Model was built to examine which teacher level variables influence the effect of student level variables on the students' science achievement. The model was tested based on the following regression equation:

Level-1 (student level) model:

$$(Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE\_NEG) + \beta_{2J} * (SELF\_EFF) + \beta_{3J} * (EP\_CER) + \beta_{4J} * (EP\_JUS) + \beta_{5J} * (GOAL\_MA) + \beta_{6J} * (GOAL\_PAV) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (TSELF\_SE)_j + \gamma_{02} * (TEP\_CER)_j + \gamma_{03} * (TEP\_DEV)_j + \gamma_{04} * (CLE\_S\_AG)_j + u_{0j}$$

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

$$\beta_{2j} = \gamma_{20} + \gamma_{21} * (TSELF\_SE)_j + \gamma_{22} * (TEP\_CER)_j + \gamma_{23} * (TEP\_DEV)_j + \gamma_{24} * (CLE\_S\_AG)_j + u_{2j}$$

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

$$\beta_{4j} = \gamma_{40} + \gamma_{41} * (TSELF\_SE)_j + \gamma_{42} * (TEP\_CER)_j + \gamma_{43} * (TEP\_DEV)_j + \gamma_{44} * (CLE\_S\_AG)_j + u_{4j}$$

$$\beta_{5j} = \gamma_{50} + \gamma_{51} * (TSELF\_SE)_j + \gamma_{52} * (TEP\_CER)_j + \gamma_{53} * (TEP\_DEV)_j + \gamma_{54} * (CLE\_S\_AG)_j + u_{5j}$$

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

To get the final model, non-significant predictors were omitted from the model. After running the final HLM, it was observed that following model was significant for all retained level-1 and level-2 predictors:

Level-1 (student level) model:

$$(Y_{ij}) = \beta_{0j} + \beta_{1j} * (CLE_{NEG}) + \beta_{2J} * (SELF_{EFF}) + \beta_{3J} * (EP_{CER}) + \beta_{4J} * (EP\_JUS) + \beta_{5J} * (GOAL\_MA) + \beta_{6J} * (GOAL\_PAV) + r_{ij}$$

Class level (level-2) model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} * (TSELF\_SE)_j + \gamma_{02} * (TEP\_DEV)_j + \gamma_{03} * (CLE\_S\_AG)_j + u_{0j}$$

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

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

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

$$\beta_{4j} = \gamma_{40} + \gamma_{41} * (CLE\_S\_AG)_j + u_{4j}$$

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

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

As similar to the Means as Outcomes Models, the one of the results of the Intercepts and Slopes as Outcomes Model indicated that *student engagement* dimension of teachers' *sense of efficacy (*γ = .103, SE = .047, p < .05), *development* dimension of teachers' epistemological beliefs *(*γ = .118, SE = .044, p < .01), and *shared control* (γ = -.097, SE = .046, p < .05) dimension (aggregated) of the constructivist learning environment were significantly associated with the students' *science achievement* which was tested with the equation β_{0j}.

Testing the equation β_{1j}, β_{2j}, β_{3j}, β_{4j}, β_{5j}, and β_{6j}, the results showed that *student negotiation* (γ = .058, SE = .016, p < .001) dimension of the students' perception of constructivist learning environment, *certainty* (γ = -.065, SE = .015, p < .001) and *justification* (γ = .059, SE = .019, p < .01) dimensions of the students' epistemological beliefs, and *performance avoidance goals* (γ = -.037, SE = .015, p < .05) dimension of students' achievement goals, and students' science self-efficacy were found as significantly associated with the students' *science achievement*. Among these student level variables, certainty and performance avoidance goals were found to be negatively linked to the outcome variable. Moreover, *shared control (*γ = -.038, SE = .018, p < .05) dimension of students' aggregated constructivist learning environment perceptions was found as a mediator for the relationship between *justification* and the science achievement. Table 4.65 presents that final estimation of fixed effects for the students' science achievement obtained from the Intercepts and Slopes as Outcomes Model.

Table 4.65 Final estimation of fixed effects for the students' Science Achievement.

Fixed Effects	Coefficient	SE
Model for Class Means[1]		
Intercept, γ_{00}	-.017	.051
T. Sense of Efficacy-Student Engagement, γ_{01}	.103*	.047
T. Epistemological Beliefs-Development, γ_{02}	.118**	.044
CLE-Shared Control (Aggregated), γ_{03}	-.097*	.046
CLE-Student Negotiation, γ_{10}	.058***	.016
Self-Efficacy, γ_{20}	.050*	.019
Epistemological Beliefs-Certainty, γ_{30}	-.065***	.015
Epistemological Beliefs-Justification, γ_{40}	.059**	.019
CLE-Shared Control (Aggregated), γ_{41}	-.038*	.018
Achievement Goals-Performance Avoidance, γ_{60}	-.037*	.015

[1]Note. The predictors that were significantly resulted in the final models were presented in the table.
**p< .05, **p<.01, ***p<.001*

Overall, results of Intercepts and Slopes as Outcomes Model revealed that students of science teachers with high self-efficacy for student engagement and with the beliefs in the evolving and changing nature of science tend to have higher science achievement scores. However, different from the results of Means as Outcomes Model, *certainty* dimension of teachers' epistemological beliefs was not found in a relationship with students' science achievement. As far as class means are considered regarding students' constructivist learning environment perceptions, the perception that students have opportunities to have a shared role in the class (*Shared Control*) was found to be negatively associated with science achievement.

Similar to the results of Random Coefficient Model, results of Intercepts and Slopes as Outcomes Model suggested that students who perceive to have opportunities communicate with their science teachers in the classroom appeared to have higher science achievement scores. In addition, students with the more sophisticated beliefs in justification of knowledge were found to have higher science achievement scores. On the other hand, students who adopt performance avoidance goals were likely to have lower science achievement level. Different from Random Coefficient Model, results of Intercepts and Slopes as Outcomes Model did not indicate a significant association between science self-efficacy and science achievement

Regarding to the mediation effect of Level-2 variables, the relationship between students' epistemological beliefs (regarding *justification*) and science achievement was weaker in the classroom where students perceive to have a shared role in the class (with respect to class means). Figure 4.7 indicates the results of the HLM analysis on a model for research question 7d. In the Figure 4.7, the variables in the orange boxes are student-level predictors and the variables in the blue boxes are teacher-level or Level-2 variables. The right one (under the "outcomes" heading) is students' outcome variable. Also, the black arrows refer to positive relationships and the red arrows refers negative relationships between student-level predictors and the outcome variables. To indicate the mediation effects, blue arrows were used in the figure. Also, abbreviated variables in a red color like “Shared Control” mediated negatively the relationships. Red colors always refers negative relationships.

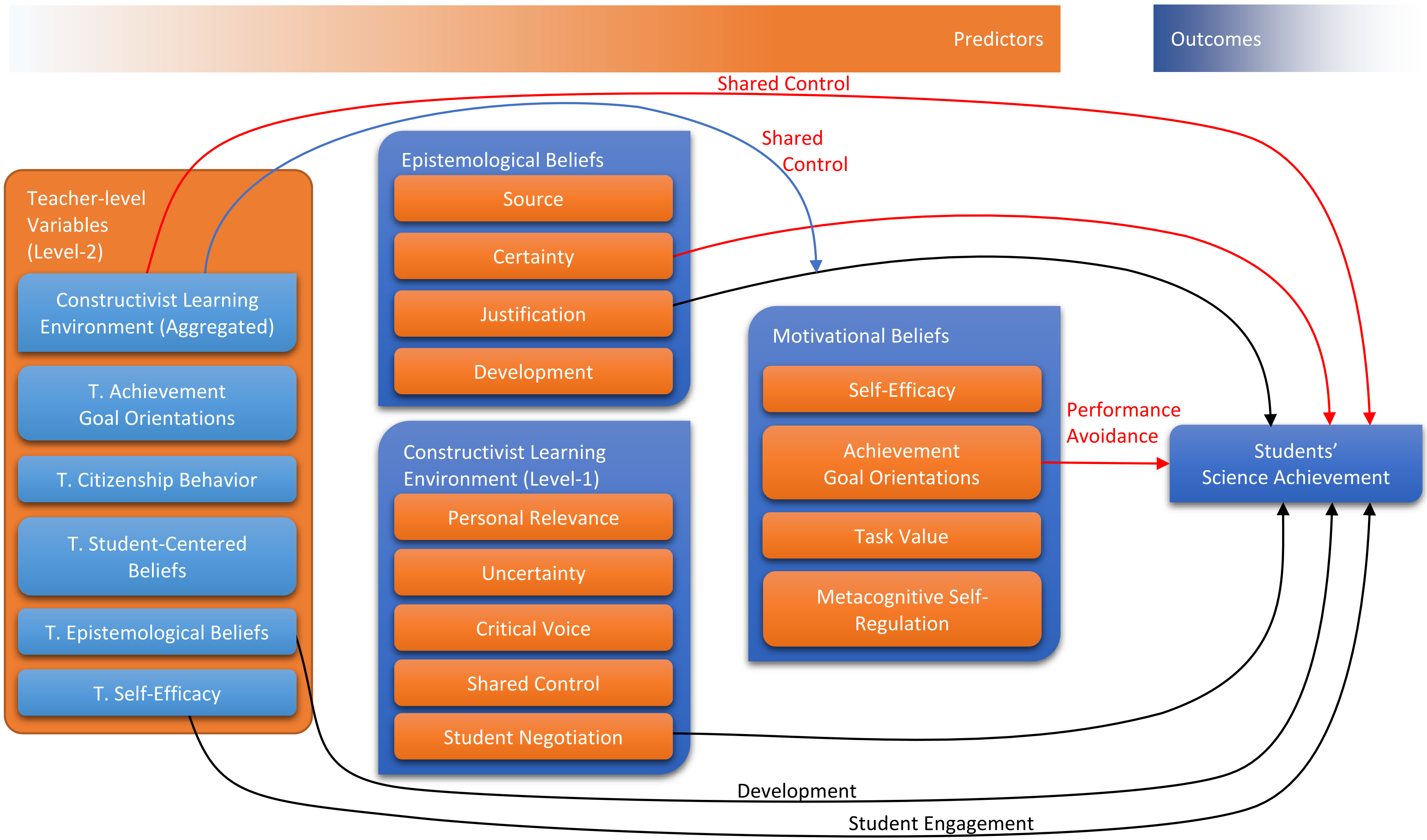


Figure 4.7 The final model based on the results of the HLM analysis for research question 7d.

Finally, the results of the Intercepts and Slopes as Outcomes Model revealed that 11.9% of the variance in the between class difference in mean *science achievement* scores was explained by adding level-2 predictors, but a significant variability still exists among the classes (X^2=1700.56, p<.001). Table 4.66 presents that final estimation of variance components for the students' science achievement as the results of the results of the Intercepts and Slopes as Outcomes Model.

Table 4.66 Final estimation of variance components for students' Science Achievement.

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Intercept				.119	
Class mean, u_{0j}	.330	133	1700.56***		.891
Self-Efficacy, u_{2j}	.013	136	186.91**		.236
Epistemological Beliefs-Justification, u_{4j}	.008	135	164.41*		.147
Achievement Goals-Mastery Approach, u_{5j}	.009	136	171.46*		.159
Level-1 Effect, r_{ij}	.558				

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

4.2.8 The Results of the Research Question 8: Random Coefficient Model for Mediation Effect (Model 1 vs. Model 2)

Following research question was constructed to see the mediation effect of self-regulation variables on the relationship between the other level-1 predictors (the students' perception of constructivist learning environment and epistemological beliefs) and science achievement. In this part, two Random Coefficient Models (Model 1 and Model 2) were tested and compared to investigate the research question 8. To do this, the variable of students' Science Achievement was assigned as outcome variable.

Research Question 8: Are students' self-regulation variables (*Self-Efficacy, Achievement Goals, Task Value, and Metaconginitve Self-Regulation*) mediating the effect of their epistemological beliefs and perception of constructivist learning environment on their science achievement?

In order to address this research question, Model 1 was tested without including students' self-regulation variables i.e. self-efficacy, achievement goals, task value, and metacognitive self-regulation in the model. They were added to regression equation while Model 2 was run. The analyses were done by addressing regression equations for each teachers' class, by computing averages of these classes' intercepts-slopes and all variations. Fixing or not fixing of the association between the outcome variable and the predictor variable are an important stage in testing the Random Coefficient Model. Fixed variation means that the degree of the relationship between the outcome variable and predictor variable does not vary through the classes, whereas random variation means that the degree of the relationship between the outcome variable and the predictor variable varies through the classes. To decide to fix or not to fix, a series of HLM models is tested. Based on the result, the final model is constructed.

Accordingly, the Random Coefficient Model 1 was tested based on the following regression equation:

Level-1 (student level) model:

$$\begin{aligned} Y_{ij} = \ \beta_{0j} + \beta_{1j} * (CLE\_PER) + \beta_{2J} * (CLE\_UNC) + \beta_{3J} * (CLE\_CRI) \\ + \beta_{4J} * (CLE\_SHA) + \beta_{5J} * (CLE\_NEG) + \beta_{6J} * (EP\_SOU) \\ + \beta_{7J} * (EP\_CER) + \beta_{8J} * (EP\_JUS) + \beta_{9J} * (EP\_DEV) \\ + r_{ij} \end{aligned}$$

Level-2 (teacher level or class level) model:

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

…

…

…

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

In these models,

Y_{ij} is the outcome variable (*science achievement*)

β_{0j} is the mean on science achievement scores for each class.

β_{1j} is the differentiating effect of *personal* dimension of the Constructivist Learning Environment Scale (CLES) in class j.

β_{2j} is the differentiating effect of *uncertainty* dimension of the CLES in class j.

β_{3j} is the differentiating effect of c*ritical voice* dimension of the CLES in class j.

β_{4j} is the differentiating effect of *shared control* dimension of the CLES in class j.

β_{5j} is the differentiating effect of *student negotiation* dimension of the CLES in class j.

β_{6j} is the differentiating effect of *source* dimension of students' Epistemological Beliefs Questionnaire (SEBQ) in class j.

β_{7j} is the differentiating effect of *certainty* dimension of students' SEBQ in class j.

β_{8j} is the differentiating effect of *justification* dimension of students' SEBQ in class j.

β_{9j} is the differentiating effect of *development* dimension of students' SEBQ in class j.

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.

Then, the Random Coefficient Model 2 was tested based on the following regression equation:

Level-1 (student level) model:

$$Y_{ij} = \beta_{0j} + \beta_{1j} * (CLE_{PER}) + \beta_{2J} * (CLE_{UNC}) + \beta_{3J} * (CLE_{CRI}) + \beta_{4J} * (CLE\_SHA) + \beta_{5J} * (CLE\_NEG) + \beta_{6J} * (TASK) + \beta_{7J} * (SELF\_EFF) + \beta_{8J} * (MC\_SR) + \beta_{9J} * (EP\_SOU) + \beta_{10J} * (EP\_CER) + \beta_{11J} * (EP\_JUS) + \beta_{12J} * (EP\_DEV) + \beta_{13J} * (GOAL\_MA) + \beta_{14J} * (GOAL\_PA) + \beta_{15J} * (GOAL\_MAV) + \beta_{16J} * (GOAL\_PAV) + r_{ij}$$

Level-2 (teacher level or class level) model:

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

…

…

…

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

In these models,

Y_{ij} is the outcome variable (*science achievement*)

β_{0j} is the mean on science achievement scores for each class.

β_{1j} is the differentiating effect of *personal* dimension of the Constructivist Learning Environment Scale (CLES) in class j.

β_{2j} is the differentiating effect of *uncertainty* dimension of the CLES in class j.

β_{3j} is the differentiating effect of c*ritical voice* dimension of the CLES in class j.

β_{4j} is the differentiating effect of *shared control* dimension of the CLES in class j.

β_{5j} is the differentiating effect of *student negotiation* dimension of the CLES in class j.

β_{6j} is the differentiating effect of students' perception of *task value* in class j.

β_{7j} is the differentiating effect of students' *self-efficacy beliefs* in class j.

β_{8j} is the differentiating effect of students' *metacognitive self-regulation* in class j.

β_{9j} is the differentiating effect of *source* dimension of students' Epistemological Beliefs Questionnaire (SEBQ) in class j.

β_{10j} is the differentiating effect of *certainty* dimension of students' SEBQ in class j.

β_{11j} is the differentiating effect of *justification* dimension of students' SEBQ in class j.

β_{12j} is the differentiating effect of dimension of students' SEBQ in class j.

β_{13j} is the differentiating effect of *mastery approach* dimension of students' Achievement Goal Orientations (AGO) in class j.

β_{14j} is the differentiating effect of *performance approach* dimension of students' AGO in class j.

β_{15j} is the differentiating effect of *mastery avoidance* dimension of students' AGO in class j.

β_{16j} is the differentiating effect of *performance avoidance* dimension of students' AGO in class j.

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.

The second Random Coefficient Model revealed that some level-1 variables that were found as significant predictors of science achievement in the Model 1 were not found as significant in the Model-2. For instance, ***source*** (γ = -.039, SE = .019, p < .05), ***certainty*** (γ = -.046, SE = .022, p < .05), and ***justification*** (γ = .045, SE = .021, p < .05) dimensions of students' epistemological beliefs were significant predictors of the *science achievement* in the Model 1. However, in the second model, they were not found as significant predictors for the outcome variable by including students' *self-regulation variables* (*Source*, γ = -.031, SE = .021, p > .05; *Justification*, γ = .043, SE = .022, p > .05) except for ***certainty*** (γ = -.039, SE = .019, p < .05). Also, students' ***self-efficacy*** (γ = .052, SE = .024, p < .05) was found as a significant predictor in the model 2. It means that students' *self-efficacy* mediated the effect of ***source*** and ***justification*** dimensions of students' epistemological *beliefs* on *science achievement*. Also, adding the other level-1 variables, the random effect of *uncertainty* and *certainty* were removed, but the random effect of *self-efficacy* (X^2= 183.41, *p* < .01) and *source* (X^2= 216.70, *p* < .001) were added to the model. In other words, while students' *self-regulation variables* were controlled, classes did not vary in terms of the slope of *uncertainty* and *certainty*, but vary in terms of the slope of *self-efficacy* and *source*. When the other level-1 variables were added to the model as predictors of *science achievement*, explained variance was decreased by 9.5%. This value was .7 point lower than Model 1. Table 4.67 and 4.68 presents the results of the Random Coefficient Models (Model -1 and Model 2) that was tested for the students' science achievement.

Table 4.67 Final estimation of fixed effects for all dimensions of students' Science Achievement with respect to comparison of Model 1 and Model 2.

	Model 1		Model 2	
Fixed Effects	γ	SE	γ	SE
Model for Class Means				
Intercept	-.028	.053	-.025	.054
CLE-Personal Relevance	.030	.019	.027	.020
CLE-Uncertainty	-.009	.020	-.007	.018
CLE-Critical Voice	.040	.022	.034	.021
CLE-Shared Control	-.013	.018	-.015	.018
CLE-Student Negotiation	.045*	.018	.048*	.018
Epistemological Beliefs-Source	-.039*	.019	-.031	.021
Epistemological Beliefs-Certainty	-.046*	.022	-.039*	.019
Epistemological Beliefs-Justification	.045*	.022	.043	.022
Epistemological Beliefs-Development	.012	.017	.013	.017
Task Value			.012	.022
Self-Efficacy			.052*	.024
Metacognitive Self-Regulation			-.036	.020
Achievement Goals-Mastery Approach			-.015	.019
Achievement Goals-Performance Approach			.004	.018
Achievement Goals-Mastery Avoidance			-.008	.016
Achievement Goals-Performance Avoidance			-.031	.018

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

Table 4.68 Final estimation of variance components for students' Science Achievement with respect to comparison of Model 1 and Model 2.

Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Results for Model 1				.088	
Science Achievement					
Class mean, u_{ij}	.369	136	1868.60***		.890
CLE-Uncertainty, u_{2j}	.007	136	168.57*		.122
CLE-Critical Voice, u_{3j}	.008	136	175.86*		.150
Epistemological Beliefs-Certainty, u_{7j}	.016	136	207.67***		.307
Epistemological Beliefs-Justification, u_{8j}	.015	136	209.71***		.244
Level-1 Effect, r_{ij}	.554				
Random Effects	*Variance Components*	*df*	X^2	R^2	Reliability
Results for Model 2					
Science Achievement					
Class mean, u_{ij}	.372	136	1801.03***		.889
CLE-Critical Voice, u_{3j}	.005	136	173.80*		.104
Self-Efficacy, u_{7j}	.013	136	183.41**		.223
Epistemological Beliefs-Source, u_{9j}	.012	136	216.70***		.261
Epistemological Beliefs-Justification, u_{11j}	.010	136	179.47**		.177
Level-1 Effect, r_{ij}	.549				

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

These finding implied that when students' science achievements are predicted by their epistemological beliefs and perception of constructivist learning environment, it can be said that the students that have less beliefs in a single right answer, beliefs that knowledge is constructed by the authority (e.g., teachers, books) and more beliefs in the role of evidence and evaluating claims for the justification of knowledge (*Justification*), perceive to communicate with their science teachers in the classroom have higher science achievement scores. After including students' self-regulation variables in the model, *source* and *justification* dimensions of epistemological beliefs were not related to science achievement anymore. Moreover, students' self-efficacy was found positively related to science achievement. It can be interpreted that self-regulation variables mediate the relationship between students' epistemological beliefs and science achievement. In other words, among the self-regulation variables only self-efficacy mediate the relationship between epistemological beliefs (i.e. source and justification) and science achievement. On the other hand, none of the self-regulation variables were found to mediate the relationship between constructivist learning environment perceptions and science achievement

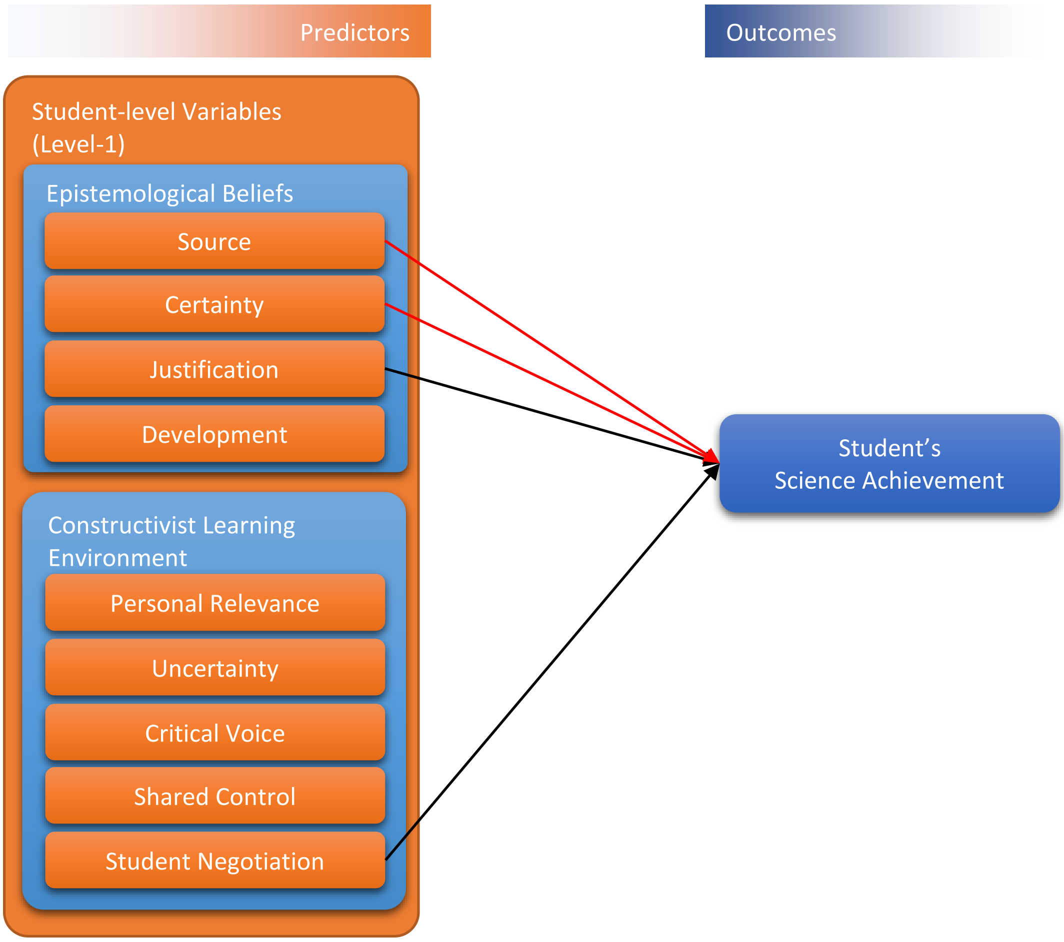


Figure 4.8 Model-1 based on the results of the HLM analysis for research question 8.

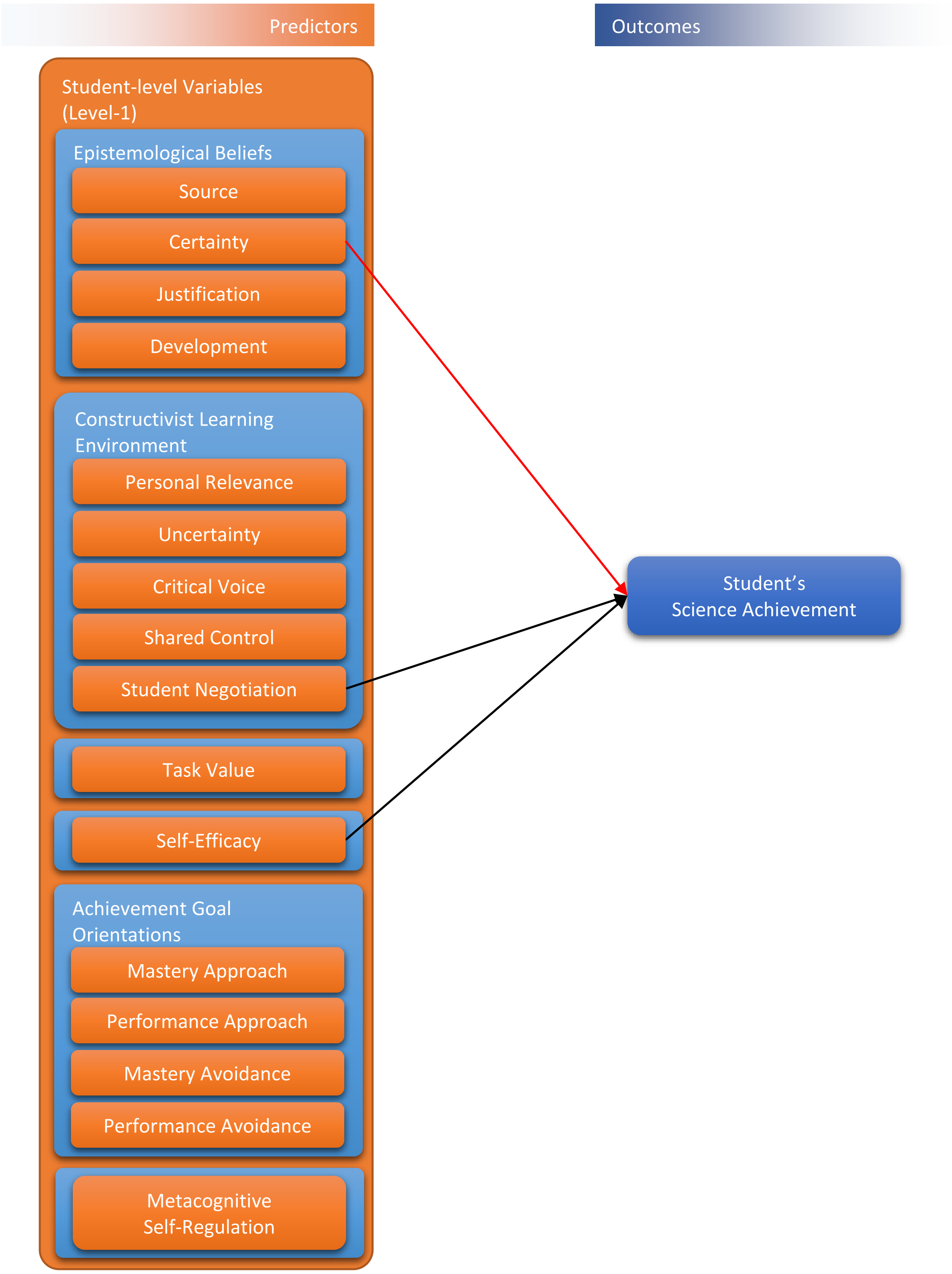


Figure 4.9 Model-2 based on the results of the HLM analysis for research question 8.

CHAPTER V

DISCUSSION AND CONCLUSION

This chapter devoted to discussion of the results followed by the conclusions, implications, limitations, and recommendations pertaining the current dissertation.

5.1 Discussion of the Results

Eight main questions and their corresponding sub-questions investigated by constructing 17 One-way Random Effect ANOVA models, 17 Means as Outcomes Models, 14 Random Coefficient Models, and 13 Intercepts and Slopes as Outcomes Models by using Hierarchical Linear Modeling (HLM) analysis. Discussion regarding the result of each analysis were presented in the Following section. First, teachers' variables that predict students' perception of constructivist learning environment were discussed.

5.1.1 Predicting Constructivist Learning Environment

In this research question, it was investigated how well students' perception of Constructivist Learning Environment (Personal Relevance, Uncertainty, Critical Voice, Shared Control, Student Negotiation) were predicted by teachers adopted Epistemological Beliefs, Self-Efficacy, and Achievement Goals. HLM analyses with five dimensions of Constructivist Learning Environment indicated that significant variation did exist among science classes in students' perception of constructivist learning environment. Five Intraclass Correlation Coefficient (ICC) were computed to assess the percent of variance in each constructivist learning environment dimension. ICCs revealed that 9% of total variability in *Personal Relevance*, 5% of total variability in *Uncertainty*, 5% of total variability in *Critical Voice*, 7% of total variability in *Shared Control*, and 4% of total variability in *Student Negotiation* can be attributed to teacher or class level variables. These results indicated that there were significant variations among the classes in students' responses to each dimension of constructivist learning environment. Thus, it was appropriate to conduct multilevel analyses for this data set. Accordingly, to explore the teacher or class level predictors accounting for between class variations in students' perception of the five dimensions of constructivist learning environment, five Means as Outcomes Models were built. Recalled that Teacher level variables were Self-Efficacy, Achievement Goal Orientations, and Epistemological Beliefs. Overall findings were presented in Figure 5.1.

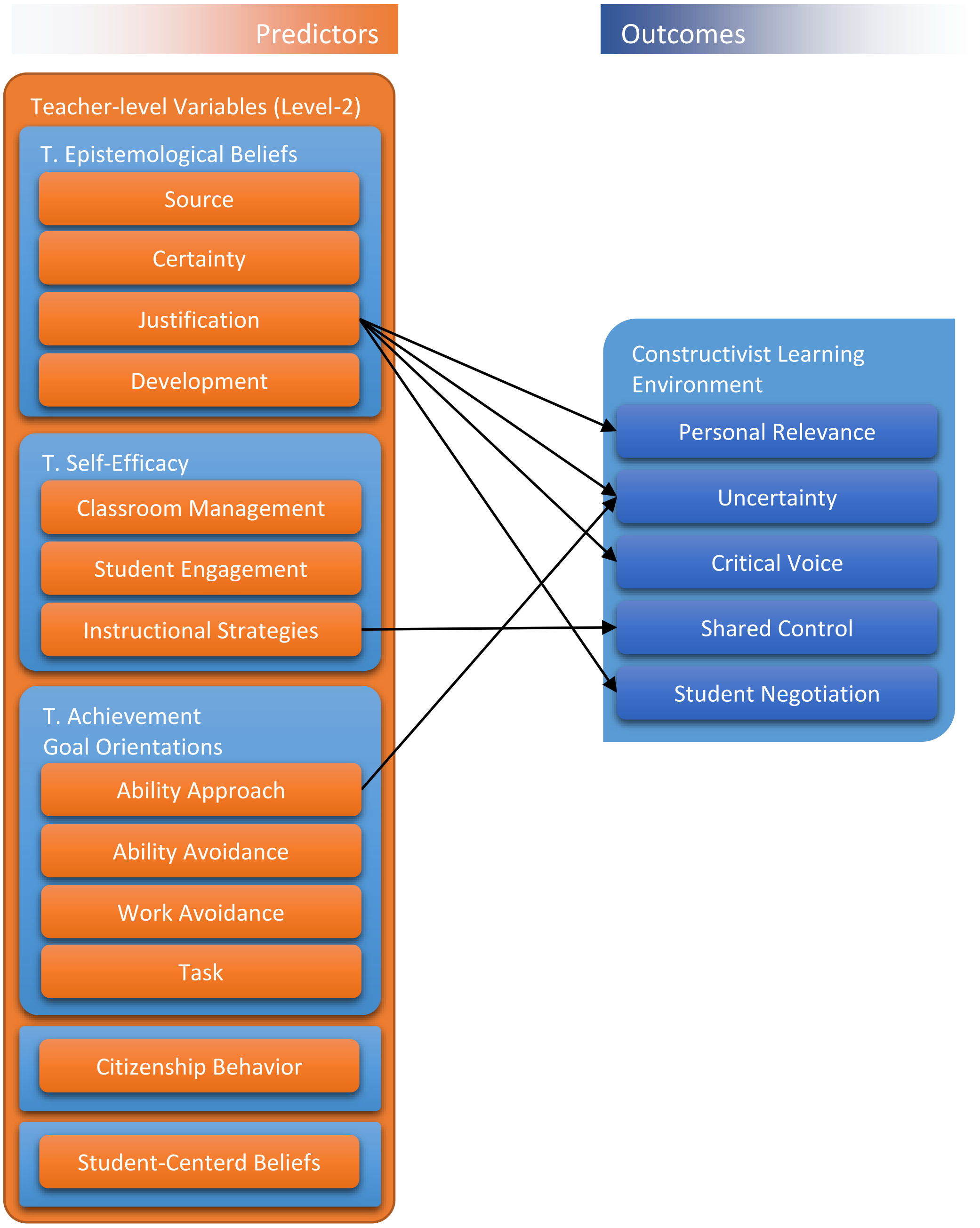


Figure 5.1 The final model based on the results of the HLM analysis for predicting Constructivist Learning Environment.

Among Epistemological Beliefs dimensions, only Justification of knowledge was found as a predictor of CLE (except for Shared Control dimension) (see Figure 5.1). It means that students of science teachers with sophisticated beliefs in justification dimension, which concerns the role of experiments and the use of data to support arguments, tend to perceive their learning environments as presenting adequate chances for them to relate science to real world, to practice the construction of scientific knowledge, to question what is going on in the lesson, and to communicate with their teachers in the classroom, but not to participate in planning, conducting, and assessing of learning. Science teachers with sophisticated beliefs in justifying of knowledge are expected to be more aware of the importance of constructivist learning environments that provide opportunities to collect data, making observations, comparing findings from different studies, and making claims using evidence. Thus, it was also expected that the students in this class supported with these activities are more likely to perceive their class to learn more about the world outside of school, to understand provisional status of scientific knowledge, to ask their teachers why they learn this, and to discuss with their teachers and classmates about an idea. On the other hand, any relation was not found between science teachers' epistemological beliefs in Source, Certainty, and Development. It appeared that science teachers had sophisticated beliefs in development (M = 4.02), but moderate scores in beliefs in source (M = 2.86) and certainty (M = 2.79). It revealed that science teachers may have some difficulties to mirror their epistemological beliefs into their teachings. To our knowledge, there was not any empirical study relating teachers' epistemological beliefs to their students' perception of learning environment, but some available studies claimed that the teachers' epistemological beliefs may influence their teaching strategies (Addy, 2011). If teachers tend to hold tentative beliefs in construction of knowledge, they may tend to create a richer teaching and learning environment such as providing materials, doing experiments, using students-centered strategies, and give chances to their students to better learning (Hashweh, 1996). Thereby, it is expected that, students taught by these teachers are likely to perceive more positive and constructivist learning environment. As stated before, there was no any known study in the literature about the influence of teachers' epistemological beliefs on students' outcomes, so more studies are needed examining these relationships to understand and interpret of them in deeply. Further studies should be conducted to reveal teachers' epistemological beliefs and how these beliefs are reflected in their classroom practices in term of creating constructivist learning environment.

Regarding teachers' achievement goals, the findings indicated that Uncertainty dimension of constructivist learning environment was predicted by teachers' ability approach goals in addition to justification dimension of teachers' epistemological beliefs (see Figure 5.1). It means that science teachers with higher levels of ability approach goals appeared to have students who feel free to practice the construction of scientific knowledge. Teachers that want to demonstrate superior teaching abilities support students to construct their scientific knowledge. That may be related to competitive settings in Turkish school in which prepare students to get higher scores in national exam. Teachers working in competitive school settings may want to exhibit superior teaching abilities by providing opportunities constructing of their scientific knowledge to be successful in class and school. On the other hand, teachers' mastery (task) goals, ability-avoidance goals, and ability-avoidance goals were not found as correlated with any dimension of CLES. Indeed, teacher had high level of mastery goals (M = 4.31) and moderate ability-avoidance (M = 3.04) and work-avoidance goals (M = 2.39). These findings may be an indicator for that science teachers' achievement goals do not translate to their implementation of instructional strategies, because their goals except for ability-approach were not correlated with students' learning environment perceptions. Butler and Shibaz (2008) found that teachers' mastery goal adoptions were positively associated with students' perception of teacher support and lower levels of perceived teacher inhibition, whereas ability avoidance goals were associated with negative instructional practices. Thus, the findings of the present study contradict to existing literature. Since there is so few studies to investigate teachers' achievement goals on students' perception of learning environment, the findings of the present study are not comparable with any other studies. Therefore, more studies are needed examining these relationships to understand deeply and interpret of them.

Regarding teachers' self-efficacy, the findings also revealed that only Shared Control dimension of constructivist learning environment was predicted by instructional strategies dimension of teachers' sense of efficacy (see Figure 5.1). This result implied that students of science teachers who believe their ability to use instructional strategies effectively are tended to feel themselves to have a shared role in class. Highly confident teachers regarding use of different instructional strategies to respond their students' needs or course context tend to enrich the learning environment in classroom to enhance participation of students to decision making process and to engage them in cooperatively working with classmates. This finding supports the idea that teachers' beliefs, such as self-efficacy in instructional strategies, have a valuable effect on teacher's planning and teaching strategies (Woolfolk Hoy, Hoy, & Davis, 2009). On the other hand, teachers' self-efficacy in Classroom Management and Student Engagement were not found as significant predictors of any dimensions of CLES. It may be related to teachers' teaching strategies. In other words, teachers may use strict management strategies to control classroom and do not encourage their students adequately to support their learning. This findings were not consistent with the previous research that teachers with high sense of efficacy create supportive and positive learning environment in classroom (Guo et al., 2010; Guo et al., 2012, Woolfolk & Hoy, 1990; Woolfolk Hoy, Hoy, & Davis, 2009; Yerdelen, 2013). Examining the nature of teachers' classroom management techniques and behaviors to engage students in learning environments may warrant further research to better understand the relationship between teachers' self-efficacy and constructivist learning environment perceptions.

In this study, it was expected that other dimensions of teachers' self-efficacy and teachers' mastery goal adoptions were positive and significant predictors of students' learning environment perceptions (Butler, 2007; Butler & Shibaz, 2008; Woolfolk & Hoy, 1990; Woolfolk Hoyet al., 2009). However, the findings of the study did not found any correlation among them. It may be supported with low values in the explained variances that were accounted teacher variables in these models. These findings support Yerdelen (2013) that stated that teachers' personal characteristics were not as high as suggested by some theoretical researchers that support powerful influences of teachers' beliefs.

5.1.2 Predicting Students' Epistemological Beliefs

HLM analyses with four dimensions of Epistemological Beliefs Questionnaire indicated that significant variation did exist among science classes in students' epistemological beliefs. Four Intraclass Correlation Coefficient (ICC) were computed to assess the percent of variance in each epistemological beliefs dimension. ICCs revealed that 8% of total variability in *Certainty*, 4% of total variability in *Development*, 6% of total variability in *Justification*, and 8% of total variability in *Source* can be attributed to teacher or class level variables. These results indicated that there were significant variations among the classes in students' responses to each dimension of epistemological beliefs. Thus, it was appropriate to conduct multilevel analyses for this data set. Accordingly, Intercepts and Slopes as Outcomes Model was tested to investigate which teacher level variables (Self-Efficacy, Achievement Goal Orientations, Epistemological Beliefs, Student-Centered Beliefs and Practices, Individual Citizenship Behavior, and aggregated students' perception of Constructivist Learning Environment) influence the effect of student level variables (dimensions of Constructivist Learning Environment) on the students' epistemological beliefs. For the specified purpose, the variables that were determined by testing the Random Coefficient Models were used as level-1 (student level) predictors. Then, the variables that were determined by testing the Means as Outcomes Models were added to the intercepts and to significantly random varied level-1 predictors as level-2 (teacher or class level) predictors. This was applied for each dimensions of Epistemological Beliefs, which are certainty, development, justification, and source. Overall findings were presented in Figure 5.2.

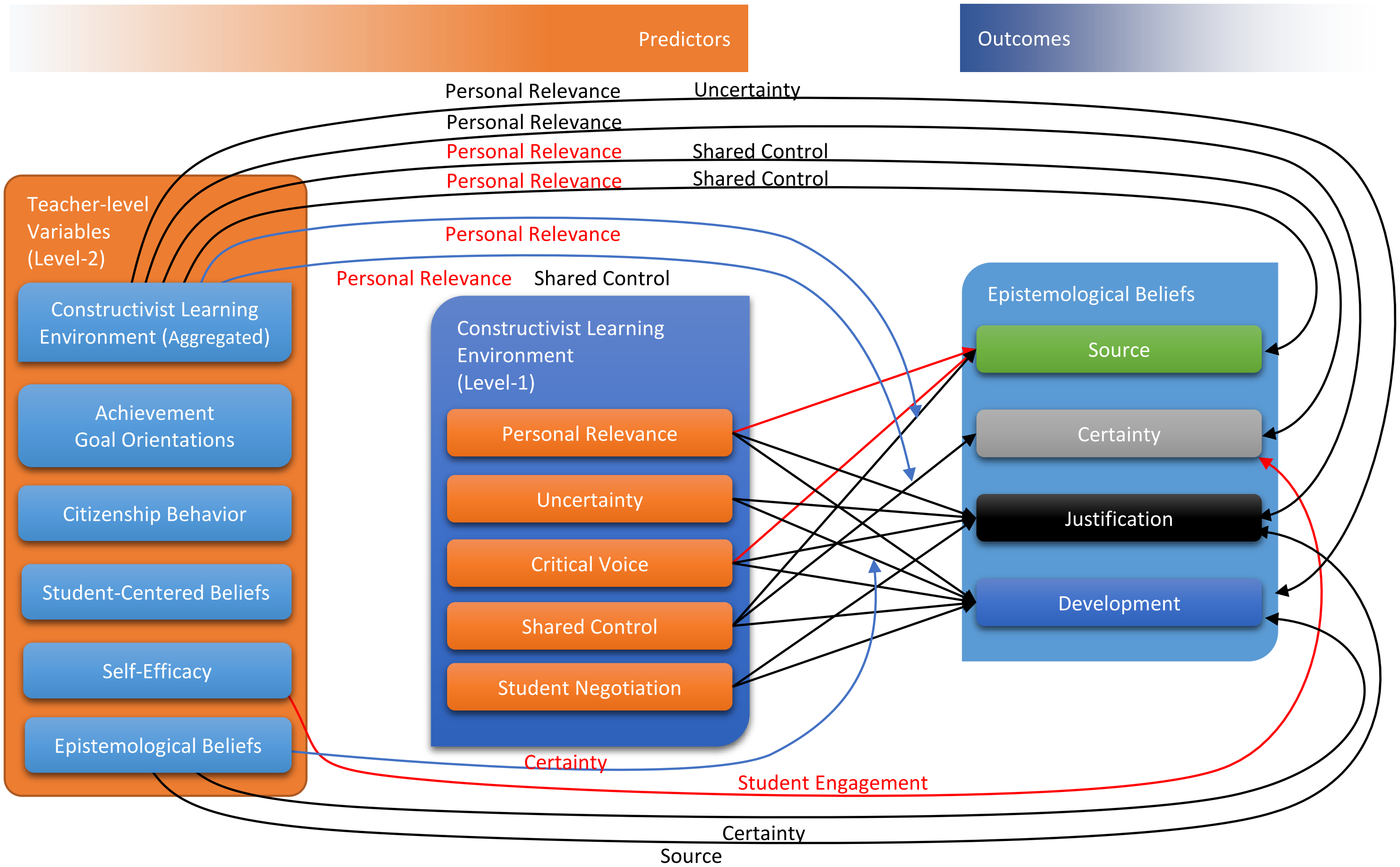


Figure 5.2 The final model based on the results of the HLM analysis for predicting Students' Epistemological Beliefs.

At individual level, it was proposed that students' perceptions of constructivist learning environment influence their epistemological beliefs. The results of HLM analyses revealed that, as proposed, students' perception of constructivist learning environment was associated with their epistemological beliefs. More specifically, all dimensions of CLES except for Shared Control were found to be positively related to Justification dimension. Also, all dimensions of CLES were positively related to Development dimension. According to findings, students who perceive that they have opportunities to relate science to real world, practice the construction of scientific knowledge, question what is going on in the science class freely, communicate with their science teachers in the classroom and have a shared role in the class (for only Development dimension), were more likely to hold tentative beliefs in justifying and development of knowledge. On the other hand, Source dimension of Epistemological Beliefs was negatively predicted by Personal Relevance and Critical Voice dimensions of CLES, but positively predicted by Shared Control dimension. Also, Certainty dimension was also positively associated with Shared Control dimension. These findings suggested that students with the perception that they have opportunities to relate science to real world and question what is going on in the lesson freely did not tend to believe in knowledge belong to external authorizes such as teachers. Thus, these students appeared to have sophisticated beliefs concerning source dimension. However, students who feel to have a shared role in the class had naïve epistemological beliefs thinking that knowledge belong to external authorizes and there are certain answers of scientific questions. This finding can be partly explained by the range of scores on Shared Control sub-scale. The scores on this sub-scale ranged from 3.08 to 4.10 with a mean of 3.08, which was the lowest sub-scale mean score on the CLES. Therefore, it appeared that student participants of the study had a less positive perceptions of the Shared Control scale than other scales and Shared Control scores may not be a good representative of full range of the possible values. In the present study, low mean score obtained from Shared Control scale compared to other scale can be attributed partly to classroom practices in which learning activities are generally designed, planned, and managed by science teachers in Turkey. Turkish teachers rarely invite their students to take responsibility in the decision making process (Ozkal et al., 2009). Also, it is important to note that since there can be some other factors, such as familial and social-cultural, affecting students' epistemological beliefs and these factors may interrelate with each other getting different findings in different context, the results of the present study should be interpreted with caution. This consideration may warrant further research.

Similar results that support the positive correlation between constructivist learning environment perception and tentative epistemological beliefs were found at class level for predicting all dimensions of Epistemological Beliefs. For instance, if students as a class were likely to feel to have opportunities to relate science to real world, they tended to have tentative epistemological beliefs in all dimensions of Epistemological Beliefs. Also, positive perception about practicing the construction of scientific knowledge in class was associated with sophisticated beliefs in changing and developing knowledge. On the contrary, perception about having a shared role in the class appeared to be linked to naïve epistemological beliefs that knowledge belongs to external authorizes and there are certain answers of scientific questions. These findings were also supported by mediation effects of aggregated Constructivist Learning Environment. For example, the relationships of Shared Control perception with Source and Certainty dimensions were weaker in the classroom where students perceive to have opportunities to relate science to real world in the class, but stronger for the students who perceive to be free to have a shared role in the class.

In general, the findings of the present study are consistent with earlier studies that found positive relationships between students' sophisticated epistemological beliefs and perceptions of constructivist learning environment (e.g. Tsai, 2000; Ozkal et al., 2009). For instance, the findings of Tsai's (2000) study revealed that students who hold epistemological beliefs toward constructivist views of science tended to choose constructivist learning environments. Similarly, Ozkal et al. (2009) found that if students perceive that they have opportunities to find personal relevance in their science classes, to express concern about their learning, to view science as ever changing and interact with each other to enhance comprehension, they tended to have tentative beliefs. Considering the findings of the present study and earlier studies, teachers are suggested to provide a constructivist learning environment that help their students to construct their knowledge through experimentation, observation, questioning, and negotiations with others. Indeed, Ozkal et al. (2009) stated that science teachers can help students realize that scientific knowledge is evolving and developing to change by providing more constructivist learning environment. However, the present study demonstrated that students' thinking about the benefit of sharing role in decision making process of conducting and assessing of learning were negatively correlated with tentative beliefs about the nature of knowledge. As explained in the discussion part related to students epistemological beliefs in relation to their constructivist learning environment perceptions, this finding may be due to science teachers' practices which do not give much emphasis on shared control in their classes. But, this explanation may be speculative and needs further investigation.

Another findings of the present study indicated that students of teachers with high self-efficacy for engaging students in learning science effectively were unlikely to have naïve beliefs in Certainty. In the literature, there is no any study examining the effects of teachers' self-efficacy on students' epistemological beliefs, but this finding can be supported by Woolfolk and Davis's (2005) research. In that study, it was claimed that teachers with a strong self-efficacy beliefs use powerful and potentially difficult methods such as inquiry and small group work to support their students learning. If teachers provide their students with opportunities to actively engage in the learning process participating in various student-centered inquiry-based activities, students may feel less dependent on external authorities.

On the other hand, concerning the relationship between science teachers' and their students' epistemological beliefs, the results indicated unexpected findings. For instance, if teachers have sophisticated beliefs in source of knowledge and certainty knowledge, their students tend to have naive beliefs in the corresponding dimensions as well as in justification and development dimensions. However, based on the previous literature, it was predicted that students of science teachers with sophisticated epistemological beliefs are also likely to hold sophisticated epistemological beliefs. For example, Hasweh (1996) and Luft and Roehrig (2007) claimed that teachers' epistemological beliefs are correlated with students' beliefs about construction of knowledge by the way of their teaching strategies. According to Hasweh (1996), teachers who hold tentative beliefs in construction of knowledge are more likely to create a richer teaching and learning environment such as providing materials, doing experiments, using students-centered strategies, and give chances to their students to better learning. As a result, their students tend to hold sophisticated epistemological beliefs. Thus, the negative relation found between science teachers' and their students' epistemological beliefs was unexpected. It appears that science teachers have difficulty in translating their epistemological beliefs into their instruction. It seems that holding sophisticated epistemological beliefs does not ensure implementation of instructional strategies to help students develop sophisticated beliefs. However, this point needs further investigation. Further studies should be conducted to reveal teachers' epistemological beliefs and how these beliefs are reflected in their classroom practices in term of developing sophisticated EB in their students. On the other hand, if teachers have naïve beliefs in certainty of knowledge, the relationship between students' perception of constructivist learning environment regarding Uncertainty and Development dimensions of epistemological beliefs was weaker.

5.1.3 Predicting Students' Self-Efficacy

HLM analyses with Self-Efficacy beliefs indicated that significant variation did exist among science classes in students' self-efficacy beliefs. Intraclass Correlation Coefficient (ICC) was computed to assess the percent of variance in self-efficacy beliefs outcome. ICC revealed that 6% of total variability in students' self-efficacy beliefs can be attributed to teacher or class level variables. These results indicated that there were significant variations among the classes in students' responses to self-efficacy beliefs items. Thus, it was appropriate to conduct multilevel analyses for this data set. Accordingly, Intercepts and Slopes as Outcomes Model was tested to investigate which teacher level variables (Self-Efficacy, Achievement Goal Orientations, Epistemological Beliefs, Student-Centered Beliefs and Practices, Individual Citizenship Behavior, and aggregated students' perception of Constructivist Learning Environment) influence the effect of student level variables (Epistemological Beliefs and Constructivist Learning Environment) on the students' self-efficacy beliefs. For the specified purpose, the variables that were determined by testing the Random Coefficient Models were used as level-1 (student level) predictors. Then, the variables that were determined by testing the Means as Outcomes Models were added to the intercepts and to significantly random varied level-1 predictors as level-2 (teacher or class level) predictors. Overall findings were presented in Figure 5.3.

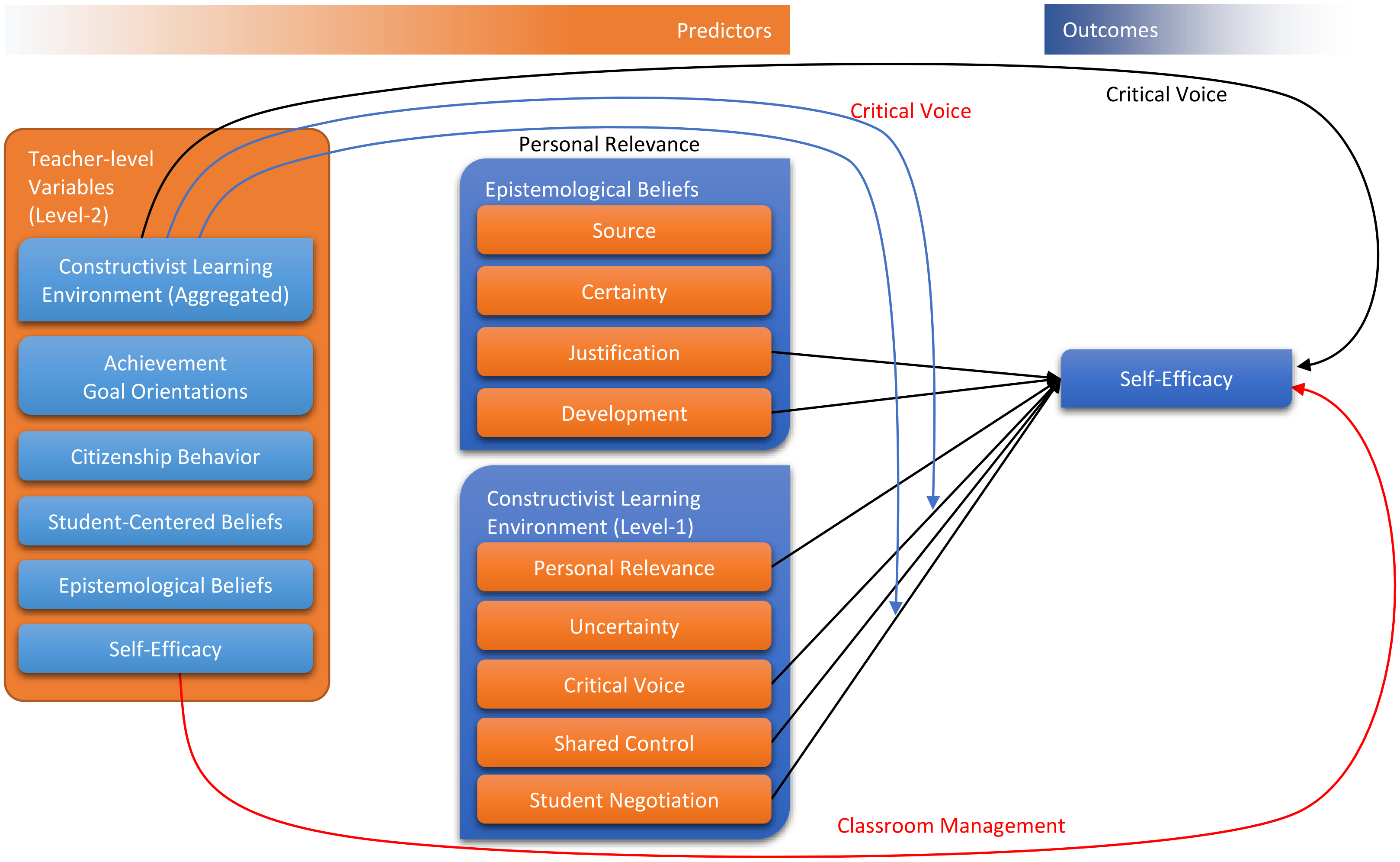


Figure 5.3 The final model based on the results of the HLM analysis for predicting Students' Self-Efficacy.

The results of the study indicated that among student-level variables, Personal Relevance, Critical Voice, Shared Control, and Student Negotiation dimensions of Constructivist Learning Environment were positively associated with students' science self-efficacy (see Figure 5.3). It means that if students perceive to have opportunity to relate what they learn in science classes to their real life, question what is going on in the lesson freely, participate in planning of learning, and involve with other students and teachers in assessing new ideas appeared to have higher levels of confidence in doing well in science. Similar to individual level, regarding class means of students' perception of Constructivist Learning Environment, results revealed that students who perceive to question what is going on in the science lesson freely are likely to have higher confidence about their learning capabilities. Moreover, regarding to the mediation effect of Level-2 variables, the relationship between students' perception of constructivist learning environment (regarding Critical Voice) and self-efficacy beliefs was weaker for the students who perceive to have opportunity to question what is going on in the science lesson freely (Critical Voice with respect to class means) (see Figure 5.3). In other words, when class average perceptions of critical voice were high, individually perception of critical voice has less effect on students' self-efficacy. On the other hand, the relationship between students' perception of constructivist learning environment (regarding Student Negotiation) and self-efficacy beliefs was stronger in the science classrooms where students perceive to have opportunities to relate science to real world (Personal Relevance with respect to class means). It means that class average of personal relevance empower the positive relationship between student negotiation and self-efficacy. All of these results are in line with the expectation of the study and also consistent with earlier studies that found positive relationships between students' perceptions of learning environment and their self-efficacy (e.g. Arisoy, 2007; Sungur & Gungoren, 2009; Yerdelen, 2013). For instance, students' self-efficacy beliefs in learning science tend to be higher when they perceive learning environment as supportive in relating science to real world, greater encouragement of their critical ideas and suggestions in their classroom learning, because constructivist learning environments provide opportunities to deal with motivating tasks and feel autonomous and emphasize personal efforts. Thus, students are more likely to perceive that they are capable of doing well in science classes.

Also, the students who have more tentative beliefs in justification of knowledge and development of knowledge were found to have higher levels of science self-efficacy (see Figure 5.3). These finding implied that if students have tentative beliefs in justifying and development of knowledge, they feel them more confident about their capacity to learn science. This finding was in line with the existing literature that investigated these relations (Chen, 2012; Chen & Pajares, 2010; Paulsen & Feldman, 1999). For example, Chen (2012) found that peers with beliefs that scientific knowledge is tentative and constantly evolving were likely to feel them to succeed in science, but, different from the present study, peers with beliefs that there is only one correct answer to scientific questions do not possess high level of self-efficacy to learn science. Similarly, Chen and Pajares (2010) found that students' self-efficacy beliefs were positively correlated with tentative beliefs in justifying knowledge and negatively correlated with certainty of knowledge. In line with expectations of the present study and the related literature, if students realize that scientific knowledge is evolving and changing and have sophisticated beliefs about the role of experiments and in justifying knowledge, they tend to be more self-efficacious in science. Contrary to all of these findings, no correlation was found between naïve beliefs in source and certainty dimensions and self-efficacy. However, it was predicted that students with sophisticated beliefs in source and certainty have higher levels of self-efficacy because self-efficacious students tend to be actively involved in the learning process constructing the knowledge in their minds. Thus, they are less likely to believe that knowledge resides in external authorities and scientific knowledge does not change. In order to provide plausible explanations for the non-significant relationship found between these two dimensions of epistemological beliefs and self-efficacy, the sources of students' science self-efficacy should be examined deeply in the future studies. For example, some students with the belief that teachers are omniscient authorities and whatever written in the science textbooks are correct and do not change may also feel more confident to learn science. Thus, this point should elaborated in the future studies.

Additionally, at class level, science teachers with higher levels of Self-Efficacy for Classroom Management tend to have students who are less self-efficacious in science (see Figure 5.3). This finding contradicts with Woolfolk Hoy and Davis's (2005) claim that teachers' sense of efficacy are positively related with students' self-efficacy. This finding can be explained by classroom management strategies used by the teachers. Teachers who have self-efficacy for classroom management may tend to utilize hard management strategies that enforce and restrict students to learn and to act better. These might be resulted by lower confidence in learning science for students. Yerdelen (2013) found, similarly, negative correlation between teacher efficacy for Classroom Management and Task Orientation dimension of classroom learning environment perception. She related it with teachers' strict behaviors in classroom management. At this point, it should be noted that this explanation is speculative and should be supported by qualitative data collection procedures such as observations and interviews and by investigating the management strategies that Turkish science teachers use to control their students in the classroom.

5.1.4 Predicting Students' Achievement Goal Orientations

HLM analyses with four dimensions of Achievement Goal Orientations indicated that significant variation did exist among science classes in students' achievement goals. Four Intraclass Correlation Coefficient (ICC) were computed to assess the percent of variance in each achievement goal orientation dimension. ICCs revealed that 8% of total variability in mastery approach goals, 4% of total variability in performance approach goals, 4% of total variability in mastery avoidance goals, and 5% of total variability in mastery avoidance goals can be attributed to teacher or class level variables. These results indicated that there were significant variations among the classes in students' responses to each dimension of achievement goal orientations. Thus, it was appropriate to conduct multilevel analyses for this data set.

Accordingly, Intercepts and Slopes as Outcomes Model was tested to investigate which teacher level variables (Self-Efficacy, Achievement Goal Orientations, Epistemological Beliefs, Student-Centered Beliefs and Practices, Individual Citizenship Behavior, and aggregated students' perception of Constructivist Learning Environment) influence the effect of student level variables (Epistemological Beliefs and Constructivist Learning Environment) on the students' achievement goals. For the specified purpose, the variables that were determined by testing the Random Coefficient Models were used as level-1 (student level) predictors. Then, the variables that were determined by testing the Means as Outcomes Models were added to the intercepts and to significantly random varied level-1 predictors as level-2 (teacher or class level) predictors. This was applied for each dimensions of Achievement Goal Orientations, which are Mastery Approach Goals, Performance Approach Goals, Mastery Avoidance Goals, and Performance Avoidance Goals. Overall findings were presented in Figure 5.4.

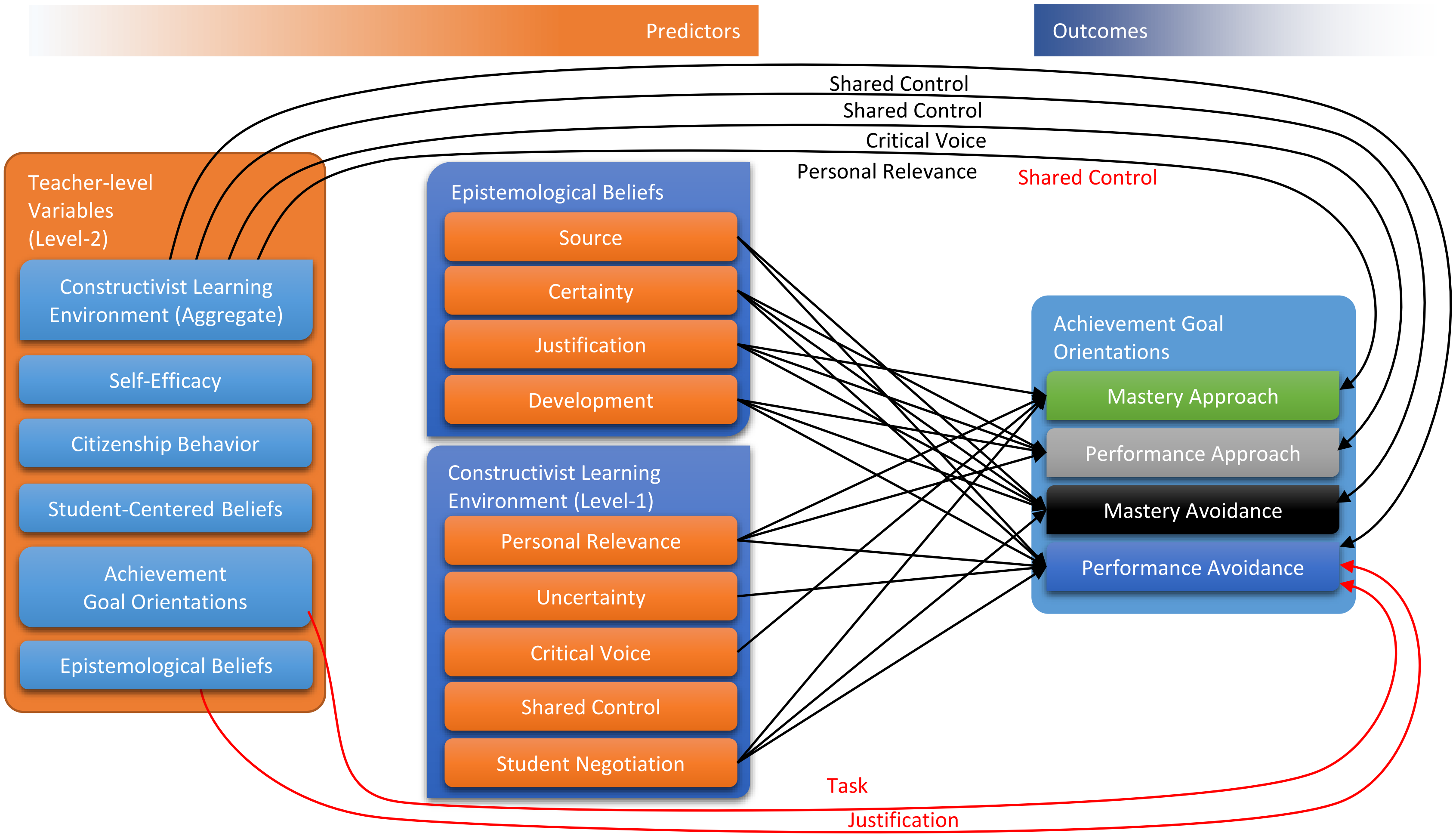


Figure 5.4 The final model based on the results of the HLM analysis for predicting Students' Achievement Goal Orientations.

The results with respect to student-level predictors indicated that Justification dimension of Epistemological Beliefs, Personal Relevance, Critical Voice, and Student Negotiation dimensions of Constructivist Learning Environment were positively related to *Mastery Approach* dimension of students' Achievement Goal Orientations (see Figure 5.4). Accordingly, students who have the perception that they have opportunities in their science classes to relate science to real world, to question what is going on in the lesson freely, and to communicate with their teachers in the classroom tend to set goals as mastering task. As far as class means are concerned regarding students' perception of constructivist learning environment, students tend to expend effort to learn and master on a task when they perceive their science learning environment connected with their everyday experiences. These findings are not surprising and in line with the previous research that indicated the considerable predictive power of learning environment in explaining students' mastery goals (Arisoy, 2007; Kizilgunes et al., 2009; Lau et al., 2008; Sungur & Gungoren, 2009; Yerdelen, 2013). Students' mastery goals can be supported by positive perception in classroom structures providing constructivist learning environment, such as collecting data, making observations, comparing findings from different studies, and making inferences using evidence. Students taught in these class may be likely to orient them to adopt mastery goals. They tend to take more difficult tasks, use effective learning strategies, and expend extra energy to learn better. On the other hand, at class level, the perception that students have opportunities to have a shared role in the class were negatively correlated with mastery approach goals. The results of the descriptive analyses indicated that class' perceptions of participation in planning, conducting, and assessing of learning were low compared to other dimensions of CLES. Although teachers invite their students to participate to design, plan, and conduct the classroom practices, students may not participate activities in science class. Thus, in addition to teacher variables, some familial and social-cultural factors related students may be examined to deeply understand the affecting students' perceptions of teachers' efforts, which indeed may be not adequate, and effects on their mastery goal adoptions. Regarding students' Epistemological Beliefs, mastery approach goals were associated positively with sophisticated beliefs in Justification of Knowledge (see Figure 5.4). Students who had sophisticated beliefs in justifying of knowledge like it comes from reasoning, thinking, and experimenting considered learning as a valuable goal. This finding is an expected result and in line with previous research results that claimed that sophistication of epistemological beliefs are positively correlated with mastery goal adoption (Cavallo et al., 2003; Hofer, 1994; Kizilgunes et al., 2009; Paulsen & Feldman, 1999; Schutzet al., 1993).

Regarding *Performance Approach* goals, the results with respect to student-level predictors indicated that Certainty, Justification, and Development dimensions of Epistemological Beliefs and Personal Relevance dimension of Constructivist Learning Environment were positively related with Performance Approach dimension of students' Achievement Goal Orientations (see Figure 5.4). Accordingly, students with the perception that they have opportunities to relate science to real world in their science classes appeared to adopt performance approach goals. As far as class means are concerned regarding students' perception of constructivist learning environment, it was found that students who perceive to opportunities to question what is going on in the lesson freely are likely to hold performance approach goals in learning science. Students who are adopted with performance approach goals compare their performance with other students' performance, try to be looking superior, and try to beat classmates in science learning. Thus, they may want to exhibit their abilities of relating learnings to out-of-schools and be interested in asking their teachers "why do I have to learn this?". Church et al. (2001) found that providing opportunities students for improvement such as doing various and effective learning activities facilitated to enhance performance-approach goals. Yerdelen (2013) indicated that performance approach goals were positively associated with Student Cohesiveness, Task Orientation, and Equity. These studies claimed that positive learning environment, providing same learning opportunities, cohesive classroom environment may support students to exhibit performance approach adopted goals. Moreover, regarding epistemological beliefs, students' with sophisticated beliefs in justification of knowledge and development of knowledge, and the naïve belief that scientific knowledge is certain were also found to hold performance approach goals at higher levels. Kizilgunes et al. (2009) found that if students had sophisticated beliefs in certainty and development of knowledge, but naïve beliefs in source and justification of knowledge, they were more likely to have higher levels of performance goals in their learning. This findings support the results of the present study.

Mastery Avoidance dimension was significantly predicted by Student Negotiation dimension of CLES in individual level (see Figure 5.4). These findings implied that the students who perceive that they are likely to communicate with their teachers in the science classroom appeared to set their goals as avoiding from misunderstanding and not be able to mastering the task. At the class-level, Shared Control was positive predictor of Mastery Avoidance dimension. It means that students who perceived to have a shared role in the class appeared to set their goals as avoiding from misunderstanding and not be able to mastering the task. Indeed, students may interact and involve with their classmates and teachers in assessing a new idea and participate in decision making process to avoid doing worse than they had previously. Thus, they may set mastery avoidance goals to their learning. On the other hand, mastery avoidance dimension was significantly predicted by all dimensions of students' Epistemological Beliefs. Students who hold naïve epistemological beliefs in Certainty and Source dimensions and tentative epistemological beliefs in Justification and Development appeared to set their goals as avoiding from misunderstanding and not be able to mastering the task. Also, regarding *Performance Avoidance* goals, the results with respect to student-level predictors indicated that Source, Certainty, and Development dimensions of Epistemological Beliefs and Personal Relevance, Uncertainty, and Student Negotiation dimensions of Constructivist Learning Environment were positively related to Performance Avoidance Goals (see Figure 5.4). Accordingly, students with the perception that they relate science to real world, practice the construction of scientific knowledge, and communicate with their teachers in the science classroom are found to adopt performance avoidance goals in learning science. Aggregated students' perception of constructivist learning environment, teachers' Achievement

Goals, and teachers' Epistemological Beliefs significantly predicted to Performance Avoidance dimension. It means that level of perception that students have opportunity to have a shared role in the class was positively linked to performance avoidance goals. Regarding epistemological beliefs, students with naïve epistemological beliefs in Source and Certainty and the sophisticated beliefs in Development were also found to adopt performance avoidance goals. Additionally, students of teachers with task goals and sophisticated epistemological beliefs in justification of knowledge tend to adopt performance avoidance goals. Overall results about avoidance goals indicated that students with naïve beliefs in source of knowledge and certainty of knowledge adopted mastery and performance avoidance goals. This was reasonable and supported by the literature (Braten & Stromso, 2004; Chen, 2012). Also, Shared Control perception of class supported their both avoidance goals. This was also in line with the general findings about the effects of Shared Control on other student outcomes like epistemological beliefs and achievement.

The overall results for student level variables indicated that students' perception of constructivist learning environment is a significant predictor in explaining their achievement goals. General findings of the present study are consistent with the previous studies, although the previous research used different classroom learning environment questionnaire and focus on different aspects of learning environment (e.g. Arisoy, 2007; Church et al., 2001; Kizilgunes et al., 2009; Lau et al., 2008; Sungur & Gungoren, 2009; Yerdelen, 2013). Related literature also indicated that students' epistemological beliefs are considerably related with their achievement goal adoptions (Braten & Stromso, 2004; Chen, 2012; Kizilgunes et al., 2009; Schutz, Pintrich, & Young, 1993). Overall results related with predictor effects of teacher-level variables revealed that teachers' personal characteristics do not have very important roles to explain in students' achievement goal adoptions (Yerdelen, 2013). Therefore, to make clear judgments about the correlation about students' achievement goals and teachers' personal characteristics, additional and replication research is needed to further investigate these possibilities.

5.1.5 Predicting Students' Perception of Task Value

HLM analyses with Task Value indicated that significant variation did exist among science classes in students' perception of task value. Intraclass Correlation Coefficient (ICC) was computed to assess the percent of variance in Task Value outcome. ICC revealed that 6% of total variability in students' perception of task value can be attributed to teacher or class level variables. These results indicated that there were significant variations among the classes in students' responses to task value items. It confirmed conducting multilevel analyses for this data set. Accordingly, Intercepts and Slopes as Outcomes Model was tested to investigate which teacher level variables (Self-Efficacy, Achievement Goal Orientations, Epistemological Beliefs, Student-Centered Beliefs and Practices, Individual Citizenship Behavior, and aggregated students' perception of Constructivist Learning Environment) influence the effect of student level variables (Epistemological Beliefs and Constructivist Learning Environment) on students' perception of task value. For the specified purpose, the variables that were determined by testing the Random Coefficient Models were used as level-1 (student level) predictors. Then, the variables that were determined by testing the Means as Outcomes Models were added to the intercepts and to significantly random varied level-1 predictors as level-2 (teacher or class level) predictors. Overall findings were presented in Figure 5.5.

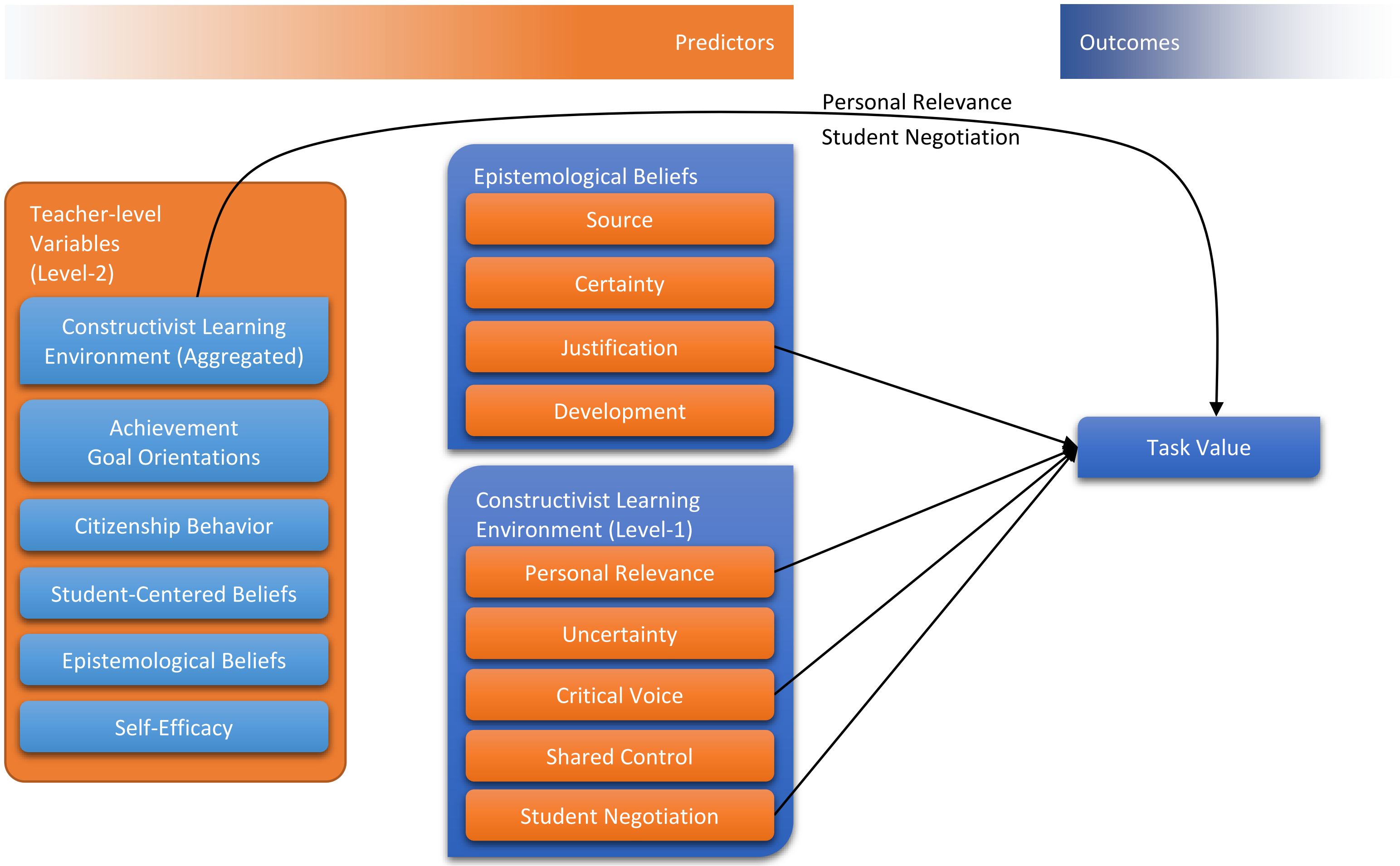


Figure 5.5 The final model based on the results of the HLM analysis for predicting Students' Perception of Task Value.

Among student-level variables, the present study was proposed that students' perceptions of constructivist learning environment is in a positive correlation with students' task value perceptions. The results of HLM analyses revealed that Personal Relevance, Critical Voice, and Student Negotiation dimensions of Constructivist Learning Environment and Justification dimension of students' Epistemological Beliefs were positively associated with students' Task Value perceptions (see Figure 5.5). These findings implied that students who perceive that they have opportunities to relate science to real world, to question what is going on in the lesson freely, and to communicate with their teachers in the classroom are likely to appreciate the value of learning tasks, find learning activities enjoyable and helpful to enhance their learning. At the class level, students with the perception as a class that they have opportunities to relate science to real world and to communicate with their teachers in the classroom, tend to find the task, content, and materials in science classes as important, useful, and interesting. All of these results are partly in line with the expectation of the study and also partly consistent with the literature that found the relationships between students' perceptions of learning environment and their appreciation value of learning tasks (e.g. Arisoy, 2007). For example, Arisoy (2007) reported that more positive perceptions of all dimensions of Constructivist Learning Environment were associated with higher level of task value perceptions. Different from Arisoy's (2007) study, in the present study, it was found that uncertainty and shared control dimensions did not significantly predict task value. The result concerning shared control may be explained by mean score for this sub-scale of the CLES: The mean score suggest that students of the study had a less positive perceptions concerning Shared Control sub-scale compared to other scales ($M = 3.08$). This finding may suggest that science teachers partly foster classroom environments that provide students with active roles as scientific investigators in learning activities and rarely invite them to take responsibility in the decision making process. Thus, their students may not be interested in learning tasks, content, and materials that are provided in science class.

Current findings also revealed that the students who have more sophisticated epistemological beliefs in Justification dimension were likely to appreciate the value of learning tasks. Thus, it appeared that students with sophisticated beliefs in justifying knowledge are likely to believe that learning tasks, content, and materials that are provided in science class are important, interesting, enjoyable, and helpful to enhance their learning. This finding was partly in line with the existing literature exploring these relations (Paulsen & Feldman, 1999). More specifically, Paulsen and Feldman (1999) found that students with a naïve beliefs in Simple Knowledge, Quick Learning, and Fixed Ability are less likely to appreciate the value of learning tasks. Certain Knowledge, similar to the present study, was not found in a relation with task value. Paulsen and Feldman (1999) explained it by considering domain difference, because they claimed that Certain Knowledge is the most domain sensitive dimension among all dimensions. In the present study, it was found that beliefs in all dimensions of epistemological beliefs except for Justification were not correlated with task value. Examining the mean scores of these dimensions, it can be seen that Justification and Development dimension had highest value in all dimensions, but Source and Certainty were not low to show tentative beliefs in these dimensions (M = 2.94 for Source, M = 3.27 for Certainty, M = 4.09 for Justification, and M = 3.80 for Development). Mean scores of Source and Certainty scales were near the mid-point of the 5-point Likert type scaling, thus, students who believe that scientific questions have a certain answer and this answer is resided by an authority (e.g. teacher) and less believe that science is an evolving and changing subject may not appreciate the value of learning tasks and not find learning activities and tasks enjoyable and helpful to enhance their learning. It may also dependent familial and social-cultural factors affecting students' epistemological beliefs and its relations with task value perceptions. Therefore, to make clear judgments about the correlation about students' epistemological beliefs and task value, additional and replication research is needed to further investigate these possibilities.

5.1.6 Predicting Students' Metacognitive Self-Regulation

HLM analyses with *Metacognitive Self-Regulation* indicated that significant variation did exist among science classes in students' Metacognitive Self-Regulation. Intraclass Correlation Coefficient (ICC) was computed to assess the percent of variance in metacognitive self-regulation outcome. ICC revealed that 6% of total variability in students' metacognitive self-regulation scores can be attributed to teacher or class level variables. These results showed that there were significant variations among the classes in students' responses to metacognitive self-regulation items confirming the use of multilevel analyses for this data set. Accordingly, Intercepts and Slopes as Outcomes Model was tested to investigate which teacher level variables (Self-Efficacy, Achievement Goal Orientations, Epistemological Beliefs, Student-Centered Beliefs and Practices, Individual Citizenship Behavior, and aggregated students' perception of Constructivist Learning Environment) influence the effect of student level variables (Epistemological Beliefs and Constructivist Learning Environment) on students' Metacognitive Self-Regulation. For the specified purpose, the variables that were determined by testing the Random Coefficient Models were used as level-1 (student level) predictors. Then, the variables that were determined by testing the Means as Outcomes Models were added to the intercepts and to significantly random varied level-1 predictors as level-2 (teacher or class level) predictors. Overall findings were presented in Figure 5.6.

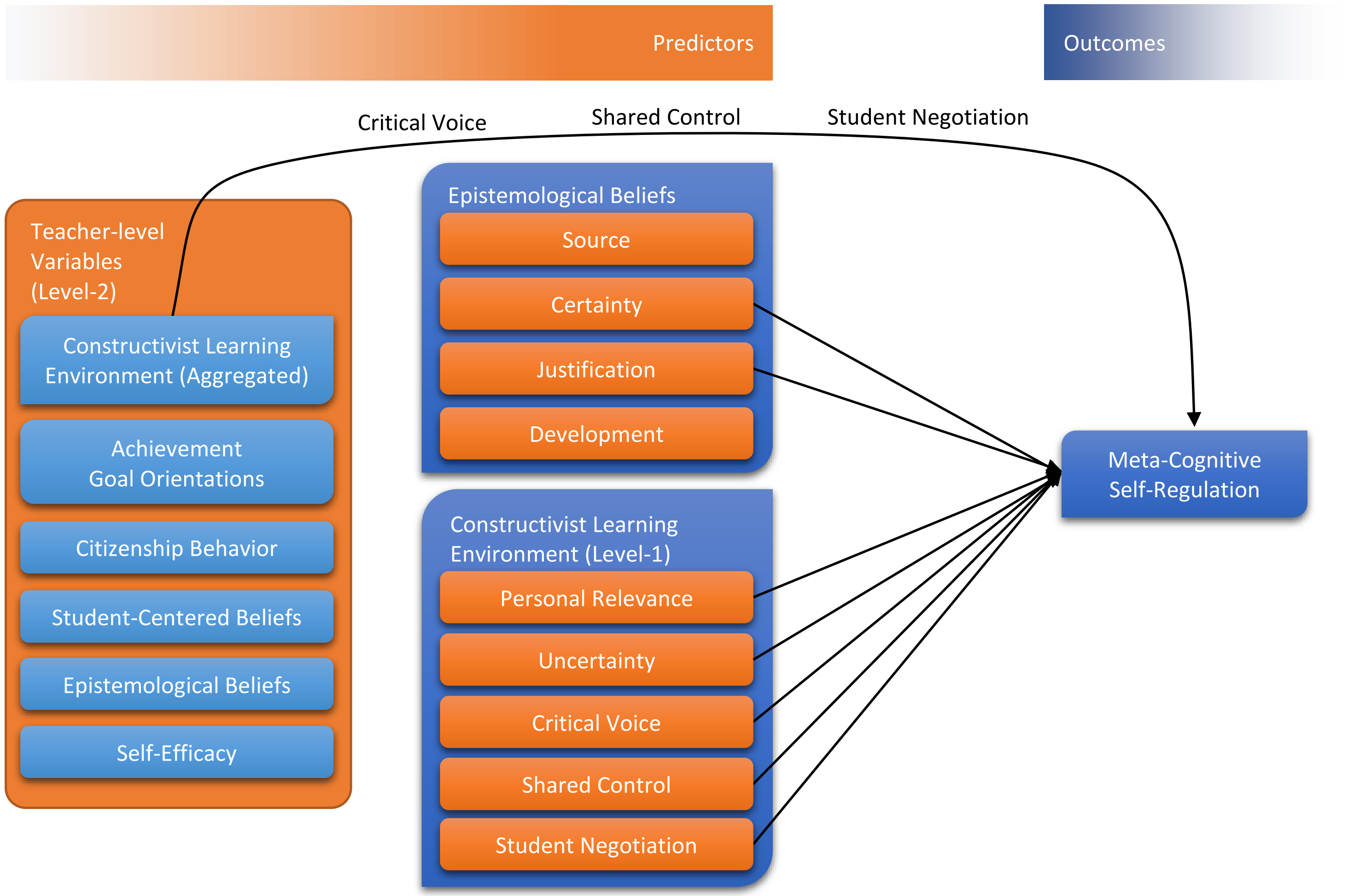


Figure 5.6 The final model based on the results of the HLM analysis for predicting Students' Metacognitive Self-Regulation.

The results of the study indicated that all dimensions of Constructivist Learning Environment were positively associated with students' Metacognitive Self-Regulation (see Figure 5.6). It means that students with perception that they have opportunities to relate science to real world, to practice the construction of scientific knowledge, to question what is going on in the lesson freely, to have a shared role in the class, and to communicate with their teachers in the classroom tend to be more metacognitively active. Haertel, Walberg, and Haertel (1981) emphasized the importance of learning environment perceptions as powerful predictors for students' cognitive, affective, and behavioral outcomes. Gunstone (1994) also emphasized one focus of constructivist learning environment as enhancing students' metacognitive self-regulated learning. Overall results are in line with this focus and revealed that students that have positive perception of constructivist learning environment use metacognitive learning strategies more actively. The literature about effects of learning environment perceptions on metacognitive self-regulation indicated similar findings (i.e. Ozkal, et al., 2009; Sungur & Gungoen, 2009, Yerdelen, 2013; Yilmaz-Tuzun & Topcu, 2010). Therefore, the findings of the present study are reasonable to find out correlations among all dimensions of constructivist learning environment and metacognitive self-regulation. Similar results were found at class level (see Figure 5.6). Accordingly, Critical Voice, Shared Control, and Student Negotiation were significant predictors of Metacognitive Self-Regulation. The association of Constructivist Learning Environment and Metacognitive Self-Regulation were similar in individual and class level.

On the other hand, the findings of this study also revealed that students with the naïve belief that scientific knowledge is certain and the more sophisticated belief in justification of knowledge were likely to use metacognitive strategies at higher levels. This findings were partly supported by the literature. Latter one is in line with the findings in the literature that students with sophisticated epistemological beliefs more likely to use metacognitive self-regulation strategies (Chan, 2003; Kardash & Howell, 2000). However, former one is contradicted and non-expected findings for both literature and expectation of the present study. In order to provide plausible explanations for the positive relationship found between naïve beliefs in certain of knowledge and metacognition, other factors affecting students' outcomes should be examined deeply in the future studies.

5.1.7 Predicting Students' Science Achievement

HLM analyses with *Science Achievement* indicated that significant variation did exist among science classes in students' Science Achievement. Intraclass Correlation Coefficient (ICC) was computed to assess the percent of variance in science achievement outcome. ICC revealed that 37% of total variability in students' Science Achievement scores can be attributed to teacher or class level variables. These results revealed that there were significant variations among the classes in students' responses to science achievement items. Thus, it was appropriate to conduct multilevel analyses for this data set. Accordingly, to explore the teacher or class level predictors accounting for between class variations in students' science achievement, Means as Outcomes Models were built. Teacher level or class level variables were Self-Efficacy, Achievement Goal Orientations, Epistemological Beliefs, Student-Centered Beliefs and Practices, Individual Citizenship Behavior, and aggregated students' perception of Constructivist Learning Environment. Overall findings were presented in Figure 5.7.

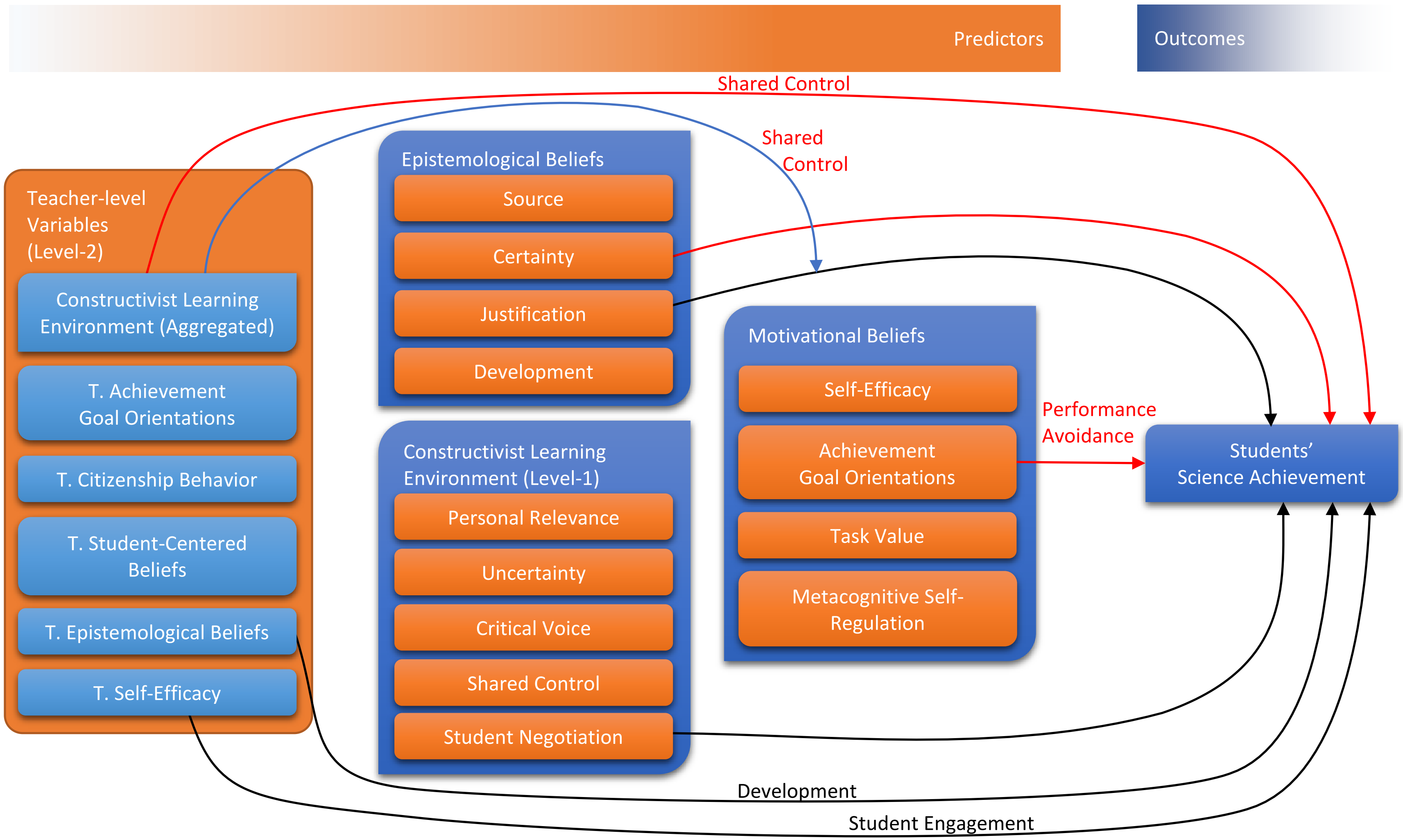


Figure 5.7 The final model based on the results of the HLM analysis for predicting Students' Science Achievement

The result revealed that that among all dimensions of Constructivist Learning Environment Scale at student-level, only Student Negotiation was significantly and positively associated with students' Science Achievement (see Figure 5.7). It means that students who perceive to have opportunities communicate with their science teachers in the classroom appeared to have higher science achievement scores. These students have positive feelings to involve with other students and their science teachers in constructing or assessing of an idea. This provides students not only engaging in learning process but also understanding science better. As far as class means are considered, however, it was found that the perception that students have opportunities to have a shared role in the class resulted in lower science achievement. As seen as in predicting epistemological beliefs and achievement goals, class' perceptions of participation in planning, conducting, and assessing of learning were positively but weakly associated with both naïve epistemological beliefs and avoidance goals for the sample of this study. Teachers may invite their students to participate to design, plan, and conduct the classroom practices, but it may not be adequate to involve them in class. In addition to, student may perceive taking responsibilities as an extra and unwanted effort. Some familial and social-cultural factors may affecting students' perceptions of teachers' efforts, though may be not adequate by their own, which in turn influence their science achievements. Thus, the results of the present study should be interpreted with caution and considered as warrant for further research.

In general, the literature found positive association between students' perception of learning environment and academic achievement and consistent with the present study (Allen & Fraser, 2007; Baek & Choi, 2002; Dorman, 2001; Fraser, 1989; Goh & Fraser; 1998; Roth, 1997; Snyder, 2005; Wolf & Fraser, 2008; Yerdelen, 2013). Thus, positive correlation between Student Negotiation and Science Achievement was considered as logical and in line with the expectation of the related literature and the expectation of the present study. However, other Personal Relevance, Uncertainty, Critical Voice, and Shared Control dimensions of CLES were not found associated with Science Achievement. In the study of den Brok et al.

(2010), none of the dimension of classroom learning environment perception scale (i.e., WIHIC) found to explain the differences in Biology Achievement scores which was obtained by grade cards reported thus, they claimed that report card achievement grades tend to indicate less variance between classes than achievement tests. Non-significant results may be explained by including other student variables to explain students' science achievement. Literature and the present study indicated that students' learning environment perceptions were in a correlation with epistemological beliefs and self-regulation. Epistemological beliefs and self-regulation variables may mediate the effects of learning environment perceptions on science achievement. It may be supported with simple correlation analyses results. Simple correlation with all dimension of CLES and Science Achievement indicated that dimensions of CLES except for Shared Control were significantly correlated with Science Achievement. Correlation Coefficients were between .060 and .101. In the present study, mediation effects of self-regulation on epistemological beliefs and learning environment perceptions were tested in next section, but deeper investigation is needed in a broader study. Thus, the results of the present study should be interpreted with caution and considered as warrant for further research.

Regarding students' Epistemological Beliefs, science achievement scores were associated positively with tentative beliefs in Justification of Knowledge and negatively with naïve beliefs in Certainty of Knowledge (see Figure 5.7). Students who had tentative beliefs in justifying of knowledge like it comes from reasoning, thinking, and experimenting may encourage students to be meaningful learners and, thus, more successful in learning science. On the other hand, students who stated naïve beliefs that knowledge is factual and certainly true may not exhibit an efforts to learn meaningfully, not query deeply provisional status of scientific knowledge, and thus, not be successful in learning science. This result expected finding and in line with previous research results that claimed that sophistication of epistemological beliefs are positively correlated with better academic achievement (Cano, 2005; Conley et al, 2004; Kardash & Scholes, 1996; Kizilgunes et al., 2009; Schommer, 1990; Schommer, Crouse, & Rhodes, 1992; Schommer & Walker, 1997; Topcu &

Tuzun, 2009). All of these studies indicated that students that have sophisticated beliefs about evaluating or justifying of knowledge and that scientific questions are uncertain and changeable are more successful in their course. These students have doubts about the certainty of knowledge. Also, they conclude that all knowledge is subjective and justification of knowledge can be limited to a special case and time. These students can easily and actively engage in learning (Schommer, 1994) and adopt to deep approaches (Kizilgunes et al., 2009), and thereby, are more likely to success in their learning. On the other hand, shared control dimension of CLES negatively mediated the relationship of students' tentative beliefs in justification with science achievement (see Figure 5.7). In other words, the positive relationship between students' beliefs in justification and science achievement was weaker in the classroom where students perceive to have a shared role in the class, and these students had lower science achievement scores. As said before, teachers' efforts to participate them to learning environment actively may be not adequate or may perceived negatively by students. If students do no perceive an encouraging environment to participate in planning, conducting, and assessing of learning, they may refrain to exhibit and to mirror their beliefs that knowledge comes from reasoning, thinking, and experimenting to success in science.

With respect to self-regulation variables, students who adopt Performance Avoidance goals were likely to have lower science achievement level. This result was not surprising and supports the existing literature that indicated negative effects of Performance Avoidance goals on students' achievement (i.e. Barzager, 2012; Elliot & McGregor, 2001; Hsieh, Sullivan, & Guerra, 2007; Yerdelen, 2013). For instance, Yerdelen (2013) found that science achievement was positively correlated with mastery approach goals, but negative with performance avoidance goals. Different from Yerdelen's (2013) study, in the present study, mastery approach was not significantly correlated with science achievement. Examining the mean scores of students on mastery goals subscale, it was seen that their scores were considerably high. In other words, reported scores indicated that students were mastery goal-adopted at higher levels, so it can be said that these students do not mirror their goal adoptions to science achievement. Regarding performance avoidance goals, the findings were in line with the expectation of the present study. Students who adopted performance avoidance goals are have unfavorable judgments about their competence and afraid of looking incompetent. Therefore, they do not attractive and competent in class and avoid to be exhibit own abilities not to be looking stupid or incompetent, so did not participated to class actively. As a result, it is expected that their achievement in their course is lower that other students.

Overall, results revealed that teachers' sense of efficacy for Student Engagement was significantly and positively associated with Science Achievement. In other words, if a teacher had higher confidence to engage their students to learn, those students had higher science achievement. These findings support Yerdelen's (2013) findings. She found that students had higher achievement scores in the classrooms taught by science teachers having high level of efficacy in engaging their students to learn. Woolfolk Hoy et al. (2009) stated that teachers with a strong sense of efficacy are more likely to spend more time teaching in that subject areas; be more open to new ideas use strategies that engage students for greater learning. The findings of the study are considered as logical and in line with the literature (Anderson et al. 1988; Klassen et al., 2011; Ross, 1992; Yerdelen, 2013). On the other hand, Teacher sense of efficacy for Instructional Strategies and Classroom Management were not found significantly correlated with science achievement. Yerdelen (2013), in her study, did not found any relationships of Efficacy for Classroom Management and Efficacy for Instructional Strategies with Science Achievement. Moreover, in another study, Vasquez (2008) examined the predictor effects of teacher self-efficacy on students' achievement, but none of dimensions of teachers self-efficacy was not found as predictors of achievement. All of these studies and the present study indicated that this relationship should be examined and interpreted with caution, but this consideration may be a warrant to further studies.

Moreover, findings of the present study, also, indicated that science teachers' beliefs in development were correlated with students' science achievement scores. More specifically, if teachers believed strongly that knowledge is evolving and changing, their students tend to be more successful in science. This is logical, because teachers that have sophisticate epistemological beliefs are more aware of student alternative conceptions, use more effective teaching strategies, and create more qualified learning environment for students to enhance their learning (Brownlee, Boulton-Lewis, & Purdie, 2002; Hashweh, 1996). Thus, their students tend to be more successful in learning. This is supported by the findings of the present study.

5.1.8 Predicting Students' Science Achievement by Epistemological Beliefs and Constructivist Learning Environment by Examining Mediator Effects of Self-Regulation Variables

To see the mediation effect of Self-Regulation variables on the relationship between the other level-1 predictors (students' perception of Constructivist Learning Environment and Epistemological Beliefs) and Science Achievement, two Random Coefficient Models (Model 1 and Model 2) were tested and compared. Model 1 was tested without including students' Self-Regulation variables i.e. Self-Efficacy, Achievement Goals, Task Value, and Metacognitive Self-Regulation in the model. They were added to regression equation while Model 2 was run. Overall findings were presented in Figure 5.8 and 5.9.

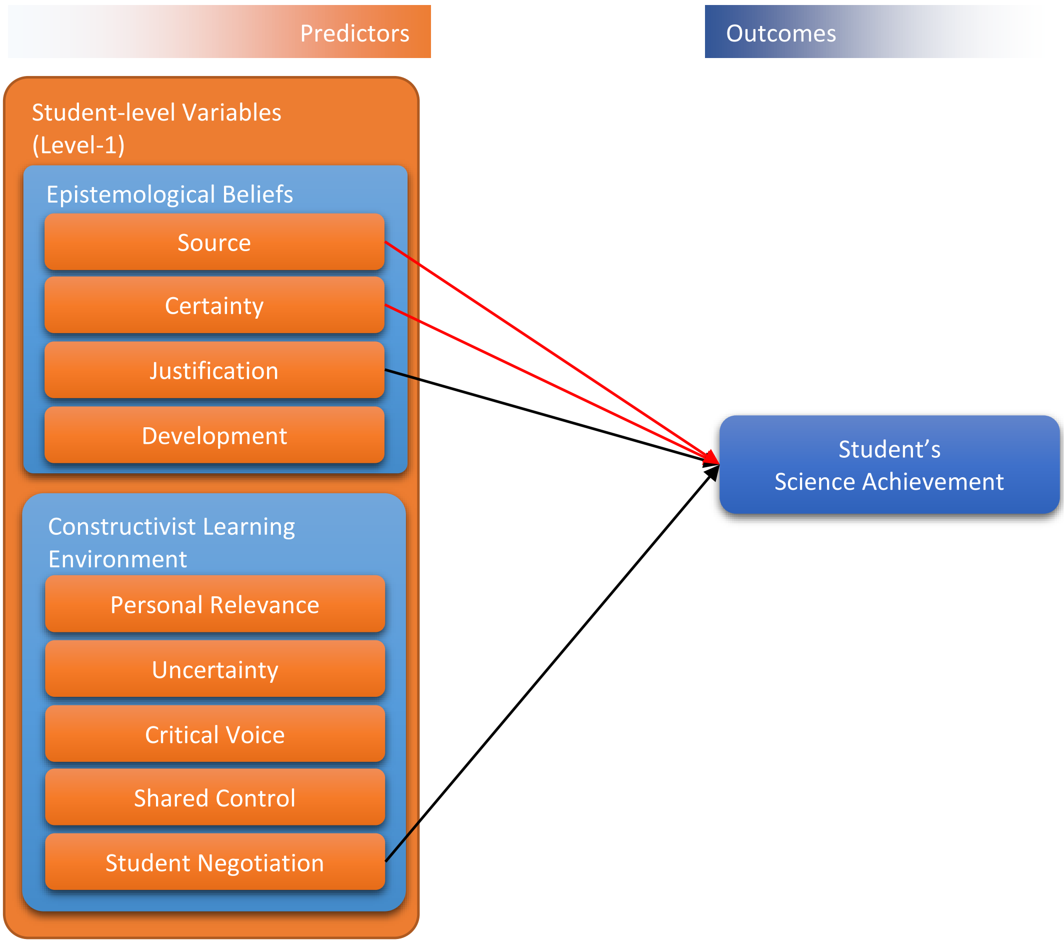


Figure 5.8 Model-1 based on the results of the HLM analysis for research question 8.

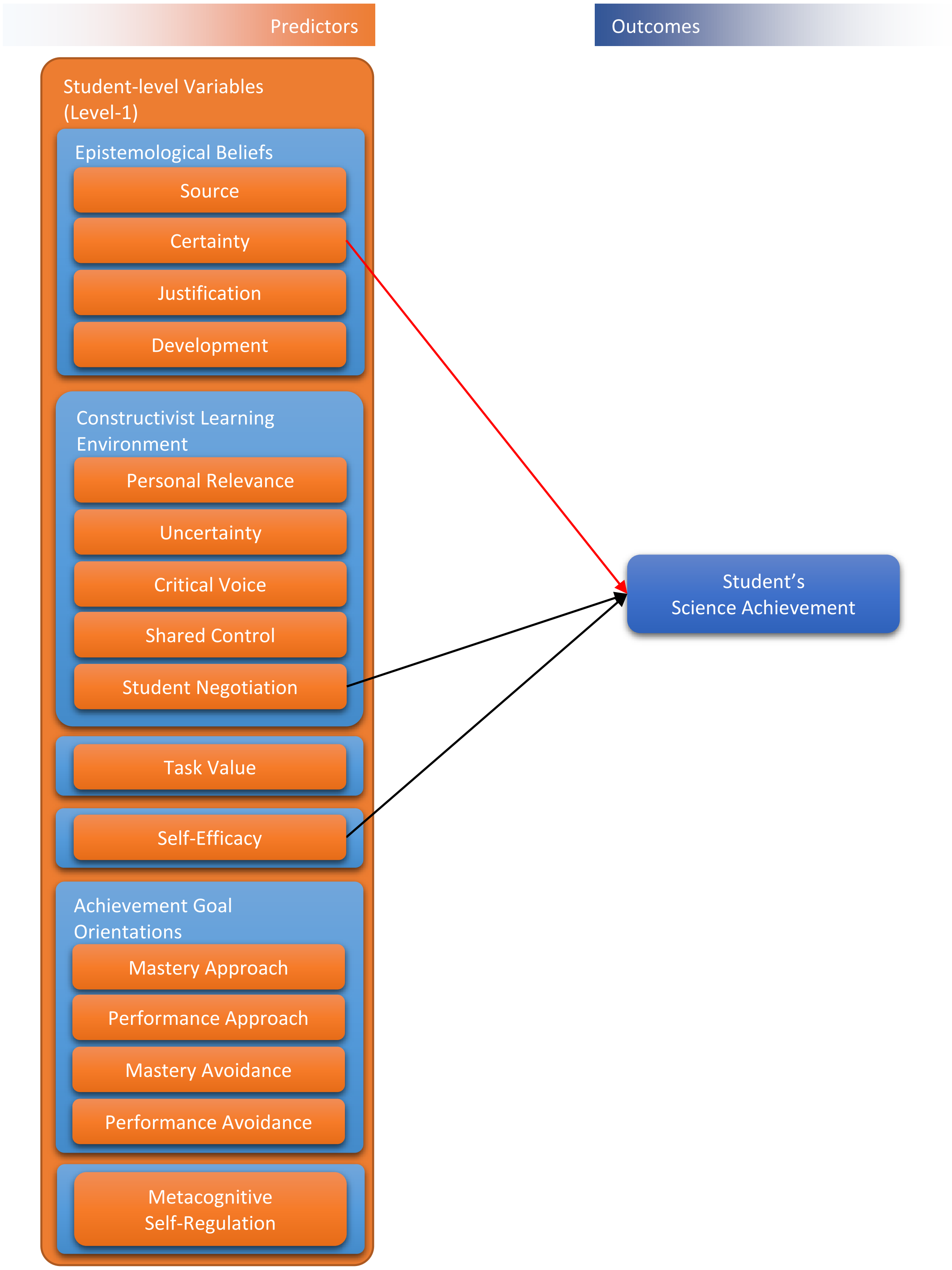


Figure 5.9 Model-2 based on the results of the HLM analysis for research question 8.

Findings indicated that students' *Science Achievements* are predicted by their Epistemological Beliefs (Certainty, Source, and Justification) and perception of Constructivist Learning Environment (Student Negotiation) in Model 1 (see Figure 5.8). Regarding Epistemological Beliefs, the students who have naïve beliefs in Certainty of Knowledge and Source of Knowledge obtained lower scores on the achievement test. Also, students that have more tentative beliefs in the role of evidence and evaluating claims for the justification of knowledge were more successful. Regarding students have positive perception about feeling free to communicate with their science teachers in the classroom have higher science achievement scores. All of these findings were found in Model 1 (Figure 5.8).

Then, Model 2 were run by adding Self-Regulation variables. After including students' self-regulation variables (Self-Efficacy, Achievement Goals, Task Value, and Metacognitive Self-Regulation) in the model, regarding Epistemological Beliefs, Source and Justification dimensions were not related to science achievement anymore. On the other hand, students' Self-Efficacy was found positively related to Science Achievement (see Figure 5.9). It was implied that after controlling for Self-Regulation variables, Source and Justification were not significantly associated with Science Achievement scores. These two dimensions of Epistemological Beliefs significantly predicted Science Achievement in the absence of Self-Regulation variables. Thus, it can be said that Self-Regulation variables mediate the relationship between Epistemological Beliefs and Science Achievement. These findings are partly in line with Chen and Pajares (2010)'s results. In their study, Self-Efficacy was a mediator role for Epistemological Beliefs in Justification and Certainty and students' Science Achievement. On the other hand, Rastegar et al. (2010) found that Achievement Goals and Self-Efficacy have a mediator role between Epistemological Beliefs and Academic Achievement. Kizilgunes et al. (2009), in their analysis, found that students' achievement motivation mediated the relations between their epistemological beliefs and science achievements. Surprisingly, in that study, tentative beliefs in justification and learning approach were found as negatively related with self-efficacy. Kizilgunes et al. claimed that 6^{th} grade students' responses to self-report instruments may be different from their actual beliefs, so this unexpected findings may depend on a mismatch between students' reported and actual beliefs in self-efficacy.

Regarding Constructivist Learning Environment, Student Negotiation predicted students' Science Achievement score. It means that students that perceive to communicate with their science teachers in the classroom have higher science achievement scores. After including Self-Regulation variables into the model, there was no any significant changing in relationship between Constructivist Learning Environment and Science Achievement. These findings contradict some studies in the literature (e.g. Church et al. 2001; Sungur & Gungoren, 2009; Yerdelen, 2013; Yildirim, 2012), because the literature claimed that self-regulation variables have a mediator role on the relationships between learning environment perceptions and academic achievement. The studies that examined the mediation effects of Self-Regulation on the relationships between Learning Environment perceptions are so rare. Thus, this study was a new attempt to attract attention to see mediation effects of students' self-regulation on association between their perception of learning environment and academic achievement.

5.2 Conclusion

The present study was conducted to examine the relationships of 7th grade students' perception of constructivist learning environment, epistemological beliefs and self-regulation with science achievement and teacher level variables. Also, teacher level variables was examined as predictors of science achievement. Overall, findings indicated that students' perceptions of constructivist learning environment were significant predictors of their epistemological beliefs, self-regulation, and science achievement. More specifically, students with positive perception of their learning environment appeared to have more sophisticated epistemological beliefs in both individual and class level. Almost all dimension of constructivist learning environment were positively related with tentative beliefs in Justification and

Development. Also, perception about Personal Relevance and Critical Voice were negatively associated with naïve beliefs in Source. One impressive result was that Shared Control was positively correlated with naïve beliefs and it supported Ozkal et al.'s (2009) findings about Shared Control. Moreover, students who have positive perception of their learning environment were found to believe in their abilities to do given tasks successfully, set mastery goals generally for themselves, have positive perceptions of task, and use metacognitive strategies effectively in science classes. These students tend to have better science achievement. Additionally, results revealed that students' epistemological beliefs were significant predictors of their self-regulation and achievement in science. According to the results, students with more sophisticated epistemological beliefs tend to be more self-regulated and successful in science. Regarding the relationship between self-regulation variables and science achievement, the finding indicated that only performance avoidance goals were significantly related to science achievement and direction of the relationship was negative. Thus, it appeared that students who study for the reasons of avoiding unfavorable judgments about their competence and looking incompetent tend to have lower levels of achievement in science.

Concerning the mediation effect of self-regulation on the relationship of epistemological beliefs and learning environment with science achievement, results showed that without inclusion of self-regulation variables, all epistemological beliefs variables except for development and student negotiation dimension of constructivist learning environment predicted science achievement. After inclusion of self-regulation variables, source and justification lost its predictive power and only certainty and student negotiation predicted science achievement. Among self-regulation variables, self-efficacy was found to be significantly linked to science achievement. These results suggested that self-regulation variables, the most powerful one was self-efficacy, mediate the relationship of epistemological beliefs variable (i.e. source and justification) and classroom learning environment perception with science achievement.

Regarding class level variables, students' perception of constructivist learning environment was found to be positively predicted by teachers' epistemological beliefs, self-efficacy beliefs, and ability approach goals. More specifically, results revealed that students of teachers with sophisticated beliefs in Justification tend to perceive their science classes as reflecting the characteristics of the constructivist learning environment (i.e. Personal Relevance, Uncertainty, Critical Voice, and Student Negotiation) at higher levels. In addition, students taught by teachers who are self-efficacious for Instructional Strategies and with Ability Approach goals feel free in their classroom respectively to have a shared role in the class and to practice the construction of scientific knowledge.

In addition, results showed that high level of teachers' Efficacy for Student Engagement was negatively related with students' naïve epistemological beliefs. Moreover, interestingly, teachers' naïve beliefs in Source and Certainty were found to be positively associated with students' sophisticated beliefs respectively in Justification and Development. Another interesting finding was that teachers' self-efficacy in classroom management was negatively related with students' self-efficacy.

Furthermore, according to the results, teacher level variables were not significant predictors of student self-regulation in science classes. However, some of these variables were found to be significantly linked to students' perceptions of constructivist learning environment, epistemological beliefs, and achievement in science. To conclude, considered significant variances almost for all outcomes, the selected teacher level variables were not adequate to explain these variances. Therefore, more studies are needed to examine the effects of any other teacher level variables on students' learning environment perceptions, epistemological beliefs, self-regulation, and science achievement.

5.3 Implications

This study gains importance due to its two main contributions to the field: Former one is to investigate factors that influence students' science achievement by examining their perceptions of their learning environment, epistemological beliefs, and self-regulation. Latter one is to contribute to the body of literature by employing multilevel analysis to examine the role of student-level (Level-1) variables (i.e. self-regulation, epistemological beliefs, and the perception of learning environment) on students' science achievement by including and considering the role of their teachers' personal characteristics (Level-2) (teachers' beliefs, goal orientations, and practices) due to the nested structure of the data. With respect to these two main contributions, the present study is the first study in the Turkish elementary science education literature that examines the effects of students' self-regulation, epistemological beliefs, and the perception of learning environment on science achievement by controlling and investigating the role of teachers. Thus, it can be said that the findings of this study have potential to provide important information and implication for teachers and their educators, educational policy makers, and researchers that study in educational psychology and science education.

The findings of the present study revealed that students' epistemological beliefs, self-regulation strategies, and academic achievement are significantly affected by constructivist learning environment perceptions. Accordingly, it is implied that science teachers should create a classroom learning environment to encourage students to feel to have opportunities to relate science to real world, to practice the construction of scientific knowledge, to question what is going on in the lesson freely, to have a shared role in the class, and to communicate with their teachers in the classroom. It is also suggested that teachers should aware of their students' epistemological beliefs when designing course to provide them having shared role and to engage them in learning science. Tsai (2000) suggested providing constructivist-based classrooms to improve students learning in science who have tentative epistemological beliefs. According to the results of the current study, if teachers reflect these suggestions to their classrooms, their students are expected to construct their knowledge, to have tentative or constructivist view of epistemological beliefs, to be self-efficacious in science, to set goals to do successful in their class, to appreciate the value of learning tasks, to be more metacognitively active, and, finally, to be more successful in science class. These findings are important for science teachers and they could use these suggestions to improve their service to students to reach educational goals of the curriculum.

The findings of the present study also have implications for teacher educators that train teachers to enhance students' positive perceptions of their classroom learning environment, to be more self-efficacious, to set mastering goals, and so on, because teachers' personal characteristics were found to be significantly associated with students' perception of learning environment, self-regulation, and science achievement. Therefore, pre-service teachers should be supported to enhance their confidence in teaching, set higher goals to be successful in teaching, and have more sophisticated beliefs by providing more chances for teaching in real classroom (regarding Mastery Experiences), observing mentor teachers in real classroom settings (regarding Vicarious Experiences), and providing positive feedbacks to develop their teaching abilities (regarding Verbal or social persuasions and emotional states). Moreover, courses in teacher education programs may be enhanced to enhance teachers' epistemological beliefs and courses about implementing science education and about teaching practice may be adapted to support pre-service teachers to be aware of and enhance students' constructivist learning environment perceptions and epistemological beliefs that were addressed in the present study. The findings of this study and these suggestions may shed light to develop teacher education programs by educational policy makers to help pre-service teachers to enhance these practices.

Regarding educational researchers, comprehensiveness of this study has substantial value in educational psychology and its application to science education. For instance, examination of the associations among students' perceptions, beliefs, and cognitive and affective components were remarkable for educational researchers.

However, with this study, influence of teachers' personal characteristics on students' outcomes were also examined. The personal characteristics of teacher were assumed its strong effects on students' outcomes about learning. The findings indicated that, teachers' personal characteristics were found as affective on students' outcomes, but not found as highly effective. With this scope, the findings of this study may shed light for educational researchers to attempt to investigate these relationships by including any other teachers' or students' level variables and to replicate this study to generalize its findings.

5.4 Limitations and Recommendations

This study has some limitations and recommendations. First of all is about providing causal relationships of this study. This is a cross sectional study and limited to give certain and strong causal relationships to explain how teachers' personal characteristics affect student outcomes and how students' perception of learning environment and epistemological beliefs affect other student outcomes. To give more clear explanation for them, experimental or longitudinal research design may be suggested. Second limitation is about data collection tools that depend on participants' self-report. Other types of data collection methods may be useful for deeper understanding of teachers' personal characteristics and students' perception of learning environment, epistemological beliefs, and self-regulation.

The variables in teacher and student level accounted small part of variances in between and within class. Therefore, including students' gender, socioeconomic status, and prior achievement may be useful to control their possible accounts in these variance and to see real effects of other teacher and student outcomes in students' learning and achievement. In addition, new teacher and student level variables like Job Satisfaction, Teacher Burnout, gender and socio-economic status of teachers and students, etc. may be included in models to better explain between or within class variances in student outcome.

Third limitation and recommendation of this study is about the domain of the study and characteristics of the participants. This study was restricted to science domain and the relationships of teacher and student level variables could be interpreted in science domain. Also, students in the sample of this study were 7^{th} graders. Therefore, to learn how these variables are associated in other domains and other grade levels, this study may be replicated in different domains and different grade levels.

The last limitation is related to Science Achievement Test. In order to assess students' science achievement, multiple-choice questions gathered from national exams that were done by Turkish Ministery of National Education in 2008 and 2009. The science curriculum in Turkey is heaviliy based on constructivist learning approach and it purposes to enhance students to learn a scientist rather than passively learning the scientific knowledge. Research revealed that science teachers are not capable to employ requirements of constructivist learning approach (Özden, 2007; Tekbıyık & Akdeniz, 2008). Most of teachers may still employ traditional teaching methods. On the other hand, questions in SBS national exams aim to assess higher order thinking skills and students may feel these questions different and have some difficulties to solve and to answer them. The low reliability test result of Science Achievement Tests indicate low, but acceptable reliability score (r = .49). Therefore, it is expected that the results of the present study are interpreted by considering this weaknesses of the science achievement test. Furhermore, new studies with more reliable and appropriate science achievement tests or open-ended questions are needed to deeper and better understanding of the relationships of students' and teachers' personal characteristics with science achievement.

REFERENCES

Addy, T. M. (2011). *Epistemological Beliefs and Practices of Science Faculty with Education Specialties: Combining Teaching Scholarship and Interdisciplinarity.* Unpublished Doctoral Dissertation, North Carolina State University, North Carolina.

Akyol, G., Sungur, S., & Tekkaya, C. (2010). The contribution of cognitive and metacognitive strategy use to students' science achievement. *Educational Research and Evaluation, 16*(1), 1-21.

Al-Harth, I. S., & Was, C. A. (2013). Goals, efficacy and metacognitive self-regulation A path analysis. *International Journal of Education*, *2*(1), 1-20.

Allen, D., & Fraser, B. J. (2007). Parent and student perceptions of classroom learning environment and its association with student outcomes. *Learning Environments Research, 10*(1), 67-82.

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of educational psychology, 84*(3), 261.

Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of educational psychology, 80*(3), 260.

Anderman, E. M., & Midgley, C. (1997). Changes in achievement goal orientations, perceived academic competence, and grades across the transition to middle-level schools. *Contemporary Educational Psychology, 22*(3), 269-298.

Areepattamannil, S., Freeman, J. G., & Klinger, D. A. (2011). Influence of motivation, self-beliefs, and instructional practices on science achievement of adolescents in Canada. *Social Psychology of Education, 14*(2), 233-259.

Arisoy, N. (2007). *Examining 8th grade students'perception of learning environment of science classrooms in relation to motivational beliefs and attitudes.* Unpublished Master's thesis, Middle East Technical University, Ankara, Turkey.

Armor, D., Conroy-Oseguera, P., Cox, M., King, N., McDonnell, L., Pascal, A., Pauly, E., & Zellman, G. (1976). *Analysis of the school preferred reading programs in selected Los Angeles minority schools,* REPORT NO. R-2007-LAUSD. Santa Monica, CA: Rand Corporation (ERIC Document Reproduction Service No. 130 243).

Ashton, P. T., & Webb, R. B. (1986). *Making a difference: Teachers' sense of efficacy and student achievement.* New York: Longman.

Ashton, P. T., Olejnik, S., Crocker, L., & McAuliffe, M. (1982). *Measurement problems in the study of teachers' sense of efficacy.* Paper presented at the annual meeting of the American Educational Research Association, New York.

Aydin, S., Boz, Y., Sungur, S., & Çetin, G. (2012). Examination of pre-service chemistry teachers' preferences for creating constructivist learning environment. *Hacettepe Universitesi Egitim Fakultesi Dergisi-Hacettepe University Journal of Education, 42*, 36-47.

Baek, S. G., & Choi, H. J. (2002). The relationship between students' perceptions of classroom environment and their academic achievement in Korea. *Asia Pacific Education Review, 3*(1), 125-135.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*, 191–215.

Bandura, A. (1983). Self-efficacy determinants of anticipated fears and calamities. *Journal of Personality and Social Psychology, 45*, 464–469.

Bandura, A. (1986). *Social foundations of thought and action* (pp. 5-107). Prentice Hall.: Englewood Cliffs, NJ.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

Bargezar, M. (2012). *The relationship between goal orientation and academic achievement- The mediation role of self-regulated learning strategies- A path analysis. Phukat.* Paper presented at the Thailand: International Conference on Management, Humanity and Economics (CMHE), Phuket, Thailand.

Bong, M. (2004). Academic motivation in self-efficacy, task value, achievement goal orientations, and attributional beliefs. *The Journal of Educational Research, 97*(6), 287-298.

Bråten, I., & Strømsø, H. I. (2004). Epistemological beliefs and implicit theories of intelligence as predictors of achievement goals. *Contemporary Educational Psychology, 29*(4), 371-388.

Britner, S. L., & Pajares, F. (2006). Sources of science self-efficacy beliefs of middle school students. *Journal of Research in Science Teaching, 43*(5), 485-499.

Brown, A. (1987). *Metacognition, executive control, self-regulation, and other more mysterious mechanisms.* In F. Weinert & R. Kluwe, eds., Metacognition, Motivation, and Understanding (pp. 65-116). Hillsdale, NJ: Erlbaum.

Brownlee, J., Boulton-Lewis, G., & Purdie, N, (2002). Core beliefs about knowing and peripheral beliefs about learning: Developing a wholistic conceptualization of epistemological beliefs. *Australian Journal of Educational & Developmental Psychology, 2,* 1-16.

Bruning, R., Schraw, G. and Ronning, R. R. (1995). *Cognitive psychology and instruction,* 2nd edition, Englewood Cliffs, NJ: Prentice-Hall.

Butler, R. (2007). Teachers' achievement goal orientations and associations with teachers' help seeking: Examination of a novel approach to teacher motivation. *Journal of Educational Psychology, 99*(2), 241.

Butler, R., & Shibaz, L. (2008). Achievement goals for teaching as predictors of students' perceptions of instructional practices and students' help seeking and cheating. *Learning and Instruction*, *18*(5), 453-467.

Cano, F. (2005). Epistemological beliefs and approaches to learning: Their change through secondary school and their influence on academic performance. *British Journal of Educational Psychology, 75*(2), 203-221.

Capa, Y., Cakiroglu, J., & Sarikaya, H. (2005). The development and validation of a Turkish version of the Teachers' Sense of Efficacy Scale. *Egitim ve Bilim [Education and Science], 30*(137), 74–81.

Caprara, G. V., Barbaranelli, C., Steca, P., & Malone, P. S. (2006). Teachers' self-efficacy beliefs as determinants of job satisfaction and students' academic achievement: A study at the school level. *Journal of school psychology, 44*(6), 473-490.

Cavallo, A. M., Potter, W. H., & Rozman, M. (2004). Gender differences in learning constructs, shifts in learning constructs, and their relationship to course achievement in a structured inquiry, yearlong college physics course for life science majors. *School Science and Mathematics, 104*(6), 288-300.

Cavallo, A.M.L., Rozman, M., Blickenstaff, J., & Walker, N. (2003). Students' learning approaches, reasoning abilities, motivational goals, and epistemological beliefs in differing college science courses. *Journal of College Science Teaching, 33,* 18–23.

Chen, J. A., & Pajares, F. (2010). Implicit theories of ability of Grade 6 science students: Relation to epistemological beliefs and academic motivation and achievement in science. *Contemporary Educational Psychology, 35*(1), 75-87.

Chen, J. A., & Usher, E. L. (2013). Profiles of the sources of science self-efficacy. *Learning and Individual Differences, 24,* 11-21.

Church, M. A., Elliot, A. J., & Gable, S. L. (2001). Perceptions of classroom environment, achievement goals, and achievement outcomes. *Journal of Educational Psychology, 93*(1), 43.

Conley, A. M., Pintrich, P. R., Vekiri, I., & Harrison, D. (2004). Changes in epistemological beliefs in elementary science students. *Contemporary Educational Psychology, 29*(2), 186-204.

Deewers, M. D. (2000). *Teacher goal endorsement, student achievement goals and student achievement in mathematics: A longitudinal study*. Unpublished Master's thesis, Cleveland State University, Cleveland.

den Brok, P., Telli, S., Cakiroglu, J., Taconis, R., & Tekkaya, C. (2010). Learning environment profiles of Turkish secondary biology classrooms. *Learning Environments Research, 13*(3), 187-204.

DiPaola, M. F., & Hoy, W. K. (2005a). Organizational citizenship of faculty and achievement of high school students. *The High School Journal, 88*(3), 35-44.

DiPaola, M. F., & Hoy, W. K. (2005b). Organizational properties that foster organizational citizenship. *Journal of School Leadership, 15*, 391-410.

DiPaola, M., & Tschannen-Moran, M. (2001). Organizational Citizenship Behavior in Schools and Its Relationship to School Climate. *Journal of School Leadership, 11*(5), 424-47.

Dorman, J. P. (2001). Associations between classroom environment and academic efficacy. *Learning Environments Research*, *4*(3), 243-257.

Dorman, P., Fisher, D.L., & Waldrip, B.G. (2006). *Learning environments, students' perceptions of assessment, academic efficacy and attitudes to science: A LISREL analysis.* In Contemporary approaches to research on learning environments: World views, Edited by: Fisher, D.L. and Khine, M.S. 1–28. Singapore: World Scientific.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological review*, *95*(2), 256.

Elder, A. D. (1999). *An exploration of fifth-grade students' epistemological beliefs in science and an investigation of their relation to science learning*. Unpublished doctoral dissertation, University of Michigan, Ann Arbor.

Elliot, A. J. (1999). Approach and avoidance motivation and achievement goals. *Educational psychologist, 34*(3), 169-189.

Elliot, A. J., & McGregor, H. A. (2001). A 2× 2 achievement goal framework. *Journal of personality and social psychology, 80*(3), 501.

Elliot, J., & Harackiewicz, J. M. (1996). Approach and avoidance achievement goals and intrinsic motivation: A mediational analysis. *Journal of Personality and Social Psychology, 70,* 461–475.

Elliott, E. S., & Dweck, C. S. (1988). Goals: an approach to motivation and achievement. *Journal of personality and social psychology, 54*(1), 5.

Emmer, E. (1990). *A scale for measuring teacher efficacy in classroom management and discipline.* Paper presented at the annual meeting of the American Educational Research Association, Boston, MA (Revised, June, 1990).

Fang, Z. (1996). A review of research on teacher beliefs and practices. *Educational research, 38*(1), 47-65.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry. *American psychologist*, *34*(10), 906.

Fraenkel, J. R., & Wallen, N. E. (2006). *How to design and evaluate research in education (sixth edition).* New York: McGraw-Hill.

Fraser, B. J. (1998). Classroom environment instruments: Development, validity and applications. *Learning environments research, 1*(1), 7-34.

Fraser, B. J. (2007). Classroom learning environments. In S. K. Abell & N. G. Lederman (Eds.), *Handbook of research on science education* (pp. 103–124). Mahwah: Lawrence Erlbaum.

Fraser, B. J., & McRobbie, C. J. (1995). Science Laboratory Classroom Environments at Schools and Universities: A Cross-National Study. *Educational Research and Evaluation, 1*(4), 289-317.

Fraser, B. J., & Treagust, D. F. (1986). Validity and use of an instrument for assessing classroom psychosocial environment in higher education. *Higher education, 15*(1-2), 37-57.

Fraser, B. J., & Walberg, H. J. (1991). *Educational environments: Evaluation, antecedents and consequences.* Oxford: Pergamon Press.

Fraser, B.J. (1994). Research on Classroom and School Climate, in D. Gabel (ed.), *Handbook of Research on Science Teaching and Learning*, Macmillan, New York, 493-541.

Fraser, B.J., Fisher, D.L., & McRobbie, C.J. (1996). *Development, Validation, and Use of Personal and Class Forms of a New Classroom Environment Instrument.* Paper presented at the annual meeting of the American Educational Research Association, New York.

Friedel, J. M., Cortina, K. S., Turner, J. C., & Midgley, C. (2007). Achievement goals, efficacy beliefs and coping strategies in mathematics: The roles of perceived parent and teacher goal emphases. *Contemporary Educational Psychology, 32*(3), 434-458.

Fritz, B. S., & Peklaj, C. (2009). Self-regulated Processes as Predictors of Students' Achievement in Music Theory in Slovenian Elementary Music Schools. *Psihološka obzorja / Horizons of Psychology, 18*(4), 5-18

Georghiades, P. (2004). From the general to the situated: Three decades of metacognition. *International Journal of Science Education, 26*(3), 365-383.

Gibson, S., & Dembo, M. (1984). Teacher efficacy: A construct validation. *Journal of Educational Psychology, 76*, 569–582.

Goh, S. C., & Fraser, B. J. (1998). Teacher interpersonal behaviour, classroom environment and student outcomes in primary mathematics in Singapore. *Learning Environments Research, 1*(2), 199-229.

Gungoren, S. (2009). *The effect of grade level on elementary school students' motivational beliefs in science.* Unpublished Master's thesis, Middle East Technical University, Ankara, Turkey.

Gunstone, RF (1994) *The importance of specific science content in the enhancement of metacognition.* In P. J. Fensham, R. F. Gunstone, & R. T. White (Eds), The Content of Science. London: Falmer Press.

Guo, Y., Connor, C. M., Yang, Y., Roehrig, A. D., & Morrison, F. J. (2012). The effects of teacher qualification, teacher self-efficacy, and classroom practices on fifth graders' literacy outcomes. *The Elementary School Journal, 113*(1), 3-24.

Guo, Y., Piasta, S. B., Justice, L. M., & Kaderavek, J. N. (2010). Relations among preschool teachers' self-efficacy, classroom quality, and children's language and literacy gains. *Teaching and Teacher Education, 26*(4), 1094-1103.

Guskey, T. R. (1986). Staff development and the process of teacher change. *Educational researcher, 15*(5), 5-12.

Guskey, T. R. (1987). Context variables that affect measures of teacher efficacy. *Journal of Educational Research, 81*(1), 41–47.

Guskey, T., & Passaro, P. (1994). Teacher efficacy: A study of construct dimensions. *American Educational Research Journal, 31*, 627–643.

Haertel, G. D., Walberg, H. J., & Haertel, E. H. (1981). Socio-psychological environments and learning: a quantitative synthesis. *British Educational Research Journal, 7*(1), 27-36.

Hashweh, M. Z. (1996). Effects of science teachers' epistemological beliefs in teaching. *Journal of Research in Science teaching, 33*(1), 47-63.

Hatcher, L., & Stepanski, E.J. (1994). *A step-by-step approach to using the SAS system for univariate and multivariate statistics.* SAS Inst. Inc., Cary, NC.

Heyman, G. D., & Dweck, C. S. (1992). Achievement goals and intrinsic motivation: Their relation and their role in adaptive motivation. *Motivation and emotion, 16*(3), 231-247.

Hofer, B. K. (1994). *Epistemological beliefs and first-year college students: Motivation and cognition in different instructional contexts.* Paper presented at the Paper presented at the annual meeting of the American Psychological Association, Los Angeles.

Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of educational research, 67*(1), 88-140.

Hofer, B. K., & Pintrich, P. R. (2002). *Personal epistemology: The psychology of beliefs about knowledge and knowing.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Hox, J. J. (2010). *Multilevel analysis: Techniques and applications (2nd ed.).* New York, NY: Routledge.

Hoy, A. W., Hoy, W. K., & Davis, H. A. (2009). Teachers' self-efficacy beliefs. In K. R. Wentzel and A. Wigfield (Eds.) *Handbook of Motivation* (pp. 627-653). New York: Routledge Press.

Hoy, A. W., Hoy, W. K., & Kurz, N. M. (2008). Teacher's academic optimism: The development and test of a new construct. *Teaching and teacher education, 24*(4), 821-835.

Hoy, W. K., & Woolfolk, A. E. (1993). Teachers' sense of efficacy and the organizational health of schools. *The Elementary School Journal, 93,* 356–372.

Johnson, B., & McClure, R. (2004). Validity and reliability of a shortened, revised version of the Constructivist Learning Environment Survey (CLES). *Learning Environments Research, 7*(1), 65-80.

Kang, N. H., & Wallace, C. S. (2005). Secondary science teachers' use of laboratory activities: Linking epistemological beliefs, goals, and practices. *Science Education, 89*(1), 140-165.

Kardash, C. M., & Howell, K. L. (2000). Effects of epistemological beliefs and topic-specific beliefs on undergraduates' cognitive and strategic processing of dual-positional text. *Journal of Educational Psychology, 92*(3), 524.

Kizilgunes, B., Tekkaya, C., & Sungur, S. (2009). Modeling the relations among students' epistemological beliefs, motivation, learning approach, and achievement. *The Journal of educational research, 102*(4), 243-256.

Klassen, R. M., Tze, V. M., Betts, S. M., & Gordon, K. A. (2011). Teacher efficacy research 1998–2009: signs of progress or unfulfilled promise? *Educational Psychology Review, 23*(1), 21-43.

Kupermintz, H. (2002). Affective and conative factors as aptitude resources in high school science achievement. *Educational Assessment, 8*(2), 123-137.

Kurien, S. A. (2011). *The Relation between Teachers' Personal Teaching Efficacy and Students' Academic Efficacy for Science and Inquiry Science.* ProQuest LLC. 789 East Eisenhower Parkway, PO Box 1346, Ann Arbor, MI 48106.

Kzehri azar, H., Lavasani, M. G., Malahmadi, E., & Amani, J. (2010). The role of self-efficacy, task value, and achievement goals in predicting learning approaches and mathematics achievement. *Procedia-Social and Behavioral Sciences*, *5*, 942-947.

Lent, R. W., Brown, S. D., & Larkin, K. C. (1986). Self-efficacy in the prediction of academic performance and perceived career options. *Journal of counseling psychology, 33*(3), 265.

Liem, A. D., Lau, S., & Nie, Y. (2008). The role of self-efficacy, task value, and achievement goals in predicting learning strategies, task disengagement, peer relationship, and achievement outcome. *Contemporary Educational Psychology, 33*(4), 486-512.

Linnenbrink-Garcia, L., Tyson, D. F., & Patall, E. A. (2008). When are achievement goal orientations beneficial for academic achievement? A closer look at main effects and moderating factors. *Revue internationale de psychologie sociale, 21*(1-2), 19-70.

Luft, J. A., & Roehrig, G. H. (2007). Capturing science teachers' epistemological beliefs: The development of the teacher beliefs interview. *Electronic Journal of Science Education, 11*(2).

Luyten, H., & der Hoeven-van Doornum, V. (1995). Classroom Composition and Individual Achievement: Effects of Classroom Composition and Teacher Goals in Dutch Elementary Education. *Tijdschrift voor Onderwijsresearch, 20*(1), 42-62.

Maehr, M. L., & Midgley, C. (1991). Enhancing student motivation: A schoolwide approach. *Educational psychologist, 26*(3-4), 399-427.

Margianti, E. S., Fraser, B. J., & Aldridge, J. M. (2001). *Classroom environment and students' outcomes among university computing students in Indonesia.* Paper presented at the annual meeting of the American Educational Research Association, Seattle, WA.

Margianti, E. S., Fraser, B. J., and Aldridge, J. M. (2002, April). *Learning environment, attitudes and achievement: Assessing the perceptions of Indonesian university students.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Meece, J. L., Herman, P., & McCombs, B. L. (2003). Relations of learner-centered teaching practices to adolescents' achievement goals. *International Journal of Educational Research, 39*(4), 457-475.

Midgley, C., Maehr, M. L., Hruda, L. Z., Anderman, E., Anderman, L., Freeman, K. E., & Urdan, T. (2000). *Manual for the patterns of adaptive learning scales.* Ann Arbor, MI: University of Michigan.

Ministry of National Education of Turkey (2003). TIMMS 1999 national report. Retreived on December 22, 2013 from http://timss.meb.gov.tr/wp-content/uploads/timss_1999_ulusal_raporu.pdf

Ministry of National Education of Turkey (2005). PISA 2003 national report. Retreived on December 22, 2013 from http://pisa.meb.gov.tr/wp-content/uploads/2013/07/PISA-2003-Ulusal-Nihai-Rapor.pdf

Ministry of National Education of Turkey (2010a). PISA 2009 project national report. Retreived on December 22, 2013 from http://pisa.meb.gov.tr/wp-content/uploads/2013/07/PISA-2009-Ulusal-On-Rapor.pdf

Ministry of National Education of Turkey (2010b). PISA 2006 national report. Retreived on December 22, 2013 from http://pisa.meb.gov.tr/wp-content/uploads/2013/07/PISA2006-Ulusal-Nihai-Rapor.pdf

(Ministry of National Education [MONE], 2011). TIMMS national report. Retrieved on December 22, 2013 from http://timss.meb.gov.tr/?page_id=25

Ministry of National Education of Turkey (2013). Science curriculum of elementary schools (3th-8th grades) [in Turkish]. Ankara, Turkey: Board of Education. Retreived December 22, 2013 from http://ttkb.meb.gov.tr/www/guncellenen-ogretim -programları-ve-kurul-kararlari/icerik/150.

Multon, K. D., Brown, S. D., & Lent, R. W. (1991). Relation of self-efficacy beliefs to academic outcomes: A meta-analytic investigation. *Journal of counseling psychology*, *38*(1), 30.

Ogbuehi, P. I., & Fraser, B. J. (2007). Learning environment, attitudes and conceptual development associated with innovative strategies in middle-school mathematics. *Learning Environments Research, 10*(2), 101-114.

Ozden, M. (2007). Problems with science and technology education in Turkey. *Eurasia Journal of Mathematics, Science & Technology Education, 3*(2), 157-161.

Ozkal, K., Tekkaya, C., Cakiroglu, J., & Sungur, S. (2009). A conceptual model of relationships among constructivist learning environment perceptions, epistemological beliefs, and learning approaches. *Learning and Individual Differences, 19*(1), 71-79.

Ozkan, S. (2008). *Modeling elementary students' science achievement: The interrelationships among epistemological beliefs, learning approaches, and self-regulated learning strategies.* Unpublished Doctoral Dissertation, Middle East Technical University, Ankara, Turkey.

Ozsoy, G., & Ataman, A. (2009). The Effect of Metacognitive Strategy Training on Mathematical Problem Solving Achievement. *Online Submission, 1*(2), 68-83.

Pajares, F. (2002). *Overview of social cognitive theory and of self-efficacy.* [Online]. Available: http://www.des.emory.edu/mfp/eff.html

Pajares, F., Britner, S. L., & Valiante, G. (2000). Relation between achievement goals and self-beliefs of middle school students in writing and science. *Contemporary Educational Psychology, 25*(4), 406-422.

Patrick, H., Ryan, A. M., & Kaplan, A. (2007). Early adolescents' perceptions of the classroom social environment, motivational beliefs, and engagement. *Journal of Educational Psychology, 99*(1), 83.

Paulsen, M. B., & Feldman, K. A. (1999). Student motivation and epistemological beliefs. *New Directions for Teaching and Learning, 78*, 17-25.

Peters, M. L. (2013). Examining the relationships among classroom climate, self-efficacy, and achievement in undergraduate mathematics: A multi-level analysis. *International Journal of Science and Mathematics Education, 11*(2), 459-480.

Pintrich, P. R. (2000). The role of goal orientation in self-regulated learning. In M. Boekarts, P. R. Pintrich, & M. Zeidner, *Handbook of Self-Regulation* (pp. 451-495). San Diego, CA: Academic Press.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of educational psychology, 82*(1), 33.

Pintrich, P. R., & Schunk, D. H. (2002). *Motivation in education: Theory, research, and applications (2nd ed.).* Englewood Cliffs, NJ: Merrill.

Pintrich, P. R., Smith, D. A., García, T., & McKeachie, W. J. (1991). *A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ).* Ann Arbor, MI: National Center for Research to Improve Postsecondary Teaching and Learning, University of Mishigan.

Pintrich, P. R., Smith, D. A., García, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and psychological measurement, 53*(3), 801-813.

Pomeroy, D. (1993). Implications of teachers' beliefs about the nature of science: Comparison of the beliefs of scientists, secondary science teachers, and elementary teachers. *Science Education, 77*(3), 261-278.

Rastegar, A., Jahromi, R. G., Haghighi, A. S., & Akbari, A. R. (2010). The relation of epistemological beliefs and mathematics achievement: the mediating role of achievement goals, mathematics self-efficacy, and cognitive engagement. *Procedia-Social and Behavioral Sciences, 5*, 791-797.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical Linear Models: Applications and Data Analysis Methods*, Second Edition. Newbury Park, CA: Sage.

Risemberg, R., & Zimmerman, B. J. (1992). Self-regulated learning in gifted students. *Roeper Review, 15*(2), 98-101.

Rose, J. S., & Medway, F. J. (1981). Measurement of teachers' beliefs in their control over student outcome. *Journal of Educational Research, 74*, 185–190.

Ross, J. A. (1992). Teacher efficacy and the effects of coaching on student achievement. *Canadian Journal of Education/Revue canadienne de l'education*, 51-65.

Ross, J. A. (1998). *The antecedents and consequences of teacher efficacy*. In J. Brophy (Ed.), Advances in research on teaching (Vol. 7, pp. 49-73). Greenwich, CT: JAI Press.

Roth, W.M. (1997). The interaction of learning environments and student discourse about knowing, learning and the nature of science: two longitudinal case studies. *International Journal of Educational Research*, *27*, 311-320.

Rotter, J. B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs, 80,* 1–28.

Schommer, M. (1993). Epistemological development and academic performance among secondary students. *Journal of educational psychology*, *85*(3), 406.

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

Schommer, M., & Walker, K. (1997). Epistemological beliefs and valuing school: Considerations for college admissions and retention. *Research in Higher Education, 38*(2), 173-186.

Schommer, M., Crouse, A., & Rhodes, N. (1992). Epistemological beliefs and mathematical text comprehension: *Believing it is simple does not make it so. Journal of educational psychology, 84*(4), 435.

Schraw, G., & Moshman, D. (1995). Metacognitive theories. *Educational psychology review, 7*(4), 351-371.

Schutz, P. A., Pintrich, P. R., & Young, A. J. (1993, April). *Epistemological beliefs, motivation, and student learning.* Paper presented at the annual meeting of the American Educational Research Association, Atlanta.

Senler, B., & Sungur, S. (2009). Parental influences on students' self-concept, task value beliefs, and achievement in science. *The Spanish journal of psychology, 12*(01), 106-117.

Senler, B., & Sungur, S. (2007, November). *Hedef yonelimi anketinin Türkçe'ye çevrilmesi ve adaptasyonu [Translation and adaptation of goal orientation questionnaire into Turkish]*. Paper presented at the 1st National Elementary Education Conference, Ankara, Turkey.

Smith, C. L., Maclin, D., Houghton, C., & Hennessey, M. G. (2000). Sixth-grade students' epistemologies of science: The impact of school science experiences on epistemological development. *Cognition and Instruction, 18*(3), 349-422.

Snyder, W. (2005*). Is there a correlation between students' perception of their middle school science classroom learning environment and their classroom grades?* Unpublished Doctoral Dissertation, Claremont Graduate University, Claremont, California.

Sperling, R. A., Howard, B. C., Miller, L. A., & Murphy, C. (2002). Measures of children's knowledge and regulation of cognition. *Contemporary educational psychology*, *27*(1), 51-79.

Sungur, S. (2004). *An implementation of problem based learning in high school biology courses.* Unpublished Doctoral Dissertation, Middle East Technical University, Ankara, Turkey.

Sungur, S., & Gungoren, S. (2009). The role of classroom environment perceptions in self-regulated learning and science achievement. *Elementary Education Online*, *8*(3), 883-900.

Sungur, S., & Senler, B. (2010). Students' achievement goals in relation to academic motivation, competence expectancy, and classroom environment perceptions. *Educational Research and Evaluation*, *16*(4), 303-324.

Tas, Y. (2008). *The interplay of students' perceptions of classroom goal structures, personal goal orientations and learning related variables.* Unpublished Master's thesis, Middle East Technical University, Ankara, Turkey.

Tas, Y. (2013). *The interplay of students' perceptions of classroom goal structures, personal goal orientations and learning related variables.* Unpublished Doctoral Dissertation, Middle East Technical University, Ankara, Turkey.

Taylor, P. C., & Fraser, B. J. (1991, April). *CLES: An instrument for assessing constructivist learning environments.* In annual meeting of the National Association for Research in Science Teaching, Lake Geneva, WI.

Taylor, P. C., Dawson, V., & Fraser, B. J. (1995). *A constructivist perspective on monitoring classroom learning environments under transformation.* In annual meeting of the American Educational Research Association, San Francisco, CA.

Taylor, P. C., Fraser, B. J., & Fisher, D. L. (1997). Monitoring constructivist classroom learning environments. *International Journal of Educational Research, 27*(4), 293-302.

Tekbıyık, A., & Akdeniz, A. R. (2008). Teachers' views about adoption and application of primary science and technology curriculum. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 2*(2), 23-37.

Thoonen, E. E., Sleegers, P. J., Oort, F. J., Peetsma, T. T., & Geijsel, F. P. (2011). How to improve teaching practices the role of teacher motivation, organizational factors, and leadership practices. *Educational Administration Quarterly, 47*(3), 496-536.

Topçu, M. S., & Yilmaz-Tuzun, O. (2009). Elementary students' metacognition and epistemological beliefs considering science achievement, gender and socioeconomic status. *Elementary Education Online, 8*(3), 676-693.

Trickett, FJ, Moss, R. H. (1973). The environment of junior classrooms. *Journal of Educational Psychology, 65*, 93-102.

Tsai, C. C. (2000). Relationships between student scientific epistemological beliefs and perceptions of constructivist learning environments. *Educational Research, 42*(2), 193-205.

Tschannen-Moran, M., & Woolfolk Hoy, A. (2001). Teacher efficacy: Capturing and elusive construct. *Teaching and Teacher Education, 17*, 783-805.

Tschannen-Moran, M., Hoy, A. W., & Hoy, W. K. (1998). Teacher efficacy: Its meaning and measure. *Review of educational research, 68*(2), 202-248.

Uysal, E. (2010). *A Modeling Study: The Interrelationships among Elementary Students" Epistemological Beliefs, Learning Environment Perceptions, Learning Approaches and Science Achievement.* Unpublished doctoral dissertation, Middle East Technical University, Ankara, Turkey.

Van Kraayenoord, C. E., & Schneider, W. E. (1999). Reading achievement, metacognition, reading self-concept and interest: A study of German students in grades 3 and 4. *European Journal of Psychology of Education, 14*(3), 305-324.

Vasquez, A. (2008). *Teacher efficacy and student achievement in ninth and tenth grade reading: A multilevel analysis.* Unpublished doctoral dissertation, College of Education University of South Florida. Florida.

Walberg, H. (1981). *A psychological theory of educational productivity.* In F.H . Farley & N Görden (Eds.), Psychology and education (pp. 81-108). Berkeley, CA : McCutchan.

Walberg, H. J., & Anderson, G. J. (1968). Classroom climate and individual learning. *Journal of educational psychology, 59*, 414-419.

Wigfield, A., & Eccles, J. S. (1992). The development of achievement task values: A theoretical analysis. *Developmental review, 12*(3), 265-310.

Wolf, S. J., & Fraser, B. J. (2008). Learning environment, attitudes and achievement among middle-school science students using inquiry-based laboratory activities. *Research in Science Education, 38*(3), 321-341.

Wolters, C. A. (2004). Advancing Achievement Goal Theory: Using Goal Structures and Goal Orientations to Predict Students' Motivation, Cognition, and Achievement. *Journal of educational psychology, 96*(2), 236.

Wolters, C. A., & Pintrich, P. R. (1998). Contextual differences in student motivation and self-regulated learning in mathematics, English, and social studies classrooms. *Instructional science, 26*(1-2), 27-47.

Woolfolk Hoy, A., & Davis, H. (2005). *Teachers' sense of efficacy and adolescent achievement.* In T. Urdan & F. Pajares (Eds.), Adolescence and education: Vol. 5: Self-efficacy beliefs during adolescence (pp. 117–137). Greenwich, CT: Information Age.

Woolfolk Hoy, A., Hoy, W. K., & Davis, H. (2009). Teachers’ self-efficacy beliefs. To appear in K. Wentzel, & A. Wigfield (Eds.). *Handbook of Motivation in School* (pp. 627-654). Mahwah, NJ: Lawrence Erlbaum.

Woolfolk Hoy, A., Hoy, W. K., & Kurz, N. M. (2008). Teacher's academic optimism: The development and test of a new construct. *Teaching and teacher education, 24*(4), 821-835.

Woolfolk, A. E., & Hoy, W. K. (1990). Prospective teachers’ sense of efficacy and beliefs about control. *Journal of Educational Psychology, 82*, 81–91.

Woolley, S. L., Benjamin, W. J. J., & Woolley, A. W. (2004). Construct validity of a self-report measure of teacher beliefs related to constructivist and traditional approaches to teaching and learning. *Educational and Psychological Measurement, 64*(2), 319-331.

Wubbels, T., & Levy, J. (1993). *Interpersonal relationships in education.* London: The Falmer Press.

Yerdelen, S. (2013). *Multilevel investigations of students' cognitive and affective learning outcomes and their relationships with perceived classroom learning environment and teacher effectiveness.* Unpublished Doctoral Dissertation, Middle East Technical University, Ankara, Turkey.

Yerdelen, S., Sungur, S., & Klassen, R. M. (2012, July). *The role of self-regulatory processes in secondary school students' biology achievement.* Presented at the bi-annual meeting of the International Society for the Study of Behavioural Development, Edmonton, Canada.

Yıldırım, S. (2012). Teacher support, motivation, learning strategy use, and achievement: A multilevel mediation model. *The Journal of Experimental Education, 80*(2), 150-172.

Yilmaz-Tüzün, Ö., & Topcu, M. S. (2010). Investigating the relationships among elementary school students' epistemological beliefs, metacognition, and constructivist science learning environment. *Journal of Science Teacher Education*, *21*(2), 255-273.

Yilmaz-Tuzun, O., Cakiroglu, J., & Boone, W. J. (2006). *Turkish high school student's perceptions of constructivist learning environment in chemistry classrooms and their attitudes toward chemistry*. Paper presented and published in the proceedings of National Association for research in Science Teaching (NARST), San Francisco, CA.

Yumusak, N., Sungur, S., & Cakiroglu, J. (2007). Turkish high school students' biology achievement in relation to academic self-regulation. *Educational Research and Evaluation*, *13*(1), 53-69.

Yürük, N. (2007). A Case Study of One Student's Metaconceptual Processes and the Changes in Her Alternative Conceptions of Force and Motion. *Eurasia Journal of Mathematics, Science & Technology Education*, *3*(4), 305-325.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekarts, P. R. Pintrich, & M. Zeidner, *Handbook of Self-Regulation* (pp. 13-39). San Diego, CA: Academic Press.

Zimmerman, B.J. (1986). Development of self-regulated learning: Which are the key sub-processes? *Contemporary Educational Psychology*, *16*, 307–313.

APPENDICES

Appendix A: Teacher Questionnaire

Sevgili Meslektaşım,

Öğretmenlerimizin öğretmenlik mesleğine yönelik bazı yaklaşımlarını belirlemek amacıyla bir doktora tezi yürütmekteyim. Bu nedenle sizlerin görüşlerinin alınmasına gerek duyulmuştur. Aşağıda size ait bazı bilgiler istenmektedir. Bu bilgiler arasında sizden kesinlikle isminiz veya sizi tanımlayabilecek bir bilgi istenmemektedir. Daha sonraki kısımlarda ise mesleğinize yönelik ifadelerin bulunduğu bir dizi anket bulunmaktadır. Bunlardan sizin duygu ve düşüncenize en yakın olduğunu düşündüğünüz tek bir seçeneği işaretleyiniz. Kişisel bilgileriniz kesinlikle gizli tutulacaktır. Araştırmanın amacının gerçekleşmesi cevaplarınızın içtenliğine ve soruları eksiksiz olarak cevaplamanıza bağlıdır.

Teşekkürler.

Araş. Gör. Savaş PAMUK
ODTÜ İlköğretim Bölümü

Cinsiyetiniz : Bay ① Bayan ②
Yaşınız : ....
Kaç yıldır öğretmenlik yapmaktasınız? ....
Üniversite eğitimi gördüğünüz fakültenin adı : ....
Üniversite eğitimi gördüğünüz anabilim dalının adı : ....

1. Kısım: Hedef Yönelimleri Anketi

Aşağıdaki durumlar gerçekleştiyse iyi ve başarılı bir iş günü geçirdiğimi düşünürüm:	Kesinlikle Katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle Katılıyorum
1. Benim sınıflarım diğer öğretmenlerin sınıflarına göre müfredatta daha ilerideyse.	1	2	3	4	5
2. Diğer öğretmenlere kıyasla mesleğimde daha iyi olduğum için takdir edildiysem.	1	2	3	4	5
3. Benim sınıflarım diğer öğretmenlerin sınıflarına göre sınavlardan daha yüksek not aldıysa.	1	2	3	4	5
4. Öğrettiğim konular üzerindeki hakimiyetimle öğrencilerimi etkilediysem.	1	2	3	4	5
5. Müdür / müfettiş dersimi gözlemlediğinde zayıf bir performans sergilemediysem	1	2	3	4	5
6. Öğrenciler cevap veremeyeceğim herhangi bir soru sormadıysa.	1	2	3	4	5
7. Benim sınıflarım sınavlarda diğer öğretmenlerin sınıflarından daha kötü sonuçlar almadıysa.	1	2	3	4	5
8. Sınıflarımın hiçbirinde konu anlatımında bir sorun yaşamadıysam.	1	2	3	4	5
9. Benim sınıflarım diğer öğretmenlerin sınıflarına göre müfredatta daha geride değilse.	1	2	3	4	5
10. İşleyeceğim konular kolaysa ve bu yüzden derse hazırlık yapmak zorunda kalmadıysam.	1	2	3	4	5
11. Çok çalışmak zorunda olmadığım bir gün geçirdiysem.	1	2	3	4	5
12. Okumak zorunda olduğum ev ödevi veya sınav yoktu ise.	1	2	3	4	5
13. Derste sorun çıkaran öğrencilerin bazıları derse gelmediyse.	1	2	3	4	5
14. Derslerimden bazıları iptal edildiyse.	1	2	3	4	5
15. Ek bir sorumluluk almaktan kaçınabildiysem.	1	2	3	4	5
16. Bir öğretmen olarak kendim hakkında yeni bir şeyler öğrendiysem.	1	2	3	4	5
17. Sınıf içerisinde olan bazı olaylar mesleki bilgilerimi derinleştirmede beni daha istekli yaptıysa.	1	2	3	4	5
18. Bir öğrenci konu hakkında tekrar düşünmemi sağlayacak bir soru sorduysa.	1	2	3	4	5
19. Geçmişe göre profesyonel anlamda daha da geliştiğimi ve daha etkili bir şekilde öğrettiğimi fark ettiysem.	1	2	3	4	5
20. Öğretme becerimle ilgili bir problemin üstesinden geldiysem.	1	2	3	4	5
21. Yeni bir öğretim metodu geliştirmek için çok zaman harcarsam ve vermiş olduğum emekler buna değdiyse.	1	2	3	4	5
22. Bütün gün işimle ilgili ve meşgul olursam.	1	2	3	4	5

2. Kısım: Öğretmen Öz-Yeterlik Anketi

	Yetersiz		Çok az yeterli		Biraz yeterli		Oldukça yeterli		Çok yeterli
1. Sınıfta dersi olumsuz yönde etkileyen davranışları kontrol etmeyi ne kadar sağlayabilirsiniz?	1	2	3	4	5	6	7	8	9
2. Derslere az ilgi gösteren öğrencileri motive etmeyi ne kadar sağlayabilirsiniz?	1	2	3	4	5	6	7	8	9
3. Öğrencileri okulda başarılı olabileceklerine inandırmayı ne kadar sağlayabilirsiniz?	1	2	3	4	5	6	7	8	9
4. Öğrencilerin öğrenmeye değer vermelerini ne kadar sağlayabilirsiniz?	1	2	3	4	5	6	7	8	9
5. Öğrencilerinizi iyi bir şekilde değerlendirmesine olanak sağlayacak soruları ne ölçüde hazırlayabilirsiniz?	1	2	3	4	5	6	7	8	9
6. Öğrencilerin sınıf kurallarına uymalarını ne kadar sağlayabilirsiniz?	1	2	3	4	5	6	7	8	9
7. Dersi olumsuz yönde etkileyen ya da derste gürültü yapan öğrencileri ne kadar yatıştırabilirsiniz?	1	2	3	4	5	6	7	8	9
8. Farklı öğrenci gruplarına uygun sınıf yönetim sistemini ne kadar iyi oluşturabilirsiniz?	1	2	3	4	5	6	7	8	9
9. Farklı değerlendirme yöntemlerini ne kadar kullanabilirsiniz?	1	2	3	4	5	6	7	8	9
10. Öğrencilerin kafası karıştığında ne kadar alternatif açıklama ya da örnek sağlayabilirsiniz?	1	2	3	4	5	6	7	8	9
11. Çocuklarının okulda başarılı olmalarına yardımcı olmaları için ailelere ne kadar destek olabilirsiniz?	1	2	3	4	5	6	7	8	9
12. Sınıfta farklı öğretim yöntemlerini ne kadar iyi uygulayabilirsiniz?	1	2	3	4	5	6	7	8	9

3. Kısım: Kişisel Vatandaşlık Davranışlar Ölçeği	Kesinlikle Katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle Katılıyorum
1. Okuldaki sosyal kulüplerde çalışırım.	1	2	3	4	5
2. Kendime ait zamanlarda da öğrencilerle ilgilenirim.	1	2	3	4	5
3. Yeni öğretmenlere yardımcı olmada ve yol göstermede gönüllü olurum.	1	2	3	4	5
4. Kendi kişisel işlerime okul günleri dışında zaman ayırırım.	1	2	3	4	5
5. Okula nadiren gelmem.	1	2	3	4	5
6. Evde veya okulda öğrenci velilerinin benimle iletişime geçebilmelerini kolaylaştırırım.	1	2	3	4	5
7. Öğrenci velilerini okul ile ilgili faaliyetlerde gönüllü olmaları ve okulu ziyaret etmeleri için davet ederim.	1	2	3	4	5

4. Kısım: Öğrenci Merkezli İnançlar Ölçeği

1. Dersi hazırlarken öğrenci fikirlerini dikkate almanın etkili bir yol olduğunu düşünüyorum.	1	2	3	4	5
2. Öğrencilerin sıralarını onların birlikte çalışmalarına olanak sağlayacak şekilde düzenlemeyi tercih ederim.	1	2	3	4	5
3. Öğrencileri sınıf panolarını etkili bir şekilde kullanmaları için teşvik ederim.	1	2	3	4	5
4. Ödevleri değerlendirme ve kendi hedeflerini belirleme sürecine öğrencileri dahil ederim.	1	2	3	4	5
5. Öğrencilere, benim yönlendirmem olmadan birlikte çalışmaları için zaman ayırmayı bir öncelik olarak görürüm.	1	2	3	4	5
6. Öğrencileri gözlem ve sözlü iletişim gibi informal yollarla değerlendirmeyi tercih ederim.	1	2	3	4	5
7. Öğrencilerin ilgilerine ve fikirlerine dayalı içeriğe sahip etkinlikler kullanmayı tercih ederim.	1	2	3	4	5

5. Kısım: Epistemolojik İnançlar Anketi

	Kesinlikle Katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle Katılıyorum
1. Tüm insanlar, bilim insanlarının söylediklerine inanmak zorundadır.	1	2	3	4	5
2. Bilimde, bütün soruların tek bir doğru yanıtı vardır.	1	2	3	4	5
3. Bilimsel deneylerdeki fikirler, olayların nasıl meydana geldiğini merak edip düşünerek ortaya çıkar.	1	2	3	4	5
4. Günümüzde bazı bilimsel düşünceler, bilim insanlarının daha önce düşündüklerinden farklıdır.	1	2	3	4	5
5. Bir deneye başlamadan önce, deneyle ilgili bir fikrinizin olmasında yarar vardır.	1	2	3	4	5
6. Bilimsel kitaplarda yazanlara inanmak zorundasınız.	1	2	3	4	5
7. Bilimsel çalışma yapmanın en önemli kısmı, doğru yanıta ulaşmaktır.	1	2	3	4	5
8. Bilimsel kitaplardaki bilgiler bazen değişir.	1	2	3	4	5
9. Bilimsel çalışmalarda düşüncelerin test edilebilmesi için birden fazla yol olabilir.	1	2	3	4	5
10. Fen ve Teknoloji dersinde, öğretmenin söylediği her şey doğrudur.	1	2	3	4	5
11. Bilimdeki düşünceler, konu ile ilgili kendi kendinize sorduğunuz sorulardan ve deneysel çalışmalarınızdan ortaya çıkabilir.	1	2	3	4	5
12. Bilim insanları bilim hakkında hemen hemen her şeyi bilir, yani bilinecek daha fazla bir şey kalmamıştır.	1	2	3	4	5
13. Bilim insanlarının bile yanıtlayamayacağı bazı sorular vardır.	1	2	3	4	5
14. Olayların nasıl meydana geldiği hakkında yeni fikirler bulmak için deneyler yapmak, bilimsel çalışmanın önemli bir parçasıdır.	1	2	3	4	5
15. Bilimsel kitaplardan okuduklarınızın doğru olduğundan emin olabilirsiniz.	1	2	3	4	5
16. Bilimsel bilgi her zaman doğrudur.	1	2	3	4	5
17. Bilimsel düşünceler bazen değişir.	1	2	3	4	5
18. Sonuçlardan emin olmak için, deneylerin birden fazla tekrarlanmasında fayda vardır.	1	2	3	4	5
19. Sadece bilim insanları, bilimde neyin doğru olduğunu kesin olarak bilirler.	1	2	3	4	5
20. Bilim insanının bir deneyden aldığı sonuç, o deneyin tek yanıtıdır.	1	2	3	4	5
21. Yeni buluşlar, bilim insanlarının doğru olarak düşündüklerini değiştirir.	1	2	3	4	5
22. Bilimdeki, parlak fikirler sadece bilim insanlarından değil, herhangi birinden de gelebilir.	1	2	3	4	5
23. Bilim insanları bilimde neyin doğru olduğu konusunda her zaman hemfikirdirler.	1	2	3	4	5
24. İyi çıkarımlar, birçok farklı deneyin sonucundan elde edilen kanıtlara dayanır.	1	2	3	4	5
25. Bilim insanları, bilimde neyin doğru olduğu ile ilgili düşüncelerini bazen değiştirirler.	1	2	3	4	5
26. Bir şeyin doğru olup olmadığını anlamak için deney yapmak iyi bir yoldur.	1	2	3	4	5

Appenddix B: Student Questionnaire

Sevgili Öğrenciler,

Bu çalışma ile sizlerin öğrenim yaşantınız hakkında bilgiler alınması hedeflenmektedir. Unutmayınız ki bu bir test değildir ve doğru ya da yanlış cevap yoktur. Lütfen her cümleyi dikkatle okuduktan sonra, size en uygun gelen seçeneği mutlaka işaretleyiniz.

Katkılarınızdan dolayı teşekkür ederim.

Ar. Gör. Savaş PAMUK
ODTÜ İlköğretim Bölümü

Kişisel Bilgiler:

1. **Cinsiyetiniz nedir?** ① Erkek ② Kız
2. **Kardeş sayısı:** ....
3. **Yaşınız:** ....
4. **Geçen dönemdeki Fen ve Teknoloji karne notunuz:** ....
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

Anne ve Babanızın eğitim düzeyi nedir?

7. **Anne**
   ① Hiç okula gitmemiş
   ② İlkokul
   ③ Ortaokul
   ③ Ortaokul
   ④ Lise
   ⑤ Üniversite
   ⑥ Yüksek Lisans
   ⑦ Doktora

8. **Baba**
   ① Hiç okula gitmemiş
   ② İlkokul
   ③ Ortaokul
   ③ Ortaokul
   ④ Lise
   ⑤ Üniversite
   ⑥ Yüksek Lisans
   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 bilgisayarınız var mı?**
    ① Evet ② Hayır

13. **Bilgisayarınızın internet bağlantısı var mı?**
    ① Evet ② Hayır

1. Kısım: Yapılandırıcı Öğrenme Ortamı Anketi

	Hiçbir Zaman	Nadiren	Bazen	Sıklıkla	Her Zaman
1. Fen ve Teknoloji dersimizde okul içindeki ve dışındaki dünya hakkında bilgi ediniyorum.	1	2	3	4	5
2. Fen ve Teknoloji dersimizde bilimin problemlere her zaman bir çözüm getiremediğini öğreniyorum.	1	2	3	4	5
3. Fen ve Teknoloji dersimizde neyin, nasıl öğretildiğini rahatlıkla sorguluyorum.	1	2	3	4	5
4. Fen ve Teknoloji dersimizde ne öğreneceğimin planlanmasında öğretmene yardımcı oluyorum.	1	2	3	4	5
5. Fen ve Teknoloji dersimizde problemleri nasıl çözeceğimi diğer öğrenciler ile tartışıyorum.	1	2	3	4	5
6. Fen ve Teknoloji dersimizde ne kadar iyi öğrendiğimin değerlendirilmesinde/ölçülmesinde öğretmene yardımcı oluyorum.	1	2	3	4	5
7. Fen ve Teknoloji dersimizde öğrendiğim yeni bilgilerin okul içinde ve dışında edindiğim deneyimler ile ilişkili olduğunun farkındayım.	1	2	3	4	5
8. Fen ve Teknoloji dersimizde neyin, nasıl öğretildiğini rahatlıkla sorgulamama izin verildiğinde daha iyi öğreniyorum.	1	2	3	4	5
9. Fen ve Teknoloji dersimizde bilimsel açıklamaların zaman içinde değiştiğini öğreniyorum.	1	2	3	4	5
10. Fen ve Teknoloji dersimizde diğer öğrenciler benim fikrimi açıklamamı istiyorlar.	1	2	3	4	5
11. Fen ve Teknoloji dersimizde bilimin okul içindeki ve dışındaki hayatın bir parçası olduğunu öğreniyorum.	1	2	3	4	5
12. Fen ve Teknoloji dersimizde hangi etkinliklerin benim için daha yararlı olacağına karar vermede öğretmene yardımcı oluyorum.	1	2	3	4	5
13. Fen ve Teknoloji dersimizde bilimin, insanların kültürel değerlerinden ve fikirlerinden etkilendiğini öğreniyorum.	1	2	3	4	5
14. Fen ve Teknoloji dersimizde fikirlerimi diğer öğrencilere açıklıyorum.	1	2	3	4	5
15. Fen ve Teknoloji dersimizde karmaşık olan etkinlikler için açıklayıcı bilgi isteyebiliyorum.	1	2	3	4	5
16. Fen ve Teknoloji dersimizde okul içindeki ve dışındaki dünya hakkında ilginç şeyler öğreniyorum.	1	2	3	4	5
17. Fen ve Teknoloji dersimizde diğer öğrencilerin fikirlerini açıklamalarını istiyorum.	1	2	3	4	5
18. Fen ve Teknoloji dersimizde öğrenmeme engel olabilecek durumlar için düşüncelerimi dile getirebiliyorum.	1	2	3	4	5
19. Fen ve Teknoloji dersimizde bilimin, soruların ortaya konması ve çözüm yollarının oluşturulmasında bir yol olduğunu öğreniyorum.	1	2	3	4	5
20. Fen ve Teknoloji dersimizde herhangi bir etkinlik/aktivite için ne kadar zamana ihtiyacım olduğunu öğretmene bildiriyorum.	1	2	3	4	5

2. Kısım: Öğrenmede Güdüsel Stratejiler Anketi

Bu ankete cevap verirken aşağıda verilen ölçeği göz önüne alınız. **Eğer ifadenin sizi tam olarak yansıttığını düşünüyorsanız, 7' yi işaretleyiniz. Eğer ifadenin sizi hiç yansıtmadığını düşünüyorsanız, 1' i işaretleyiniz. Bu iki durum dışında ise 1 ve 7 arasında sizi en iyi tanımladığını düşündüğünüz numarayı işaretleyiniz.** Unutmayın Doğru ya da Yanlış cevap yoktur yapmanız gereken sizi en iyi tanımlayacak numarayı işaretlemenizdir.

1 --- 2 --- 3 --- 4 --- 5 --- 6 -- 7

beni hiç yansıtmıyor — beni tam olarak yansıtıyor

– ←——●——→ +

	beni hiç yansıtmıyor				**beni tam olarak yansıtıyor**		
1. Fen ve Teknoloji dersinde öğrendiklerimi başka derslerde de kullanabileceğimi düşünüyorum.	1	2	3	4	5	6	7
2. Fen ve Teknoloji dersinden çok iyi bir not alacağımı düşünüyorum.	1	2	3	4	5	6	7
3. Fen ve Teknoloji dersi ile ilgili okumalarda yer alan en zor konuyu bile anlayabileceğimden eminim.	1	2	3	4	5	6	7
4.Fen ve Teknoloji dersindeki konuları öğrenmek benim için önemlidir	1	2	3	4	5	6	7
5. Fen ve Teknoloji dersinde öğretilen temel kavramları öğrenebileceğimden eminim.	1	2	3	4	5	6	7
6. Fen ve Teknoloji dersinde, öğretmenin anlattığı en karmaşık konuyu anlayabileceğimden eminim.	1	2	3	4	5	6	7
7. Fen ve Teknoloji dersinin kapsamında yer alan konular çok ilgimi çekiyor.	1	2	3	4	5	6	7
8. Fen ve Teknoloji dersinde verilen sınav ve ödevleri en iyi şekilde yapabileceğimden eminim.	1	2	3	4	5	6	7
9. Fen ve Teknoloji dersinde çok başarılı olacağımı umuyorum	1	2	3	4	5	6	7
10. Fen ve Teknoloji dersinde öğrendiklerimin benim için faydalı olduğunu düşünüyorum.	1	2	3	4	5	6	7
11. Fen ve Teknoloji dersindeki konulardan hoşlanıyorum.	1	2	3	4	5	6	7
12. Fen ve Teknoloji dersindeki konuları anlamak benim için önemlidir.	1	2	3	4	5	6	7
13. Fen ve Teknoloji dersinde öğretilen becerileri iyice öğrenebileceğimden eminim.	1	2	3	4	5	6	7
14. Dersin zorluğu, öğretmen ve benim becerilerim göz önüne alındığında, Fen ve Teknoloji dersinde başarılı olacağımı düşünüyorum	1	2	3	4	5	6	7
15. Fen ve Teknoloji dersi sırasında başka şeyler düşündüğüm için önemli kısımları sıklıkla kaçırırım.	1	2	3	4	5	6	7
16. Fen ve Teknoloji dersi ile ilgili bir şeyler okurken, okuduklarıma odaklanabilmek için sorular oluştururum.	1	2	3	4	5	6	7
17. 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
18.Eğer Fen ve Teknoloji dersi ile ilgili okumam gereken konuları anlamakta zorlanıyorsam, okuma stratejimi değiştiririm.	1	2	3	4	5	6	7
19. 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
20. Fen ve Teknoloji dersinde işlenen konuları anladığımdan emin olabilmek için kendi kendime sorular sorarım.	1	2	3	4	5	6	7
21. Çalışma tarzımı, dersin gereklilikleri ve öğretmenin öğretme stiline uygun olacak tarzda değiştirmeye çalışırım.	1	2	3	4	5	6	7
22. Genelde derse gelmeden önce konuyla ilgili bir şeyler okurum fakat okuduklarımı çoğunlukla **anlamam**	1	2	3	4	5	6	7
23. Fen ve Teknoloji dersine çalışırken, konuları sadece okuyup geçmek yerine ne öğrenmem gerektiği konusunda düşünmeye çalışırım.	1	2	3	4	5	6	7
24. Fen ve Teknoloji dersine çalışırken iyi anlamadığım kavramları belirlemeye çalışırım.	1	2	3	4	5	6	7
25. Fen ve Teknoloji dersine çalışırken, çalışmalarımı yönlendirebilmek için kendime hedefler belirlerim.	1	2	3	4	5	6	7
26. Ders sırasında not alırken kafam karışırsa, notlarımı dersten sonra düzenlerim.	1	2	3	4	5	6	7

– ←——●——→ +

3. Kısım: Epistemolojik İnançlar Anketi	Kesinlikle Katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle Katılıyorum
1. Tüm insanlar, bilim insanlarının söylediklerine inanmak zorundadır.	1	2	3	4	5
2. Bilimde, bütün soruların tek bir doğru yanıtı vardır.	1	2	3	4	5
3. Bilimsel deneylerdeki fikirler, olayların nasıl meydana geldiğini merak edip düşünerek ortaya çıkar.	1	2	3	4	5
4. Günümüzde bazı bilimsel düşünceler, bilim insanlarının daha önce düşündüklerinden farklıdır.	1	2	3	4	5
5. Bir deneye başlamadan önce, deneyle ilgili bir fikrinizin olmasında yarar vardır.	1	2	3	4	5
6. Bilimsel kitaplarda yazanlara inanmak zorundasınız.	1	2	3	4	5
7. Bilimsel çalışma yapmanın en önemli kısmı, doğru yanıta ulaşmaktır.	1	2	3	4	5
8. Bilimsel kitaplardaki bilgiler bazen değişir.	1	2	3	4	5
9. Bilimsel çalışmalarda düşüncelerin test edilebilmesi için birden fazla yol olabilir.	1	2	3	4	5
10. Fen ve Teknoloji dersinde, öğretmenin söylediği her şey doğrudur.	1	2	3	4	5
11. Bilimdeki düşünceler, konu ile ilgili kendi kendinize sorduğunuz sorulardan ve deneysel çalışmalarınızdan ortaya çıkabilir.	1	2	3	4	5
12. Bilim insanları bilim hakkında hemen hemen her şeyi bilir, yani bilinecek daha fazla bir şey kalmamıştır.	1	2	3	4	5
13. Bilim insanlarının bile yanıtlayamayacağı bazı sorular vardır.	1	2	3	4	5
14. Olayların nasıl meydana geldiği hakkında yeni fikirler bulmak için deneyler yapmak, bilimsel çalışmanın önemli bir parçasıdır.	1	2	3	4	5
15. Bilimsel kitaplardan okuduklarınızın doğru olduğundan emin olabilirsiniz.	1	2	3	4	5
16. Bilimsel bilgi her zaman doğrudur.	1	2	3	4	5
17. Bilimsel düşünceler bazen değişir.	1	2	3	4	5
18. Sonuçlardan emin olmak için, deneylerin birden fazla tekrarlanmasında fayda vardır.	1	2	3	4	5
19. Sadece bilim insanları, bilimde neyin doğru olduğunu kesin olarak bilirler.	1	2	3	4	5
20. Bilim insanının bir deneyden aldığı sonuç, o deneyin tek yanıtıdır.	1	2	3	4	5
21. Yeni buluşlar, bilim insanlarının doğru olarak düşündüklerini değiştirir.	1	2	3	4	5
22. Bilimdeki, parlak fikirler sadece bilim insanlarından değil, herhangi birinden de gelebilir.	1	2	3	4	5
23. Bilim insanları bilimde neyin doğru olduğu konusunda her zaman hemfikirdirler.	1	2	3	4	5
24. İyi çıkarımlar, birçok farklı deneyin sonucundan elde edilen kanıtlara dayanır.	1	2	3	4	5
25. Bilim insanları, bilimde neyin doğru olduğu ile ilgili düşüncelerini bazen değiştirirler.	1	2	3	4	5
26. Bir şeyin doğru olup olmadığını anlamak için deney yapmak iyi bir yoldur.	1	2	3	4	5

4. Kısım: Öğrencilere Yönelik Hedef Yönelimleri Ölçeği

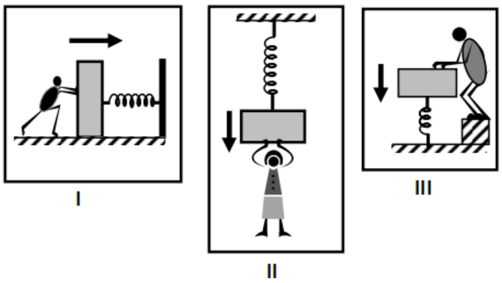
(– ←●→ +)

	Hiçbir Zaman	Nadiren	Bazen	Çoğunlukla	Her Zaman
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. Fen ve Teknoloji dersinin zorlayıcı noktalarının bana ileride olumlu katkılarının olacağını düşünüyorum.	1	2	3	4	5
4. Diğer öğrencilerden daha iyisini yapmak benim için önemlidir.	1	2	3	4	5
5. Fen ve Teknoloji dersinin bana tehdit oluşturduğunu düşünüyorum.	1	2	3	4	5
6. Fen ve Teknoloji dersinden mümkün olduğunca çok şey öğrenmek istiyorum.	1	2	3	4	5
7. Fen ve Teknoloji dersinde beni sıklıkla motive eden şey, diğerlerinden daha körü performans sergileme korkusudur.	1	2	3	4	5
8. Fen ve Teknoloji dersinde verilen her şeyi tam olarak öğrenmek arzusundayım.	1	2	3	4	5
9. Fen ve Teknoloji dersinin zorlayıcı noktaları benim için olumlu etkiler ifade eder.	1	2	3	4	5
10. Fen ve Teknoloji dersinde amacım, diğer pek çok öğrenciden daha iyi bir not almaktır.	1	2	3	4	5
11. Fen ve Teknoloji dersinde öğrenebileceğimden daha azını öğrenmekten korkuyorum.	1	2	3	4	5
12. Fen ve Teknoloji dersini okul hayatımda bir tehdit olarak görüyorum.	1	2	3	4	5
13. Fen ve Teknoloji dersindeki tek amacım diğerlerinden daha başarısız olmanın önüne geçmektir.	1	2	3	4	5
14. Fen ve Teknoloji dersinde öğrenilecek her şeyi öğrenemeyebileceğimden sıklıkla endişe duyuyorum.	1	2	3	4	5
15. Fen ve Teknoloji dersinde başarılı olmayı bekliyorum.	1	2	3	4	5
16. Fen ve Teknoloji dersinde diğerlerine göre daha başarılı olmak benim için önemlidir.	1	2	3	4	5
17. Bazen Fen ve Teknoloji dersinin içeriğini istediğim kadar iyi anlayamayacağımdan korkuyorum.	1	2	3	4	5
18. Fen ve Teknoloji dersinden mükemmel bir not alacağıma inanıyorum.	1	2	3	4	5
19. Fen ve Teknoloji dersinde amacım başarısız olmaktan kaçınmaktır.	1	2	3	4	5
20. Fen ve Teknoloji dersinde beni sıklıkla motive eden şey başarısız olma korkusudur.	1	2	3	4	5
21. Fen ve Teknoloji dersinde sadece başarısız olmaktan kaçınmak istiyorum.	1	2	3	4	5

7. Sınıf Fen ve Teknoloji Testi

1.

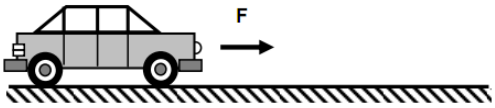
Üç öğrenci I, II, III'teki yaylara oklarla gösterilen yönlerdeki kuvvetleri uyguluyorlar.



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

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

2.



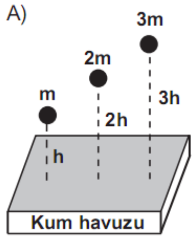
F kuvveti etkisiyle düzgün doğrusal yolda hareket eden bir arabanın, hareketinden bir süre sonra şoför frene basıyor. Frenin etkisi ile arabaya etki eden net kuvvet hareket süresince sıfır olduğuna göre; bundan sonra arabanın hareketi için ne söylenebilir?

A) Süratlenerek yoluna devam eder.
B) Sabit süratle yoluna devam eder.
C) Frene basıldığı anda durur.
D) Yavaşlayarak durur.

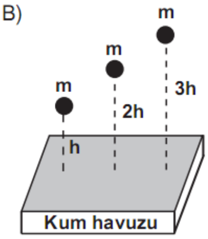
3. **Bir öğretmen öğrencilerinden "Kinetik enerji kütle ile doğru orantılıdır." ifadesini doğrulayan bir deney düzeneği hazırlamalarını istiyor.**
Öğrencilerin hazırladığı aşağıdaki düzeneklerde kütleleri verilmiş eşit hacimli küresel cisimler, belirtilen yüksekliklerden serbest bırakılıyor ve bu cisimlerin kum havuzunda oluşturdukları çukurların derinlikleri not ediliyor.

Bunlardan hangisi öğretmenin istediği düzenektir?

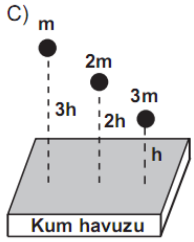
A)



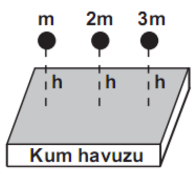
B)



C)



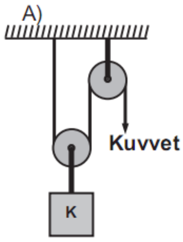
D)



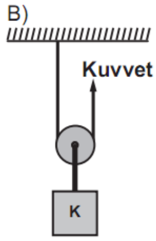
4. **Öğretmen öğrencilerine, "Bana öyle bir makara sistemi hazırlayın ki bu sistem, uyguladığım kuvveti K cismine zıt yönde iletsin." diyor. Öğrenciler de aşağıdaki düzenekleri hazırlıyorlar.**

Hangisi öğretmenin istediği düzenektir?

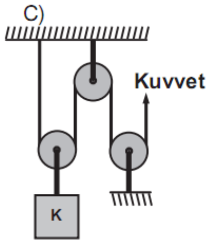
A)



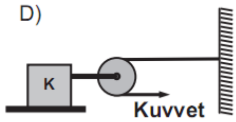
B)



C)

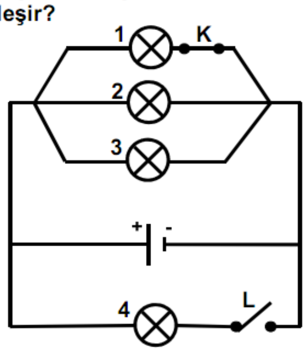


D)



5.

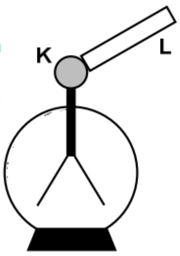
Numaralandırılmış özdeş ampullerle kurulu şekildeki devrede K anahtarı açılıp L anahtarı kapatıldığında aşağıdaki durumlardan hangisi gerçekleşir?



A) 2 ve 3 nolu ampullerin parlaklığı aynı kalır.
B) Ana koldan geçen akım artar.
C) 1 nolu ampulün parlaklığı artar.
D) Devrenin eşdeğer direnci artar.

6.

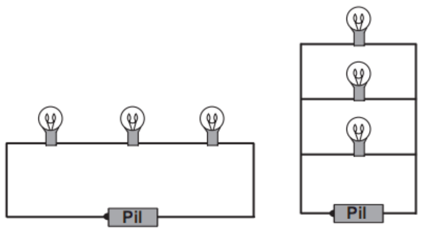
Cem, yaprakları biraz açık bulunan K elektroskobunun topuzuna L cismini şekildeki gibi dokundurduğunda K'nın yapraklarının önce kapanıp sonra tekrar açıldığını gözlemliyor.
Buna göre K ve L'nin birbirine dokundurulmadan önceki yük durumları hangisindeki gibi olabilir?



	K	L
A)	Nötr	–
B)	–	+
C)	–	–
D)	+	+

7.

Öğretmen; Gül, Tuğba ve İlker'den tahtaya çizdiği 1. ve 2. devreleri oluşturacakları bir deney düzeneği kurmalarını istiyor.



1. devre 2. devre

Deney öncesinde öğrenciler aşağıdaki tahminlerde bulunuyorlar.

Gül : 2. devredeki ampuller 1. devredekilere göre daha uzun süre ışık verirler.
Tuğba : 2. devredeki ampuller 1. devredekilere göre daha parlak ışık verirler.
İlker : Ampullerin 1. veya 2. devredeki gibi bağlanması ışık verme sürelerini değiştirmez.

Devrelerdeki pil, iletken tel ve ampuller özdeş olduğuna göre, deney sonucunda hangi öğrencilerin tahmini doğru çıkacaktır?

A) Yalnız Gül B) Yalnız Tuğba
C) Gül ve Tuğba D) Tuğba ve İlker

8.

K, L ve M cisimlerinden M'nin nötr olduğu biliniyor, K ve L'nin yük durumları ise bilinmiyor. K, L'ye dokundurulup ayrıldığında K ve L'nin birbirine itme-çekme kuvveti uygulamadıkları görülüyor. K, L'ye dokundurulmadan önce M'ye dokundurulup ayrıldığında ise K ve M'nin birbirini ittikleri görülüyor.

Buna göre, K ve L'nin <u>ilk</u> yük durumlarıyla ilgili aşağıda verilenlerden hangileri doğru olabilir?

I- K ve L nötrdür.
II- K ve L pozitif yüklüdür.
III- K pozitif, L negatif yüklüdür.

A) Yalnız I B) Yalnız III
C) I - III D) II - III

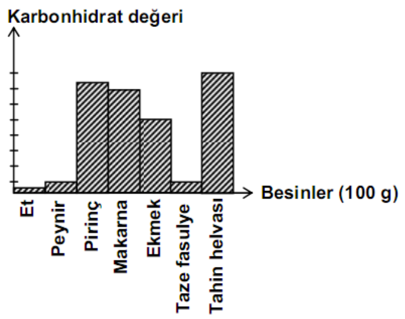
9.

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

10.



Doktor, Ayşe'ye fazla kilo aldığını söyleyip beslenme uzmanı (diyetisyen)na göndermiştir. Beslenme uzmanı, karbonhidratlı besinleri az yemesini önerip, bazı besinlerdeki karbonhidrat değerlerini yukarıdaki grafikle anlatmıştır.

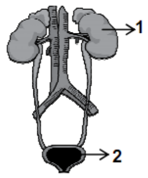
Ayşe, miktarları eşit olan aşağıdaki yemeklerden hangisini yerse, beslenme uzmanının önerisine uymuş olur?

A) Etli taze fasulye
B) Etli pirinç pilavı
C) Peynirli makarna
D) Ekmek arasında tahin helvası

11.

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

12.

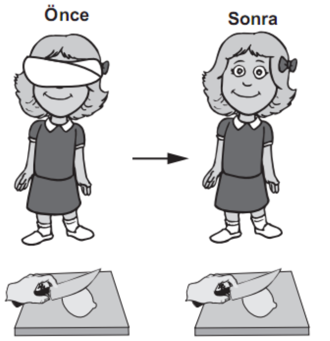
Aşağıdaki tabloyu hazırlayan öğretmen, öğrencilerine tahtadaki yazıları yakından ve uzaktan okumalarını söylüyor.

Sorular / İsimler	Tahtadaki yazıyı yakından okuyor mu?	Tahtadaki yazıyı uzaktan okuyor mu?
Ayşe	Evet	Hayır
Ahmet	Evet	Evet
Mehmet	Hayır	Evet
Seda	Hayır	Evet
Ali	Evet	Evet

Sonuçları tabloya yazan öğretmen öğrencilerinde hangi göz kusurlarını belirlemek istiyor?

A) Miyopluk ve hipermetropluk
B) Şaşılık ve renk körlüğü
C) Astigmatlık ve şaşılık
D) Renk körlüğü ve miyopluk

13.



Hipotez: Limon kesilirken görünce ağız sulanır.

Bu hipotezin doğruluğunu araştırmak isteyen bir öğrenci, arkadaşının gözlerini bağlayıp ona söylemeden yanında limon kesiyor. Sonra da arkadaşının gözleri açıkken yanında limon kesiyor.

Öğrencinin hipotezinin doğru olması için arkadaşında hangi durumu gözlemesi gerekir?

A) Her iki durumda da ağzının sulanması
B) Her iki durumda da ağzının sulanmaması
C) Sadece gözleri bağlı iken ağzının sulanması
D) Sadece gözleri açık iken ağzının sulanması

14.

Hastanedeki nefroloji (böbrek hastalıkları ve tedavisi) uzmanı Doktor Ahmet, aşağıdaki tabloya hastaların günde ne kadar su içtiklerini yazacaktır.

Özellikler / Hasta adı	Hastalık adı	Günde içilen su miktarı
Sema Demir	Böbrek iltihabı	
Mehmet Yıldız	İdrar yolu iltihabı	
Serdar Kaya	Böbrek taşı	
Ayşe Yılmaz	Böbrek taşı	

Buna göre, Doktor Ahmet'in araştırma sorusu nedir?

A) Boşaltım sistemi hastalıkları, içilen su miktarına bağlı mıdır?
B) Çok su içen hastalarda idrar daha fazla olur mu?
C) Böbrek iltihabı bir süre sonra böbrek taşı oluşturur mu?
D) Boşaltım sistemi hastalıkları beslenmeye bağlı mıdır?

Appendix C: Permission from Turkish Ministery of National Education

EĞİTİM FAKÜLTESİ DEKANLIĞI
Ev. Ars. Md. Şazi:

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

BÖLÜM : İstatistik Bölümü
SAYI : B.B.08.4.MEM.4.06.00.06-312/111787
KONU : Araştırma İzni
Savaş PAMUK

16/12/2009

ORTA DOĞU TEKNİK ÜNİVERSİTESİNE
(İlköğretim Anabilim Dalı)

İlgi : a) MEB Bağlı Okul ve Kurumlarda Yapılacak Araştırma ve Araştırma Desteğine Yönelik İzin ve Uygulama Yönergesi.
b) Üniversiteniz İlköğretim Anabilim Dalının 20/11/2009 tarih ve 16563 sayılı yazısı.

Üniversiteniz İlköğretim Anabilim Dalı Doktora Öğrencisi Savaş PAMUK' un **"Öğretmenlerin kişisel karakterleri, öğrencilerin epistemolojik inançları ve öz-düzenlemeleri arasındaki ilişkilerin bir model ile açıklanması"** konulu tez ile ilgili çalışma yapma isteği Müdürlüğümüzce uygun görülmüş ve araştırmanın yapılacağı İlçe Milli Eğitim Müdürlüğüne bilgi verilmiştir.

Mühürlü anketler (18 sayfadan oluşan) ekte gönderilmiş olup, uygulama yapılacak sayıda çoğaltılması ve çalışmanın bitiminde iki örneğinin (CD/disket) Müdürlüğümüz İstatistik Bölümüne gönderilmesini rica ederim.

Gülçin UYSAL
Müdür a.
Müdür Yardımcısı

EKLER :
Anket (18 sayfa)

21.12.09 021713

İ.Ö. bölümüne iletelim 22/12/09

İl Milli Eğitim Müdürlüğü-Beşevler
Strateji Geliştirme Bölümü
Bilgi İçin: Kamil COŞGUN

Tel : 215 15 43- 413 36 66- 212 66 40/110
Fax: 215 15 43
strateji06@meb.gov.tr

Appendix D: Assumptions of Hierarchical Linear Modeling Analysis

Comparison of multilevel standard errors with robust standard errors is main assumption test for Hierarchical Linear Modeling analysis. Considerable differences between these errors reveal violations of an important assumtions of HLM (Maas & Hox, 2004). Following parts presented the comparison of multilevel standard errors with robust standard errors for all outcome variables of this study. Accordingly, there were not any large differences between values of multilevel standard errors and robust standard errors. It implied that there is no any serious problem with tenability of assumptions.

Constructivist Learning Environment Dimensions

Table D.1 Final estimation of fixed effects for Critical Voice outcome of CLES.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.000216	.024096	.009	135	.993
TEP_JUS, γ_{01}	.092635	.024066	3.849	135	.000

Table D.2 Final estimation of fixed effects (with robust standard errors) for Critical Voice outcome of CLES.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.000216	.024091	.009	135	.993
TEP_JUS, γ_{01}	.092635	.022018	4.207	135	.000

Table D.3 Final estimation of fixed effects for Student Negotiation outcome of CLES.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.001746	.023704	.074	135	.942
TEP_JUS, γ_{01}	.051540	.023672	2.177	135	.031

Table D.4 Final estimation of fixed effects (with robust standard errors) for Student Negotiation outcome of CLES.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.001746	.023753	.074	135	.942
TEP_JUS, γ_{01}	.051540	.024012	2.146	135	.033

Table D.5 Final estimation of fixed effects for Personal Relevance outcome of CLES.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.007379	.029332	-.252	135	.802
TEP_JUS, γ_{01}	.100651	.029338	3.431	135	.001

Table D.6 Final estimation of fixed effects (with robust standard errors) for Personal Relevance outcome of CLES.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.007379	.029339	-.252	135	.802
TEP_JUS, γ_{01}	.100651	.028803	3.494	135	.001

Table D.7 Final estimation of fixed effects for Shared Control outcome of CLES.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.004017	.027409	.147	135	.884
TSELF_IS, γ_{01}	.058324	.027384	2.130	135	.035

Table D.8 Final estimation of fixed effects (with robust standard errors) for Shared Control outcome of CLES.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.004017	.027404	.147	135	.884
TSELF_IS, γ_{01}	.058324	.027719	2.104	135	.037

Table D.9 Final estimation of fixed effects for Uncertainty outcome of CLES.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.005113	.023938	-.214	134	.831
TGOALAAP, γ_{01}	.072549	.024630	2.946	134	.004
TEP_JUS, γ_{02}	.073911	.024506	3.016	134	.004

Table D.10 Final estimation of fixed effects (with robust standard errors) for Uncertainty outcome of CLES.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.005113	.023870	-.214	134	.831
TGOALAAP, γ_{01}	.072549	.025583	2.836	134	.006
TEP_JUS, γ_{02}	.073911	.024570	3.008	134	.004

Epistemological Beliefs Dimensions

Table D.11 Final estimation of fixed effects for Certainty outcome of EB.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.018206	.025759	.707	133	.481
TSELF_SE, γ_{01}	-.063302	.026037	-2.431	133	.017
CLE_P_AG, γ_{02}	-.091600	.027495	-3.332	133	.001
CLE_S_AG, γ_{03}	.169727	.027400	6.194	133	.000
For CLE_CRI, β_1					
INTRCPT2, γ_{10}	-.033425	.021482	-1.556	136	.122
For CLE_CRI, β2					
INTRCPT2, γ_{20}	.182706	.021534	8.485	134	.000
CLE_P_AG, γ_{21}	-.084862	.021975	-3.862	134	.000
CLE_S_AG, γ_{22}	.066091	.022418	2.948	134	.004

Table D.12 Final estimation of fixed effects (with robust standard errors) for Certainty outcome of EB.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.018206	.025771	.706	133	.481
TSELF_SE, γ_{01}	-.063302	.028521	-2.219	133	.028
CLE_P_AG, γ_{02}	-.091600	.029341	-3.122	133	.003
CLE_S_AG, γ_{03}	.169727	.029113	5.830	133	.000
For CLE_CRI, β_1					
INTRCPT2, γ_{10}	-.033425	.021119	-1.583	136	.116
For CLE_CRI, β2					
INTRCPT2, γ_{20}	.182706	.021194	8.621	134	.000
CLE_P_AG, γ_{21}	-.084862	.020146	-4.212	134	.000
CLE_S_AG, γ_{22}	.066091	.022007	3.003	134	.004

Table D.13 Final estimation of fixed effects for Development outcome of EB.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.007826	.018023	-.434	133	.664
TEP_CER, γ_{01}	.046886	.017868	2.624	133	.010
CLE_P_AG, γ_{02}	.089339	.026301	3.397	133	.001
CLE_U_AG, γ_{03}	.092399	.026344	3.507	133	.001
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.128428	.026405	4.864	136	.000
For CLE_UNC, β_2					
INTRCPT2, γ_{20}	.147006	.023614	6.225	135	.000
TEP_CER, γ_{21}	-.047183	.017793	-2.652	135	.009
For CLE_CRI, β_3					
INTRCPT2, γ_{30}	.126100	.026383	4.780	136	.000
For CLE_SHA, β_4					
INTRCPT2, γ_{40}	.065024	.020604	3.156	3271	.002
For CLE_NEG, β_5					
INTRCPT2, γ_{50}	.059882	.021706	2.759	3271	.006

Table D.14 Final estimation of fixed effects (with robust standard errors) for Development outcome of EB.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.007826	.018167	-.431	133	.667
TEP_CER, γ_{01}	.046886	.017457	2.686	133	.009
CLE_P_AG, γ_{02}	.089339	.027800	3.214	133	.002
CLE_U_AG, γ_{03}	.092399	.024097	3.834	133	.000
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.128428	.026404	4.864	136	.000
For CLE_UNC, β_2					
INTRCPT2, γ_{20}	.147006	.023168	6.345	135	.000
TEP_CER, γ_{21}	-.047183	.017553	-2.688	135	.008
For CLE_CRI, β_3					
INTRCPT2, γ_{30}	.126100	.026740	4.716	136	.000
For CLE_SHA, β_4					
INTRCPT2, γ_{40}	.065024	.021806	2.982	3271	.003
For CLE_NEG, β_5					
INTRCPT2, γ_{50}	.059882	.020735	2.888	3271	.004

Table D.15 Final estimation of fixed effects for Justification outcome of EB.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.008807	.018147	-.485	134	.628
TEP_SOU, γ_{01}	.043624	.017813	2.449	134	.016
CLE_P_AG, γ_{02}	.226351	.017710	12.781	134	.000
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.225772	.024598	9.178	136	.000
For CLE_UNC, β_2					
INTRCPT2, γ_{20}	.171546	.023280	7.369	136	.000
For CLE_CRI, β_3					
INTRCPT2, γ_{30}	.174626	.022195	7.868	136	.000
For CLE_NEG, β_4					
INTRCPT2, γ_{40}	.086530	.018664	4.636	3274	.000

Table D.16 Final estimation of fixed effects (with robust standard errors) for Justification outcome of EB.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.008807	.018355	-.480	134	.632
TEP_SOU, γ_{01}	.043624	.020315	2.147	134	.033
CLE_P_AG, γ_{02}	.226351	.021753	10.406	134	.000
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.225772	.024461	9.230	136	.000
For CLE_UNC, β_2					
INTRCPT2, γ_{20}	.171546	.023345	7.348	136	.000
For CLE_CRI, β_3					
INTRCPT2, γ_{30}	.174626	.022499	7.761	136	.000
For CLE_NEG, β_4					
INTRCPT2, γ_{40}	.086530	.018666	4.636	3274	.000

Table D.17 Final estimation of fixed effects for Source outcome of EB.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.017373	.025825	.673	134	.502
CLE_P_AG, γ_{01}	-.115202	.027738	-4.153	134	.000
CLE_S_AG, γ_{02}	.158652	.027547	5.759	134	.000
For CLE_PER, β_1					
INTRCPT2, γ_{10}	-.045460	.021946	-2.071	3274	.038
For CLE_CRI, β_2					
INTRCPT2, γ_{20}	-.055116	.023193	-2.376	3274	.018
For CLE_SHA, β_3					
INTRCPT2, γ_{30}	.213210	.024085	8.852	135	.000
CLE_P_AG, γ_{31}	-.063867	.021913	-2.915	135	.005

Table D.18 Final estimation of fixed effects (with robust standard errors) for Source outcome of EB.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.017373	.025842	.672	134	.502
CLE_P_AG, γ_{01}	-.115202	.028556	-4.034	134	.000
CLE_S_AG, γ_{02}	.158652	.027877	5.691	134	.000
For CLE_PER, β_1					
INTRCPT2, γ_{10}	-.045460	.022263	-2.042	3274	.041
For CLE_CRI, β_2					
INTRCPT2, γ_{20}	-.055116	.023626	-2.333	3274	.020
For CLE_SHA, β_3					
INTRCPT2, γ_{30}	.213210	.021876	9.746	135	.000
CLE_P_AG, γ_{31}	-.063867	.023317	-2.739	135	.007

Self-Efficacy

Table D.19 Final estimation of fixed effects for Self-Efficacy.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.003158	.017662	-.179	134	.859
TSELF_CM, γ_{01}	-.033282	.016810	-1.980	134	.049
CLE_C_AG, γ_{02}	.185225	.017904	10.346	134	.000
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.165249	.019405	8.516	3270	.000
For CLE_CRI, β_2					
INTRCPT2, γ_{20}	.221077	.024662	8.964	135	.000
CLE_C_AG, γ_{21}	-.045461	.020888	-2.176	135	.031
For CLE_SHA, β_3					
INTRCPT2, γ_{30}	.052463	.018216	2.880	3270	.004
For CLE_NEG, β_4					
INTRCPT2, γ_{40}	.064690	.023226	2.785	135	.007
CLE_P_AG, γ_{41}	.046688	.019393	2.407	135	.018
For EP_JUS, β_5					
INTRCPT2, γ_{50}	.194016	.019075	10.171	3270	.000
For EP_DEV, β_6					
INTRCPT2, γ_{60}	.050640	.017610	2.876	3270	.005

Table D.20 Final estimation of fixed effects (with robust standard errors) for Self-Efficacy outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.003158	.017677	-.179	134	.859
TSELF_CM, γ_{01}	-.033282	.016175	-2.058	134	.041
CLE_C_AG, γ_{02}	.185225	.016540	11.199	134	.000
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.165249	.020580	8.030	3270	.000
For CLE_CRI, β_2					
INTRCPT2, γ_{20}	.221077	.024746	8.934	135	.000
CLE_C_AG, γ_{21}	-.045461	.020940	-2.171	135	.032
For CLE_SHA, β_3					
INTRCPT2, γ_{30}	.052463	.018179	2.886	3270	.004
For CLE_NEG, β_4					
INTRCPT2, γ_{40}	.064690	.024373	2.654	135	.009
CLE_P_AG, γ_{41}	.046688	.020333	2.296	135	.023
For EP_JUS, β_5					
INTRCPT2, γ_{50}	.194016	.022000	8.819	3270	.000
For EP_DEV, β_6					
INTRCPT2, γ_{60}	.050640	.018100	2.798	3270	.006

Achievement Goal Orientations

Table D.21 Final estimation of fixed effects for Mastery Approach outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.002318	.018944	-.122	134	.903
CLE_P_AG, γ_{01}	.143719	.019083	7.531	134	.000
CLE_S_AG, γ_{02}	-.047543	.018151	-2.619	134	.010
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.201736	.022920	8.802	136	.000
For CLE_CRI, β_2					
INTRCPT2, γ_{20}	.096045	.023623	4.066	136	.000
For CLE_ NEG, β_3					
INTRCPT2, γ_{30}	.039376	.018570	2.120	136	.036
For EP_JUS, β_4					
INTRCPT2, γ_{40}	.375312	.020897	17.960	136	.000

Table D.22 Final estimation of fixed effects (with robust standard errors) for Mastery Approach outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.002318	.018756	-.124	134	.902
CLE_P_AG, γ_{01}	.143719	.021857	6.575	134	.000
CLE_S_AG, γ_{02}	-.047543	.015685	-3.031	134	.003
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.201736	.022962	8.786	136	.000
For CLE_CRI, β_2					
INTRCPT2, γ_{20}	.096045	.023484	4.090	136	.000
For CLE_ NEG, β_3					
INTRCPT2, γ_{30}	.039376	.018555	2.122	136	.035
For EP_JUS, β_4					
INTRCPT2, γ_{40}	.375312	.021294	17.626	136	.000

Table D.23 Final estimation of fixed effects for Performance Approach outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.004435	.020680	.214	135	.831
CLE_C_AG, γ_{01}	.063814	.019486	3.275	135	.002
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.108984	.021494	5.071	3271	.000
For CLE_CRI, β_2					
INTRCPT2, γ_{20}	.046273	.027014	1.713	136	.089
For CLE_SHA, β_3					
INTRCPT2, γ_{30}	.025571	.024185	1.057	136	.293
For CLE_NEG, β_4					
INTRCPT2, γ_{40}	.037296	.023829	1.565	136	.120
For EP_SOU, β_5					
INTRCPT2, γ_{50}	.001154	.023661	.049	136	.962
For EP_CER, β_6					
INTRCPT2, γ_{60}	.122453	.021311	5.746	3271	.000
For EP_JUS, β_7					
INTRCPT2, γ_{70}	.231116	.021338	10.831	3271	.000
For EP_DEV, β_8					
INTRCPT2, γ_{80}	.051963	.022226	2.338	136	.021

Table D.24 Final estimation of fixed effects (with robust standard errors) for Performance Approach outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.004435	.020494	.216	135	.829
CLE_C_AG, γ_{01}	.063814	.021876	2.917	135	.005
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.108984	.021707	5.021	3271	.000
For CLE_CRI, β_2					
INTRCPT2, γ_{20}	.046273	.025541	1.812	136	.072
For CLE_SHA, β_3					
INTRCPT2, γ_{30}	.025571	.024083	1.062	136	.291
For CLE_NEG, β_4					
INTRCPT2, γ_{40}	.037296	.023578	1.582	136	.116
For EP_SOU, β_5					
INTRCPT2, γ_{50}	.001154	.025074	.046	136	.964
For EP_CER, β_6					
INTRCPT2, γ_{60}	.122453	.022498	5.443	3271	.000
For EP_JUS, β_7					
INTRCPT2, γ_{70}	.231116	.021664	10.668	3271	.000
For EP_DEV, β_8					
INTRCPT2, γ_{80}	.051963	.022853	2.274	136	.025

Table D.25 Final estimation of fixed effects for Mastery Avoidance outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.007155	.020663	.346	135	.729
CLE_S_AG, γ_{01}	.064252	.020148	3.189	135	.002
For CLE_UNC, β_1					
INTRCPT2, γ_{10}	.036170	.024871	1.454	136	.148
For CLE_SHA, β_2					
INTRCPT2, γ_{20}	.025806	.024472	1.055	136	.294
For CLE_NEG, β_3					
INTRCPT2, γ_{30}	.070982	.021491	3.303	3272	.001
For EP_SOU, β_4					
INTRCPT2, γ_{40}	.092097	.022484	4.096	3272	.000
For EP_CER, β_5					
INTRCPT2, γ_{50}	.155674	.022605	6.887	3272	.000
For EP_JUS, β_6					
INTRCPT2, γ_{60}	.057076	.021895	2.607	3272	.010
For EP_DEV, β_7					
INTRCPT2, γ_{70}	.070170	.020835	3.368	3272	.001

Table D.26 Final estimation of fixed effects (with robust standard errors) for Mastery Avoidance outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.007155	.020709	.345	135	.730
CLE_S_AG, γ_{01}	.064252	.018130	3.544	135	.001
For CLE_UNC, β_1					
INTRCPT2, γ_{10}	.036170	.023717	1.525	136	.129
For CLE_SHA, β_2					
INTRCPT2, γ_{20}	.025806	.025592	1.008	136	.316
For CLE_NEG, β_3					
INTRCPT2, γ_{30}	.070982	.024430	2.906	3272	.004
For EP_SOU, β_4					
INTRCPT2, γ_{40}	.092097	.024059	3.828	3272	.000
For EP_CER, β_5					
INTRCPT2, γ_{50}	.155674	.025844	6.024	3272	.000
For EP_JUS, β_6					
INTRCPT2, γ_{60}	.057076	.024693	2.311	3272	.021
For EP_DEV, β_7					
INTRCPT2, γ_{70}	.070170	.024439	2.871	3272	.005

Table D.27 Final estimation of fixed effects for Performance Avoidance outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.010725	.021487	.499	133	.618
TGOALTAS, γ_{01}	-.052307	.020616	-2.537	133	.013
TEP_JUS, γ_{02}	-.040715	.020140	-2.022	133	.045
CLE_S_AG, γ_{03}	.057552	.019676	2.925	133	.005
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.055992	.021801	2.568	3271	.011
For CLE_UNC, β_2					
INTRCPT2, γ_{20}	.052809	.021199	2.491	3271	.013
For CLE_NEG, β_3					
INTRCPT2, γ_{30}	.056938	.019482	2.923	3271	.004
For EP_SOU, β_4					
INTRCPT2, γ_{40}	.079320	.024989	3.174	136	.002
For EP_CER, β_5					
INTRCPT2, γ_{50}	.216174	.021953	9.847	3271	.000
For EP_DEV, β_6					
INTRCPT2, γ_{60}	.084337	.017767	4.747	3271	.000

Table D.28 Final estimation of fixed effects (with robust standard errors) for Performance Avoidance outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.010725	.021254	.505	133	.614
TGOALTAS, γ_{01}	-.052307	.030761	-1.700	133	.091
TEP_JUS, γ_{02}	-.040715	.019562	-2.081	133	.039
CLE_S_AG, γ_{03}	.057552	.017915	3.213	133	.002
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.055992	.020971	2.670	3271	.008
For CLE_UNC, β_2					
INTRCPT2, γ_{20}	.052809	.023234	2.273	3271	.023
For CLE_NEG, β_3					
INTRCPT2, γ_{30}	.056938	.020397	2.791	3271	.006
For EP_SOU, β_4					
INTRCPT2, γ_{40}	.079320	.023123	3.430	136	.001
For EP_CER, β_5					
INTRCPT2, γ_{50}	.216174	.022380	9.659	3271	.000
For EP_DEV, β_6					
INTRCPT2, γ_{60}	.084337	.018718	4.506	3271	.000

Task Value

Table D.29 Final estimation of fixed effects for Task Value outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.005063	.017943	-.282	134	.778
CLE_P_AG, γ_{01}	.132188	.019832	6.665	134	.000
CLE_N_AG, γ_{02}	.049984	.019290	2.591	134	.011
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.243570	.022161	10.991	136	.000
For CLE_CRI, β_2					
INTRCPT2, γ_{20}	.163072	.019570	8.333	3274	.000
For CLE_NEG, β_3					
INTRCPT2, γ_{30}	.078546	.017590	4.465	3274	.000
For EP_JUS, β_4					
INTRCPT2, γ_{40}	.269083	.021434	12.554	136	.000

Table D.30 Final estimation of fixed effects (with robust standard errors) for Task Value outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.005063	.017685	-.286	134	.775
CLE_P_AG, γ_{01}	.132188	.019841	6.662	134	.000
CLE_N_AG, γ_{02}	.049984	.018690	2.674	134	.009
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.243570	.020977	11.611	136	.000
For CLE_CRI, β_2					
INTRCPT2, γ_{20}	.163072	.020663	7.892	3274	.000
For CLE_NEG, β_3					
INTRCPT2, γ_{30}	.078546	.017306	4.539	3274	.000
For EP_JUS, β_4					
INTRCPT2, γ_{40}	.269083	.021832	12.325	136	.000

Metacognitive Self-Regulation

Table D.31 Final estimation of fixed effects for Metacognitive Self-Regulation.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.001394	.019001	.073	133	.942
CLE_C_AG, γ_{01}	.080574	.026794	3.007	133	.004
CLE_S_AG, γ_{02}	.054939	.025526	2.152	133	.033
CLE_N_AG, γ_{03}	.053944	.026905	2.005	133	.047
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.152295	.020659	7.372	3266	.000
For CLE_UNC, β_2					
INTRCPT2, γ_{20}	.063980	.019391	3.299	3266	.001
For CLE_CRI, β_3					
INTRCPT2, γ_{30}	.144906	.023712	6.111	136	.000
For CLE_SHA, β_4					
INTRCPT2, γ_{40}	.125467	.018726	6.700	3266	.000
For CLE_NEG, β_5					
INTRCPT2, γ_{50}	.056237	.019516	2.882	3266	.004
For EP_SOU, β_6					
INTRCPT2, γ_{60}	.037272	.020948	1.779	136	.077
For EP_CER, β_7					
INTRCPT2, γ_{70}	.090583	.019554	4.632	3266	.000
For EP_JUS, β_8					
INTRCPT2, γ_{80}	.147101	.023367	6.295	136	.000
For EP_DEV, β_9					
INTRCPT2, γ_{90}	.030919	.019791	1.562	134	.120
CLE_C_AG, γ_{91}	-.054078	.021859	-2.474	134	.015
CLE_N_AG, γ_{92}	.066346	.021560	3.077	134	.003

Table D.32 Final estimation of fixed effects (with robust standard errors) for Metacognitive Self-Regulation outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	.001394	.018729	.074	133	.942
CLE_C_AG, γ_{01}	.080574	.023814	3.383	133	.001
CLE_S_AG, γ_{02}	.054939	.024349	2.256	133	.026
CLE_N_AG, γ_{03}	.053944	.024872	2.169	133	.032
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.152295	.021658	7.032	3266	.000
For CLE_UNC, β_2					
INTRCPT2, γ_{20}	.063980	.017829	3.589	3266	.001
For CLE_CRI, β_3					
INTRCPT2, γ_{30}	.144906	.022436	6.459	136	.000
For CLE_SHA, β_4					
INTRCPT2, γ_{40}	.125467	.020121	6.236	3266	.000
For CLE_NEG, β_5					
INTRCPT2, γ_{50}	.056237	.020799	2.704	3266	.007
For EP_SOU, β_6					
INTRCPT2, γ_{60}	.037272	.020846	1.788	136	.076
For EP_CER, β_7					
INTRCPT2, γ_{70}	.090583	.019904	4.551	3266	.000
For EP_JUS, β_8					
INTRCPT2, γ_{80}	.147101	.023489	6.263	136	.000
For EP_DEV, β_9					
INTRCPT2, γ_{90}	.030919	.019884	1.555	134	.122
CLE_C_AG, γ_{91}	-.054078	.020821	-2.597	134	.011
CLE_N_AG, γ_{92}	.066346	.021481	3.089	134	.003

Science Achievement

Table D.33 Final estimation of fixed effects for Science Achievement outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.024979	.050426	-.495	133	621
TSELF_SE, γ_{01}	.102369	.045116	2.269	133	.025
TEP_DEV, γ_{02}	.128757	.042980	2.996	133	.004
CLE_S_AG, γ_{03}	-.092935	.045578	-2.039	133	.043
For CLE_CRI, β_1					
INTRCPT2, γ_{10}	.045402	.017845	2.544	3272	.011
For CLE_NEG, β_2					
INTRCPT2, γ_{20}	.046690	.017078	2.734	3272	.007
For EP_CER, β_3					
INTRCPT2, γ_{30}	-.071618	.018420	-3.888	136	.000
For EP_JUS, β_4					
INTRCPT2, γ_{40}	.056030	.020422	2.744	135	.007
CLE_S_AG, γ_{41}	-.038627	.016830	-2.295	135	.023

Table D.34 Final estimation of fixed effects (with robust standard errors) for Science Achievement outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.024979	.050785	-.492	133	623
TSELF_SE, γ_{01}	.102369	.047246	2.167	133	.032
TEP_DEV, γ_{02}	.128757	.051866	2.483	133	.015
CLE_S_AG, γ_{03}	-.092935	.039834	-2.333	133	.021
For CLE_CRI, β_1					
INTRCPT2, γ_{10}	.045402	.018186	2.497	3272	.013
For CLE_NEG, β_2					
INTRCPT2, γ_{20}	.046690	.015871	2.942	3272	.004
For EP_CER, β_3					
INTRCPT2, γ_{30}	-.071618	.018359	-3.901	136	.000
For EP_JUS, β_4					
INTRCPT2, γ_{40}	.056030	.018815	2.978	135	.004
CLE_S_AG, γ_{41}	-.038627	.014269	-2.707	135	.008

Science Achievement (without Self-Regulation variables)

Table D.35 Final estimation of fixed effects for Science Achievement outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.027970	.053825	-.520	136	.604
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.029681	.019406	1.529	3271	.126
For CLE_UNC, β_2					
INTRCPT2, γ_{20}	-.009363	.019680	-.476	136	.635
For CLE_CRI, β_3					
INTRCPT2, γ_{30}	.040413	.021505	1.879	136	.062
For CLE_SHA, β_4					
INTRCPT2, γ_{40}	-.012888	.017718	-.727	3271	.467
For CLE_NEG, β_5					
INTRCPT2, γ_{50}	.045189	.018425	2.453	3271	.014
For EP_SOU, β_6					
INTRCPT2, γ_{60}	-.038910	.018733	-2.077	3271	.038
For EP_CER, β_7					
INTRCPT2, γ_{70}	-.045480	.021944	-2.073	136	.040
For EP_JUS, β_8					
INTRCPT2, γ_{80}	.044732	.021924	2.040	136	.043
For EP_DEV, β_9					
INTRCPT2, γ_{90}	.012107	.017390	.696	3271	.486

Table D.36 Final estimation of fixed effects (with robust standard errors) for Science Achievement outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.027970	.053864	-.519	136	.604
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.029681	.019652	1.510	3271	.131
For CLE_UNC, β_2					
INTRCPT2, γ_{20}	-.009363	.018827	-.497	136	.619
For CLE_CRI, β_3					
INTRCPT2, γ_{30}	.040413	.020587	1.963	136	.051
For CLE_SHA, β_4					
INTRCPT2, γ_{40}	-.012888	.018529	-.696	3271	.487
For CLE_NEG, β_5					
INTRCPT2, γ_{50}	.045189	.017632	2.563	3271	.011
For EP_SOU, β_6					
INTRCPT2, γ_{60}	-.038910	.018829	-2.066	3271	.039
For EP_CER, β_7					
INTRCPT2, γ_{70}	-.045480	.020386	-2.231	136	.027
For EP_JUS, β_8					
INTRCPT2, γ_{80}	.044732	.020392	2.194	136	.030
For EP_DEV, β_9					
INTRCPT2, γ_{90}	.012107	.017046	.710	3271	.477

Science Achievement (with Self-Regulation variables)

Table D.37 Final estimation of fixed effects for Science Achievement outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.024772	.054034	-.458	136	.647
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.027242	.019967	1.364	3264	.173
For CLE_UNC, β_2					
INTRCPT2, γ_{20}	-.006664	.018245	-.365	3264	.715
For CLE_CRI, β_3					
INTRCPT2, γ_{30}	.034263	.021182	1.618	136	.108
For CLE_SHA, β_4					
INTRCPT2, γ_{40}	-.015159	.017770	-.853	3264	.394
For CLE_NEG, β_5					
INTRCPT2, γ_{50}	.048028	.018421	2.607	3264	.010
For TASK, β_6					
INTRCPT2, γ_{60}	.012403	.022091	.561	3264	.574
For SELF_EFF, β_7					
INTRCPT2, γ_{70}	.052381	.024170	2.167	136	.032
For MC_SR, β_8					
INTRCPT2, γ_{80}	-.035892	.019750	-1.817	3264	.069
For EP_SOU, β_9					
INTRCPT2, γ_{90}	-.031001	.020994	-1.477	136	.142
For EP_CER, β_{10}					
INTRCPT2, γ_{100}	-.038852	.019163	-2.027	3264	.042
For For EP_JUS, β_{11}					
INTRCPT2, γ_{110}	.042605	.021867	1.948	136	.053
For EP_DEV, β_{12}					
INTRCPT2, γ_{120}	.013178	.017371	.759	3264	.448
For GOAL_MA, β_{13}					
INTRCPT2, γ_{130}	-.014692	.018864	-.779	3264	.436
For GOAL_PA, β_{14}					
INTRCPT2, γ_{140}	.003454	.018122	.191	3264	.849
For GOAL_MAV, β_{15}					
INTRCPT2, γ_{150}	-.008100	.015846	-.511	3264	.609
For GOAL_PAV, β_{16}					
INTRCPT2, γ_{160}	-.030499	.017778	-1.716	3264	.086

Table D.38 Final estimation of fixed effects (with robust standard errors) for Science Achievement outcome.

Fixed Effect	*Coefficient*	*Standard Error*	*t-ratio*	*Approx. d.f.*	*p-value*
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	-.024772	.054199	-.457	136	.648
For CLE_PER, β_1					
INTRCPT2, γ_{10}	.027242	.019407	1.404	3264	.161
For CLE_UNC, β_2					
INTRCPT2, γ_{20}	-.006664	.017561	-.379	3264	.704
For CLE_CRI, β_3					
INTRCPT2, γ_{30}	.034263	.020943	1.636	136	.104
For CLE_SHA, β_4					
INTRCPT2, γ_{40}	-.015159	.018658	-.812	3264	.417
For CLE_NEG, β_5					
INTRCPT2, γ_{50}	.048028	.017800	2.698	3264	.007
For TASK, β_6					
INTRCPT2, γ_{60}	.012403	.021223	.584	3264	.559
For SELF_EFF, β_7					
INTRCPT2, γ_{70}	.052381	.023498	2.229	136	.027
For MC_SR, β_8					
INTRCPT2, γ_{80}	-.035892	.018066	-1.987	3264	.047
For EP_SOU, β_9					
INTRCPT2, γ_{90}	-.031001	.019058	-1.627	136	.106
For EP_CER, β_{10}					
INTRCPT2, γ_{100}	-.038852	.020938	-1.856	3264	.063
For For EP_JUS, β_{11}					
INTRCPT2, γ_{110}	.042605	.020072	2.123	136	.035
For EP_DEV, β_{12}					
INTRCPT2, γ_{120}	.013178	.017301	0.762	3264	.446
For GOAL_MA, β_{13}					
INTRCPT2, γ_{130}	-.014692	.019020	-.772	3264	.440
For GOAL_PA, β_{14}					
INTRCPT2, γ_{140}	.003454	.017955	.192	3264	.848
For GOAL_MAV, β_{15}					
INTRCPT2, γ_{150}	-.008100	.016059	-.504	3264	.614
For GOAL_PAV, β_{16}					
INTRCPT2, γ_{160}	-.030499	.019335	-1.577	3264	.115

Appendix E: Turkish Summary

ÖĞRENCİLERİN FEN BİLİMLERİ DERSİNDEKİ BAŞARILARININ YAPILANDIRMACI ÖĞRENME ORTAMI ALGISI, EPİSTEMOLOJİK İNANÇLAR, ÖZ-DÜZENLEME BECERİLERİ VE ÖĞRETMEN ÖZELLİKLERİ İLE OLAN İLİŞKİSİNİN ÇOK DÜZEYLİ ANALİZİ

Giriş

Uluslararası değerlendirme çalışmaları (Programme for International Student Assessment, [PISA], 2003; 2006; 2009; Trends in International Mathematics and Science Study, TIMMS, 1999; 2007), diğer ülkelerle karşılaştırıldığında Türkiye'nin Fen Bilimlerinde başarısız sonuçlar elde ettiğini göstermiştir. Bu sonuçlar Türkiye'deki Fen Eğitimi araştırmacılarını, öğrencilerin Fen Bilimlerini öğrenmelerini etkileyen muhtemel faktörleri araştırmak için harekete geçirmiştir. Araştırmalar incelendiğinde hem Türkiye'ki çalışmalar hem de dünya literatüründeki çalışmalar benzer bulguları ortaya koymuştur. Buna göre öğrencilerin öz-düzenleme becerileri (örn. Sungur & Gungoren, 2009; Tas, 2008; 2013; Yerdelen, 2013; Yuruk, 2007), epistemolojik inançları (örn. Kizilgunes, Tekkaya, & Sungur, 2009, Uysal, 2010) ve öğrenme ortamı algıları (örn. Sungur & Gungoren, 2009; Uysal, 2010;

Yerdelen, 2013) öğrencilerin fen öğrenimini etkileyen önemli birer faktör olarak bulunmuştur. Buna ek olarak öz-yeterlik (örn. Tschannen-Moran, Woolfolk-Hoy, & Hoy, 1998; Woolfolk Hoy & Davis, 2005; Yerdelen, 2013), hedef yönelimi (örn. Butler, 2007), epistemolojik inançlar (örn. Luft & Roehrig, 2007), öğrenci merkezli inançlar ve kişisel vatandaşlık davranışları (örn. Woolfolk Hoy, Hoy, & Kurz, 2008) gibi öğretmenlerin bazı kişisel özelliklerinin de öğrencilerin başarıları üzerinde etkisi olduğu saptanmıştır. Bu bulgular dikkate alındığında bu çalışmada tüm bu değişkenlerin öğrenci başarısı üzerindeki etkileri ve birbirleri ile karşılıklı ilişkilerinin incelenmesi amaçlanmıştır.

Eğitim psikolojisini araştıran birçok çalışma, öğrencilerin öz düzenleme becerilerinin, onların öğrenmeleri ve akademik başarıları üzerinde önemli bir role sahip olduğunu göstermiştir (örn. Bandura, 1986; Pintrich, 2000; Zimmerman, 2000). Öz düzenleme becerileri yüksek olan öğrenciler, Zimmerman (2000) tarafından bireysel olarak biliş, duyuş ve davranışlarını aktive edebilen, bu doğrultuda hedefler koyabilen ve bu süreci devamlı olarak işletebilen kişiler olarak tanımlanmıştır. Bu öğrenciler kendilerine verilen bir görevi yapabilmede kendi yeteneklerine daha çok inanır, kendileri için daha etkili hedefler koyar, kendilerine sunulan aktivitelerin değerini anlar ve üstbilişsel stratejileri etkili kullanabilirler (Pintrich, 2000; Risemberg, & Zimmerman, 1992). Öz düzenleme becerileri, bilişsel, üstbilişsel, duyuşsal ve davranışsal süreçlerden oluşmaktadır. İlgili literatür incelendiğinde tüm bu süreçler arasında duyuşsal süreçlerden öz-yeterlik, hedef yönelimleri ve değer verme algıları, bilişsel süreçlerden ise üstbilişsel öz düzenleme becerileri öğrencilerin öğrenmesini önemli derecede etkileyen faktörler olarak karşımıza çıkmaktadır. Öz yeterlik, kişinin bir işi başarmada kendi yeterlikleri hakkındaki yargılarıdır (Bandura, 1997). Eğer bir öğrenci kendi öğrenme yetileriyle ilgili pozitif bir yargıya sahipse o öğrenci akademik olarak başarılı olmaya daha yatkındır (Areepattamannil, Freeman, & Klinger, 2011; Britner & Pajares, 2006; Kupermintz, 2002; Lent, Brown, & Larkin, 1984; Pajares, Britner, & Valiante, 2000; Pintrich & DeGroot, 1990; Yerdelen, 2013). Hedef yönelimleri diğer bir öz düzenleme becerisi bileşeni olarak öne çıkmaktadır (Pintrich & Schunk, 2002). Öğrencilerin hedef yönelimleri dört ana başlık halinde incelenmektedir. Bunlardan birincisi öğrenme yaklaşma hedefleridir ve öğrenmeye, verilen görevi başarmaya dönük hedefleri kapsamaktadır. Diğer bir hedef yönelimi olan performans yaklaşma hedeflerinde ise öğrenci başarıyı diğer öğrencilere kıyaslanma ve yüksek not alma için hedeflemektedir. Bir diğer hedef yönelimi olan öğrenme kaçınma hedeflerinde, öğrenci konuyu anlayamamaktan veya yanlış anlamaktan kaçınmaktadır. Dördüncü tip hedef yönelimleri ise performans kaçınma hedefleridir. Bu tip yönelimlerde ise öğrenci başarısız olmaktan ve diğer öğrencilerle kıyaslandığında başarısız görünmekten kaçınmaktadır. İlgili literatür öğrenme yaklaşımı hedefleri ile başarı arasında pozitif bir korelasyon olduğunu göstermektedir (örn. Bargezar, 2012; Linnenbrink-Garcia, Tyson, & Patall, 2008; Yerdelen, 2013). Fakat performans yaklaşma hedeflerinin başarıyla olan ilişkisinde ise tutarsız sonuçlar dikkati çekmektedir. Bazı çalışmalar pozitif ilişki gösterirken (Barzegar, 2012; Elliot and McGregor, 2001; Wolters, 2004) bazıları ise ilişki bulamamıştır (Tas, 2008, 2013; Yerdelen, 2013). Öz düzenleme becerilerinin diğer bir duyuşsal süreç bileşeni ise değer verme'dir. İçsel değer, öğrencinin öğrenmesi ile ilgili verilen bir ödeve ya da aktiviteye verdiği değer algısıdır ve öğrencinin akademik aktivitelere katılmasında önemli bir motivasyon unsurudur (Wigfield & Eccles, 1992). Hedef yönelimlerine benzer şekilde değer verme ile ilgili araştırma sonuçlarında da tutarsızlıklar görülmektedir. Bazı çalışmalar pozitif bir korelasyonu işaret ederken (Bong, 2001, Kzehri azar, Lavasani, Malahmadi, & Amani, 2010), Liem, Lau, ve Nie (2008) anlamlı bir ilişki bulamamıştır. Öz düzenleme becerilerinin bilişsel boyutundaki bileşeni üst bilişsel öz düzenleme, kişinin kendi bilişsel süreci hakkındaki bilgisini ve düzenleyebilmesini ifade etmektedir. Üst bilişsel öz düzenlemenin başarı ile ilişkisini inceleyen çalışmaların sonuçları yine tutarsız olarak görülmektedir. Bazı çalışmalar pozitif bir ilişki bulurken (Akyol, Sungur, Tekkaya, 2009; Georghiades, 2004; Topcu & Yilmaz-Tuzun, 2009; Yuruk, 2007) diğer bazı çalışmalarda ise anlamlı bir ilişki bulunamamıştır (Yerdelen, 2013; Yumusak, Sungur, & Cakiroglu, 2007). Tüm bu sonuçlar incelendiğinde yüksek öz-yeterliğe sahip, öğrenme yaklaşma veya performans yaklaşma hedeflerine odaklanan, derse ve ödevlere değer veren ve üst bilişsel öz düzenleme becerilerine sahip öğrencilerin akademik olarak başarılı olmaları beklenmektedir.

Öğrencilerin epistemolojik inançları, akademik başarılarını etkileyecek diğer bir faktör olarak karşımıza çıkmaktadır. Epistemolojik inançlar, bir bireyin, bilginin ne olduğuna, bilmenin ve bilgiyi öğrenmenin nasıl gerçekleştiğine dair inançları olarak tanımlanmaktadır (Hofer & Pintrich, 1997). Hofer ve Pintrich (1997) epistemolojik inançları tanımlamak için ikili bir yapı ileri sürmüşlerdir: Bilginin doğasına dair inançlar ve bilmenin doğasına dair inançlar. Bilginin doğasına dair inançlar bilginin kesinliği ve bilginin basitliği ile ilgili inançları kapsamaktadır. Bilmenin doğasına dair inançlar ise bilginin kaynağı ve bilmeyi yargılamayla ilgili inançları kapsamaktadır. Epistemolojik inançları sofistike olan öğrenciler bilimsel bilginin değişken, yanlı, ve gelişmekte olabileceğine inanır. Epistemolojik inançları naif olan öğrenciler ise bilimsel bilginin kesin ve değişmeyen, kaynağının tek bir otoriteye dayandığına dair inançlara sahiptirler. Literatürde epistemolojik inançların öğrenci başarısı ile ilişkisine (Conley, Pintrich, Vekiri, & Harrison, 2004; Elder, 1999; Kizilgunes, et al., 2009; Schommer, 1990; Smith, Maclin, Hougthon, & Hennessey, 2000) ve öz düzenleme becerileri ile ilişkisine (Braten & Stromso, 2004; Bruning, Schraw, & Ronning, 1995; Hofer, 1994; Hofer & Pintrich, 1997; Kizilgunes et al., 2009; Paulsen & Feldman, 1999; Schutz, Pintrich, & Young, 1993) dair birçok çalışma mevcuttur. Bu çalışmalara göre sofistike epistemolojik inançlara sahip öğrenciler daha yüksek öz-yeterliğe, içsel hedef yönelimlerine, öğrenme aktivitelerine değer verme eğilimine ve daha yüksek akademik başarıya sahiptirler.

Öğrenci başarısını etkileyen bir diğer önemli faktör ise öğrencilerin sınıf ortamı algılarıdır (Baek, & Choi, 2002; Dorman, 2001; Fraser, 1994; Margianti, Fraser & Aldridge, 2002). Sınıf ortamı algısına ait çalışmalarda kullanılan ölçekler farklı algıları ölçmeye odaklandığı için bu çalışmalarda genellikle ölçek geliştirmenin ve doğrulamanın amaçlandığı dikkati çekmektedir (Fraser, 1998). Geliştirilen ölçekler ilk zamanlarda öğretmen merkezli olarak hazırlanmış olmakla beraber zaman içerisinde öğrenci merkezli ölçekler geliştirilmiştir (Fraser, 2007). Yapılandırıcı Öğrenme Ortamı Anketi (YÖOA-CLES; Taylor & Fraser, 1991) öğrenci merkezli olarak geliştirilen ölçeklerden birisidir. Öğrenci merkezli öğrenme ortamı sunmayı hedefleyen sınıflardaki öğrencilerin sınıf ortamını nasıl algıladıklarını ölçmeyi hedefleyen bu ölçek, öğretmenlere öğretme tekniklerini geliştirmede, araştırmacılara ise yapılandırıcı sınıf ortamı algıları ile ilgili araştırmalarda yardımcı olması amacıyla geliştirilmiştir. Ölçek beş farklı alt boyuta sahiptir ve bu alt boyutlarla öğrencilerin sınıfta öğrendikleri bilimle günlük yaşamı ilişkilendirebilmelerine, bilimsel bilginin değişken yapısına, ders içerisinde ne olup bittiğine dair sorular sorabilmesine, ders içi planlamalara dair aktif katılımlarına ve sınıf içi tartışmalara aktif katılabilmelerine dair algılarını ölçmek hedeflenmiştir. Literatürdeki çalışmalarda öğrencilerin sınıf ortamı algıları birçok öğrenci değişkeni ile ilişkilendirilmiştir. Bunlar arasında akademik başarı (Allen & Fraser, 2007; Baek & Choi, 2002; Dorman, 2001; Goh & Fraser; 1998; Roth, 1997; Snyder, 2005; Sungur & Gungoren, 2009; Wolf & Fraser, 2008; Yerdelen, 2013), epistemolojik inançlar (Ozkal et al., 2009; Yilmaz-Tuzun & Topcu, 2010), ve öz-yeterlik (Arisoy, 2007; Dorman, 2001; Dorman, Fisher, & Waldrip, 2006; Sungur & Gungoren, 2009; Yerdelen, 2013), hedef yönelimleri (Ames, 1992; Arisoy, 2007; Sungur & Gungoren, 2009; Yerdelen, 2013), değer verme (Arisoy, 2007), üst bilişsel öz düzenleme (Yilmaz-Tuzun & Topcu, 2010; Yerdelen, 2013) gibi öz düzenleme becerilerinin bileşenleri dikkati çekmektedir. Bu çalışmalara göre sınıf ortamını yapılandırmacı olarak algılayan öğrenciler fen öğrenmeye dönük daha yüksek öz-yeterliğe sahipler, içsel hedef yönelimlerine odaklanmışlar, verilen aktivitelerin öneminin farkındalar, daha yüksek üst bilişsel öz düzenleme yetisine sahipler ve daha sofistike epistemolojik inançlara sahipler.

Literatüre göre öğrenci değişkenlerinin dışında öğretmenlerin bazı özelliklerinin de öğrenci başarısı üzerinde etkili olduğu gözlenmiştir (örn. Butler, 2007; Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). Woolfolk Hoy, Hoy ve Davis (2009) öğretmenlerin bazı inanışlarının onların derslerini planlamalarında, sınıf yönetimi ile ilgili karar almalarında, öğretme stratejilerini belirlemede, öğrencilerle ilişkilerinde önemli bir role sahip olduğunu vurgulamıştır. Öğretmen öz-yeterliği bu inançlar arasında en çok çalışılanı ve göze batanı olarak öne çıkmıştır. Bu inanç Tschannen-Moran ve diğerleri (1998) tarafından, öğretmenlerin bir dersi başarılı bir şekilde organize etmede ve yürütmede kendi yeteneklerine dair inançları olarak tanımlanmıştır. Öz-yeterlik üç alt boyutta incelenmiştir. Bunlar değişik öğretim stratejileri kullanmaya dönük öz-yeterliği ifade eden öğretimsel stratejiler alt boyutu, etkili bir sınıf yönetimine dair öz-yeterliği ifade eden sınıf yönetimi alt boyutu ve öğrencileri derse başarılı bir şekilde entegre etmeye dair öz-yeterlik olan öğrenci entegrasyonu alt boyutundan oluşmaktadır. Woolfolk Hoy ve Davis (2005), öğretmen öz-yeterliğinin öğrencilerin öz-yeterlikleri, hedef yönelimleri, değer verme algıları, öz düzenlemeleri ve akademik başarıları üzerinde etkili olabileceğini öne sürmüştür. Öte yandan Butler (2007), Butler ve Shibaz (2008), Deevers (2000) ve Friedel, Cortina, Turner ve Midgley (2007) öğretmenlerin hedef yönelimlerinin öğrenci başarıları, hedef yönelimleri gibi değişkenler üzerinde etkili olabileceğini öne sürmüşlerdir. Öz yeterlikleri yüksek ve uzmanlık hedef yönelimi olan öğretmenler yeni fikirlere ve öğrencilerin öğrenme ihtiyaçlarını karşılayabilecek yeni metotları kullanmaya daha açık, onları öğrenmeye pozitif yönde zorlayan, ihtiyaç olduğunda tekrardan kaçınmayan, öğrencilerin öğrenme motivasyonunu artırıcı davranan, öğrencileri aktivitelere aktif olarak dâhil eden bir çizgi çizmeye meyilli olmaları beklenmektedir. Öğretmenlerin, sınıf ortamına ve öğrenci değişkenlerine etki edebilecek bir diğer inançları ise öğrenci merkezli inançlarıdır. Öğrenci merkezli inançlara ve pratiklere sahip öğretmenler öğrencilerinin ilgileri, yetenekleri, bilgileri ve ihtiyaçları konusunda daha iyi farkındalıklara sahiptirler ve bu öğretmenler öğretme tekniklerini öğrenci ihtiyaçlarına odaklanarak planladıkları için öğrencileri daha başarılı olma eğilimindedirler (Woolfolk Hoy ve diğerleri, 2008). Benzer bir şekilde öğretmenliği bir vatandaşlık görevi olarak gören öğretmenler, sorumluluk almaktan çekinmeme, öğrencilerle ve aileleri ile daha çok ilgilenme ve genelde normal meslek beklentilerinin ötesinde bir gayret sarf etme eğilimindedirler (Woolfolk Hoy ve diğerleri, 2008). Öğrenci merkezli pratiklerin ve kişisel vatandaşlık davranışlarının, öğrencilerin öğrenme ortamı algıları ve motivasyonları ile pozitif bir ilişki içinde olması beklenmektedir. Son olarak öğrenme ortamını ve öğrenci başarısını etkileyebilecek bir diğer öğretmen değişkeni ise onların epistemolojik inançlarıdır. Luft ve Roehrig (2007) öğretmenlerin epistemolojik inançları ile diğer öğretmen inançları ve bazı öğrenci değişkenlerinin karşılıklı bir ilişki içinde olduğunu iddia etmiştir. Brownlee, Boulton-Lewis ve Purdie (2002) ve Hashweh (1996)'e göre sofistike epistemolojik inançlara sahip öğretmenler, öğrencilerin alternatif kavramlarının konusunda farkındalıkları yüksek, daha efektif öğretme stratejileri kullanan, daha kaliteli bir öğrenme ortamı yaratan bir karakter çizmektedirler. Bu nedenle öğrencilerin öğrenme ve öğrenme ortamı ile ilgili değişkenlerinin, sofistike epistemolojik inançlara sahip öğretmenlerden olumlu yönde etkilenmesi beklenmektedir.

Özetle, fen eğitimi alanında, öğrencilerin fen bilimlerini öğrenmelerini etkileyen muhtemel faktörleri araştırırken, onların öz düzenleme becerileri (öz-yeterlik, hedef yönelimleri, değer verme, üst bilişsel öz düzenleme becerileri), epistemolojik inançları ve yapılandırıcı öğrenme ortamı algıları açısından incelemek konusunda bir ihtiyaç ortaya çıkmıştır. Bunu yaparken öğretmen özelliklerinin de bu faktörleri ve öğrenci başarısını etkileyebileceği göz önünde bulundurulmalıdır. Bu çalışma ile öğrencilerin fen başarılarını etkileyen öğrenci değişkenleri (öz-yeterlik, hedef yönelimleri, değer verme, üst bilişsel öz düzenleme becerileri) öğretmen değişkenlerinin (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları) etkileri kontrol edilerek incelenmiştir.

Öte yandan Raudenbush ve Bryk (2002) öğrencilerden toplanan verilerin incelendiğinde, verilen cevapların tamamen bağımsız olarak dağılmadıklarını aksine belirli gruplar halinde yuvalandıklarını iddia etmiştir. Bu yuvalanmanın sebepleri arasında öğretmen karakteristikleri, öğrenme ortamları, okulları veya bulundukları şehirler gösterilebilir. Bu yuvalanmaları ve öğrenci değişkenleri üzerindeki muhtemel etkilerini anlayabilmek ve daha doğru sonuçlara ulaşabilmek için çok düzeyli analiz yapılması uygun görülmüştür. Çok düzeyli analiz, farklı düzeylerdeki değişkenler (öğrenci değişkenleri birinci düzey, öğretmen değişkenleri ise ikinci düzeyi oluşturmaktadır) arasındaki ilişkileri inceleme fırsatı sunmaktadır. Bu çalışmayla bu ilişkilerde incelenerek daha kapsamlı sonuçlara ulaşmak, fen eğitimindeki muhtemel sorunlara dikkat çekmek ve fen eğitiminin kalitesinin artırılması hedeflenmektedir.

Bu çalışmaya ait 8 temel araştırma sorusu yer almaktadır. Bunlar:

1. Öğretmen düzeyindeki değişkenler (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları), öğrencilerin yapılandırıcı öğrenme ortamı algılarını ne derece yordamaktadır?

2. Öğretmen düzeyindeki değişkenler (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları) ve öğrencilerin yapılandırıcı öğrenme ortamı algıları, öğrencilerin epistemolojik inançlarını ne derece yordamaktadır?

3. Öğretmen düzeyindeki değişkenler (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları), öğrencilerin yapılandırıcı öğrenme ortamı algıları ve öğrencilerin epistemolojik inançları, öğrencilerin öz-yeterliklerini ne derece yordamaktadır?

4. Öğretmen düzeyindeki değişkenler (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları), öğrencilerin yapılandırıcı öğrenme ortamı algıları ve öğrencilerin epistemolojik inançları, öğrencilerin hedef yönelimlerini ne derece yordamaktadır?

5. Öğretmen düzeyindeki değişkenler (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları), öğrencilerin yapılandırıcı öğrenme ortamı algıları ve öğrencilerin epistemolojik inançları, öğrencilerin değer verme algılarını ne derece yordamaktadır?

6. Öğretmen düzeyindeki değişkenler (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları), öğrencilerin yapılandırıcı öğrenme ortamı algıları ve öğrencilerin epistemolojik inançları, öğrencilerin üst bilişsel öz düzenlemelerini ne derece yordamaktadır?

7. Öğretmen düzeyindeki değişkenler (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları), öğrencilerin yapılandırıcı öğrenme ortamı algıları, öğrencilerin epistemolojik inançları ve öğrencilerin öz-düzenleme becerileri (öz-yeterlik, hedef yönelimleri, değer verme, üst bilişsel öz düzenleme becerileri), öğrencilerin fen başarılarını ne derece yordamaktadır?

8. Öğrencilerin öz-düzenleme becerileri (öz-yeterlik, hedef yönelimleri, değer verme, üst bilişsel öz düzenleme becerileri), öğrencilerin yapılandırıcı öğrenme ortamı algıları ve öğrencilerin epistemolojik inançlarının öğrencilerin fen başarıları ile arasındaki ilişkide aracı rol oynuyor mu?

Yöntem

Bu çalışma, Ankara ili Yenimahalle ve Çankaya ilçelerinden rastgele seçilen 113 ilköğretim okulunda öğrenim gören 7. sınıf öğrencilerinin ve onların fen ve teknoloji öğretmenlerinin katılımıyla, bir dizi ölçek ve testler uygulanarak yapılmıştır. Toplanan veriler, yuvalanmış yapıya sahip olduğu için çok düzeyli analiz yöntemi (HLM) kullanılarak analiz edilmiştir.

Evren ve Örneklem

Çalışmanın evrenini Ankara ilinde yer alan devlet okullarındaki 7. sınıf öğrencileri ve onların fen ve teknoloji öğretmenleri oluşturmaktadır. Toplamda 3281 öğrenci ve onların öğretmenleri çalışmaya katılmıştır. Hemen hemen her okuldan bir öğretmenin dâhil olduğu öğretmen örneklemi 137 kişiden oluşmaktadır.

Veri Toplama Araçları

Çalışmada kullanılan veri toplama araçları öğretmen ve öğrenci olarak iki kısımdan oluşmaktadır.

Öğretmen Veri Toplama Aracı

Tablo E.1 Öğretmen veri toplama aracının içerdiği ölçekler.

Veri Toplama Aracı	*Değişkenler*
Demografik Bilgi Ölçeği	Cinsiyet Yaş Deneyim Mezun Olduğu Bölüm
Öğretmenler için Öz-Yeterlik Ölçeği *Geliştiren: Tschannen-Moran & Woolfolk-Hoy (2001)* *Türkçe'ye Adaptasyon: Çapa, Çakıroğlu, & Sarıkaya (2005)*	Sınıf Yönetimi Öğrenci Entegrasyonu Öğretim Stratejileri
Öğretmenler için Hedef Yönelimi Ölçeği *Geliştiren: Butler (2007)* *Türkçe'ye Adaptasyon: Araştırmacı tarafından yapılmıştır.*	Uzmanlık Yaklaşma Performans Yaklaşma Uzmanlık Kaçınma Performans Kaçınma
Kişisel Vatandaşlık Davranışları Ölçeği *Geliştiren: Woolfolk Hoy, Hoy, & Kurz (2008)* *Türkçe'ye Adaptasyon: Araştırmacı tarafından yapılmıştır.*	Öğretmenlik Mesleğine Dönük Vatandaşlık Davranışları
Öğrenci Merkezli İnançlar ve Pratikler Ölçeği *Geliştiren: Woolley, Benjamin, & Woolley (2004)* *Türkçe'ye Adaptasyon: Araştırmacı tarafından yapılmıştır.*	Öğrenci Merkezli İnançlar ve Pratikler
Epistemolojik İnançlar Ölçeği *Geliştiren: Conley, Pintrich, Vekiri, & Harrison (2004)* *Türkçe'ye Adaptasyon: Özkan (2008)*	Bilginin Kaynağı Bilginin Değişmezliği Bilginin Gerekçelendirilmesi Bilginin Gelişimi

Öğrenci Veri Toplama Aracı

Tablo E.2 Öğrenci veri toplama aracının içerdiği ölçekler.

Veri Toplama Aracı	*Değişkenler*
Demografik Bilgi Ölçeği	Cinsiyet Kardeş Sayısı Yaş Fen Notu Sosyo-Ekonomik Durum
Öğrenmede Güdüsel Stratejiler Ölçeği (MSLQ) *Geliştiren: Pintrich, Garcia, & McKeachie (1993)* *Türkçe'ye Adaptasyon: Sungur (2004)*	Öz-Yeterlik Üst Bilişsel Öz Düzenleme Değer Verme
Hedef Yönelimleri Ölçeği *Geliştiren: Elliot & McGregor (2001)* *Türkçe'ye Adaptasyon: Senler & Sungur (2007)*	Öğrenme Yaklaşma Performans Yaklaşma Öğrenme Kaçınma Performans Kaçınma
Yapılandırıcı Öğrenme Ortamı Ölçeği *Geliştiren:Taylor, Fraser, & Fisher (1997)* *Türkçe'ye Adaptasyon: Yılmaz-Tüzün, Çakıroğlu, & Boone (2006)*	Dünyayı Öğrenme Bilimi Öğrenme Düşünceleri ifade etmeyi öğrenme Öğrenmeyi Öğrenme İletişim Kurmayı Öğrenme
Epistemolojik İnançlar Ölçeği *Geliştiren: Conley, Pintrich, Vekiri, & Harrison (2004)* *Türkçe'ye Adaptasyon: Özkan (2008)*	Bilginin Kaynağı Bilginin Değişmezliği Bilginin Gerekçelendirilmesi Bilginin Gelişimi
Fen Başarı Testi	14 test sorusu

Çalışmanın Sayıltıları

1. Çalışmada kullanılan ölçekler tüm öğrenciler ve öğretmenler için aynı şartlarda uygulanmıştır.

2. Öğrenciler ve öğretmenler ölçeklerdeki maddeleri ciddiyetle cevaplandırmışlardır.

3. Ölçekler uygulanırken öğretmenler ve öğrencileri etkileşim halinde olmamışlardır.

Bulgular ve Tartışma

Çalışmada öğretmen ve öğrencilerden toplanan veriler, 61 model halinde HLM yöntemi kullanılarak analiz edilmiştir. Çalışmanın bulguları 8 temel araştırma sorusu üzerinde incelenmiş, rapor edilmiş ve tartışılmıştır.

Araştırma Sorusu 1: Yapılandırıcı Öğrenme Ortamı Algılarını Yordama

İlk araştırma sorusunda öğrencilerin yapılandırıcı ortam algıları, bu öğrencilerin öğretmenlerinin bazı özellikleri (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları) tarafından tahmin edilmeye çalışılmıştır. HLM sonuçları öğrenme ortamı algısı açısından sınıflar arasında anlamlı bir varyasyon olduğunu göstermiştir.

Bu sonuçlara göre yapılan analizler öğretmenlerin epistemolojik inançlarında bilginin gerçekleştirilmesi alt boyutu, öğrencilerin yapılandırıcı öğrenme ortamını açıklamada en etkili öğretmen faktörü olarak göze çarpmaktadır. Bilginin gerçekleştirilmesi alt boyutu, öğrenme ortamı algısı ölçeğinin alt boyutlarından sadece öğrenmeyi öğrenme alt boyutunu açıklayamamıştır. Bu sonuçlar, sınıf içerisinde deneylerin, bilimsel bir argümanın desteklenmesi için veriler toplanmasının ve kullanılmasının öneminin farkında olan öğretmenlerin sınıflarındaki öğrenciler, sınıfta öğrendikleri bilimsel bilgileri günlük hayatı ile eşleştirebilmede, bilimsel bilgiyi oluşturmada pratik yapma şansına sahip olmada, ders içerisinde neler olup bittiğine dair sorular sormada ve sınıf içerisinde iletişim kurmada kendilerini daha özgür hissetmektedirler. Bu bulgular hem genel beklentilerle hem de çalışmanın beklentileriyle uyum içerisindedir. Ancak öğretmenlerin epistemolojik inançlarının diğer alt boyutlarının anlamlı bir etkiye sahip olmamaları beklentinin biraz dışında kalmıştır. Ölçeklerin örneklem bazında ortalamaları incelendiğinde sofistike epistemolojik inançlar için yüksek, naif inançlar için ortalama değerler bulunmuştur. Bu değerlerin öğrenci algılarına yansımamış olması, öğretmenlerin epistemolojik inançlarını kendi öğretim stratejilerine ve sınıf içi ortama yansıtamadıklarına dair bir sonuç ortaya çıkarmaktadır. Literatürde öğretmenlerin epistemolojik inançlarının sınıf içi ve öğrenci çıktılarına etkisini araştıran yeteri kadar çalışma bulunmamaktadır. Addy (2011) öğretmenlerin epistemolojik inançlarının, onların öğretme stratejilerini etkileyebileceğini, Hashweh (1996) ise sofistike epistemolojik inançlara sahip öğretmenlerin, öğrencileri için daha zengin bir öğretim tekniği sunduğunu ve öğrencilerine öğrenmeleri için daha çok şans tanıdıklarını iddia etmiştir. Bu araştırmalara dayanarak bu çalışmanın kısmen ilgili literatürü desteklediği fakat daha net bulgulara ulaşmak için hem öğretmenlerin epistemolojik inançlarını hem de bu inançların onların öğretim tekniklerine ve sınıf içine yansımalarının araştırılması için yeni çalışmalara ihtiyaç duyulduğu ortaya çıkmıştır.

Sonuçlar, öğretmenlerin hedef yönelimleri açısından incelendiğinde performans yaklaşma hedeflerinin, öğrencilerin bilimi öğrenme algıları ile pozitif ilişkili olduğu bulunmuştur. Bir başka deyişle, diğer öğretmenlere kıyasla daha başarılı görünmek isteyen öğretmenlerin öğrencileri, öğrenme ortamı algıları açısından bilimi öğrenme konusunda kendilerini daha özgür hissetmişlerdir. Öğretmenlerin uzmanlıktan daha çok performanslarını gösterme hedefleri belirlemelerinin sebebi olarak, öğrencileri seçmek için yapılan ulusal sınavlar ve bunlara hazırlıklar gösterilebilir. Öğretmenler, sınıflarındaki öğrencilerin diğer sınıflara göre daha başarılı olması için ve dolayısıyla kendisinin de başarılı görünmesi için bu hedefleri belirlemiş olabilir. Öte yandan epistemolojik inançlardakine benzer şekilde, alt boyutların ortalamaları incelendiğinde uzmanlık hedeflerinin ortalamaları en yüksek skor olarak karşımıza çıkmaktadır. Ancak gerek rekabetçi ortam ve gerekse öğretmenlerin uzmanlıkla ilgili görüşlerini sınıf ortamına yansıtamaması sebebiyle, bu hedefler ile öğrencilerin yapılandırıcı öğrenme ortamı algıları arasında anlamlı bir ilişki bulunamamıştır. Hâlbuki, Butler ve Shibaz (2008), öğretmenlerin uzmanlık yaklaşma hedeflerinin, öğrencilerin öğretmen desteği algıları ile pozitif bir ilişki içinde olduğunu tespit etmiştir. Yani öğretmenler uzmanlığı ve kendini geliştirmeyi hedefliyorsa, öğrencilerin destek algıları artmaktadır. Öğretmen hedef yönelimleri ve bu yönelimlerin öğrenci değişkenleri ile ilişkisi çok fazla çalışılmadığı için bu çalışmanın sonuçlarını literatürle karşılaştırmak konusunda sıkıntılar mevcuttur. Bu nedenle öğretmen hedef yönelimleri ve öğrenci değişkenleri ile ilişkisi konusunda yeni çalışmalara ve onların derinlemesine yorumlanmasına ihtiyaç duyulmaktadır.

Son olarak öğretmenlerin öz-yeterliklerinde öğretme stratejisi alt boyutu ile öğrencilerin öğrenmeyi öğrenme algıları arasında pozitif bir ilişki bulunmuştur. Buna göre, eğer bir öğretmen kendisini farklı ve etkili öğretim stratejileri kullanma konusunda kendi yeteneklerine inanıyorsa, öğrencileri öğrenmeyi öğrenme konusunda kendilerini daha rahat hissetmektedirler. Bu beklenen bir sonuçtur, çünkü bu tip öğretmenler, dersi zenginleştirmek, öğrenci ihtiyaçlarına daha çok yanıt verebilmek için öğrencileri dersi planlamaya katılma, değerlendirme sürecine ve öğrenmeleri ile ilgili kararlarda fikirlerini beyan etme konusunda daha cesaretlendirici davranıp, bunu bir öğretim tekniği olarak kullanabilirler. Woolfolk Hoy ve diğerleri (2009)'nin iddia ettiği gibi öğretim teknikleri konusunda yeteneklerine güvenen öğretmenler, daha etkili ve değerli öğretim stratejileri üretme ve uygulama konusunda bir adım önde yer almaktadırlar.

Özetle, sofistike epistemolojik inançlara sahip, öğretme yetenekleri konusunda kendisine güvenen, uzmanlık ya da performans odaklı hedef yönelimlerine sahip öğretmenlerin daha çok öğrenci merkezli bir sınıf ortamı oluşturması ve öğrencilerinin bu ortamı kendi öğrenmeleri için pozitif algılamaları beklenmektedir. Bu çalışmanın sonuçları kısmen de olsa bu beklentileri desteklemektedir. Ancak ileriki çalışmalarda, bu konuda daha çok araştırma yapılmasına gereksinim olduğu açıktır.

Araştırma Sorusu 2: Epistemolojik İnançları Yordama

Bu araştırma sorusunda öğrencilerin epistemolojik inançları, onların yapılandırıcı öğrenme ortamı algıları ve öğretmenlerinin bazı özellikleri (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları) tarafından tahmin edilmeye çalışılmıştır. HLM sonuçları epistemolojik inançlar açısından sınıflar arasında anlamlı bir varyasyon olduğunu göstermiştir.

Sonuçlar, öğrenci düzeyinde, yapılandırıcı öğrenme ortamı algısının sofistike epistemolojik inançları ile pozitif bir ilişki içinde olduğunu göstermektedir. Buna göre sınıflarında, öğrendikleri bilimsel bilgileri günlük hayatı ile eşleştirebilmede, bilimsel bilgiyi oluşturmada pratik yapma şansına sahip olmada, ders içerisinde neler olup bittiğine dair sorular sormada, dersi planlamaya, biçimlendirmeye dahil olmada ve sınıf içerisinde iletişim kurmada kendilerini daha özgür hisseden öğrencilerin epistemolojik inançları bilimin gerekçelendirilmesi ve gelişiminde daha sofistike görünmektedir. Öte yandan bilimin kaynağında naif olan öğrenci, sınıf içindeki kendilerini rahat hissetme konusunda, inançları dünyayı öğrenme ve düşüncelerini ifade etmeyi öğrenme değişkenleri açısından zayıf bir görünüm çizmektedir. Ancak bu öğrenciler öğrenmeyi öğrenme yani dersteki öğrenme ortamına müdahale etme konusunda daha güçlü bir algı göstermişlerdir. Benzer bir şekilde bilimin değişmezliği yönünde naif bir inanış seviyesi gösteren öğrenciler de ders ortamının şekline, sürecine daha çok müdahale etme algısına sahipler. Epistemolojik inançlar tahmin edilirken öğrencilerin öğrenme ortamı algıları bir de sınıf bazında değerlendirilmiştir. Sınıf ortalamaları dikkate alındığında, yine öğrenci düzeyindekine benzer sonuçlar elde edilmiştir. Tüm bu bulgular incelendiğinde, öğrenmeyi öğrenme faktörüne bağlı sonuçlar dışındaki tüm bulgular literatürle örtüşmektedir ancak öğrenmeyi öğrenme faktörü genel olarak negatif bir etki göstermiştir. Öğrencilerin, öğrenmeyi öğrenme alt boyutuna verdikleri cevapların ortalama skorları incelendiğinde 3.08 gibi orta bir değerle karşılaşılmaktadır. Bu sonuç bize öğretmenlerin öğrencileri, dersi planlama, süreci birlikte yönetme ve birlikte karar alma gibi süreçlere çok dahil etmediğini göstermektedir. Benzer bir sonuca Özkal ve diğerleri (2009) de ulaşmıştır. Burada öğretmenlerin sınıf içerisinde nasıl davrandıklarının incelendiği ve bunun üstüne bir de ailesel ve sosyo kültürel faktörlerin de dâhil edildiği yeni çalışmalara ihtiyaç duyulduğu ortaya çıkmıştır. Tüm bu sonuçlar literatürle karşılaştırıldığında, bulguların genel olarak literatür ile örtüştüğü görülmüştür (örn. Tsai, 2000; Özkal ve diğerleri, 2009). Tsai (2000) sofistike epistemolojik inançlara sahip olan öğrencilerin, sınıf ortamlarını daha yapılandırıcı olarak algıladıklarını vurgulamıştır. Yine Özkal ve diğerleri (2009)'de benzer bir şekilde öğrenme ortamlarını yapılandırıcı olarak algılayan öğrencilerin, epistemolojik inançlarının diğer öğrencilere göre daha sofistike olduğu ortaya çıkmıştır. Bu durum sadece öğrenmeyi öğrenme alt boyutunda beklentilerin dışında çıkmıştır ve tartışmalı bir sonuçtur. Burada öğretmenlerin sınıf içi katılıma yeterince önem vermediğine vurgu yapılmakla birlikte bu konunun daha derinlemesine araştırılması tavsiye edilmektedir.

Öğretmen değişkenlerini etkisi incelendiğinde ise, öğretmenlerin öğrencileri derse entegre etme konusunda yüksek öz-yeterliğe sahip olmaları, öğrencilerin bilginin değişmezliği konusundaki naif inanışlarını azaltmaktadır. Bu beklenen bir sonuçtur ancak, bilginin kaynağı ve değişmezliği konusunda naif inanışlara sahip öğretmenlerin öğrencileri, bilginin gerekçelendirilmesi ve gelişimi konusunda sofistike inanışlara sahip çıkmıştır. Bu beklenmeyen bir sonuçtur ve öğretmenlerin kendi epistemolojik inançlarını sınıflarına, öğretimlerine ve öğrencilerine aktaramadığının bir göstergesidir. Bu yorumun dışında öğrencilerin ailesel ve sosyo-kültürel değişkenlerinin de etkisi olabileceği düşünülmektedir. Bu konuda daha derinlemesine çalışmalar yapılması, konunun daha iyi anlaşılması ve bulguların daha derinlemesine incelenmesi hususunda bir ihtiyaç olarak görülmektedir.

Araştırma Sorusu 3: Öz-Yeterlik İnançlarını Yordama

Bu araştırma sorusunda öğrencilerin öz-yeterlik inançları, onların epistemolojik inançları, yapılandırıcı öğrenme ortamı algıları ve öğretmenlerinin bazı özellikleri (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları) tarafından tahmin edilmeye çalışılmıştır. HLM sonuçları öz-yeterlik açısından sınıflar arasında anlamlı bir varyasyon olduğunu göstermiştir.

Sonuçlar, öğrenci düzeyinde, yapılandırıcı öğrenme ortamı algısının onların öz-yeterlik inançları ile pozitif bir ilişki içinde olduğunu göstermektedir. Buna göre sınıflarında, öğrendikleri bilimsel bilgileri günlük hayatı ile eşleştirebilmede, ders içerisinde neler olup bittiğine dair sorular sormada, dersi planlamaya, biçimlendirmeye dahil olmada ve sınıf içerisinde iletişim kurmada kendilerini daha özgür hisseden öğrencilerin öğrenmeye karşı daha fazla öz-yeterliğe sahip oldukları ve daha zor konulara karşı istekli oldukları görülmüştür. Benzer sonuçlar öğrenme ortamı algılarının sınıf düzeyinde incelenmesinde de karşımıza çıkmaktadır. Tüm bu sonuçlar beklenti dâhilindedir ve literatürle uyumludur (örn. Arisoy, 2007; Sungur & Gungoren, 2009; Yerdelen, 2013). Öte yandan öğrencilerin epistemolojik inançları incelendiğinde ise bilimin gerekçelendirilmesi ve bilimin gelişmesi hakkında daha sofistike inançlara sahip olan öğrenciler, daha yüksek öz-yeterlik inancı göstermişler ve kendilerini Fen'i öğrenmede daha yetenekli ve kapasiteli görmüşlerdir. Literatürdeki çalışmalar incelendiğinde de buna paralel sonuçları görmek mümkündür (örn. Chen, 2012; Chen & Pajares, 2010; Paulsen & Feldman, 1999).

Öğretmen düzeyindeki değişkenler incelendiğinde, öğretmenlerin sınıf yönetimi konusundaki öz-yeterliklerinde rapor ettikleri yüksek skorlar, öğrencilerin öz-yeterliklerindeki skorlar ile ters ilişkili olarak bulunmuştur. Yani sınıf yönetiminde kendisini iyi olarak düşünen öğretmenlerin öğrencileri, daha düşük öz-yeterliğe sahip bulunmuştur. Burada öğretmenlerin nasıl bir sınıf yönetimi tercih ettiklerini derinlemesine incelemek gerekmektedir. Eğer öğretmen iyi bir sınıf yönetimi derken katı kurallar ve disipline edici davranışlarla sınıfı yönetmeye çalışmışsa, öğrencilerin düşük öz-yeterlik göstermeleri normal karşılanabilir. Bu konuda yapılacak yeni çalışmalarda öğretmenin sınıf içerisinde gösterdiği sınıf yönetimi teknikleri detaylı incelenmeli ve bulgular buna göre yorumlanmalıdır.

Araştırma Sorusu 4: Hedef Yönelimlerini Yordama

Bu araştırma sorusunda öğrencilerin hedef yönelimleri, onların epistemolojik inançları, yapılandırıcı öğrenme ortamı algıları ve öğretmenlerinin bazı özellikleri (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları) tarafından tahmin edilmeye çalışılmıştır. HLM sonuçları hedef yönelimleri açısından sınıflar arasında anlamlı bir varyasyon olduğunu göstermiştir.

Hedef yönelimlerini her bir alt boyutta tek tek ele alırsak, öğrenme yaklaşma hedeflerini yüksek olan öğrencilerin, epistemolojik inançlarda bilginin gerekçelendirilmesi alt boyutunda, öğrenme ortamı algılarında ise dünyayı öğrenme, düşünceleri ifade etmeyi öğrenme ve iletişim kurmayı öğrenme alt boyutlarında yüksek skorlara sahip oldukları görülmüştür. Buna göre öğrenci, kendi gelişimi açısından öğrenmeyi hedeflemişse, deneylerin, veri toplamanın bilginin oluşumunda önemli yer tuttuğunu, öğrendiği bilgileri kendi günlük yaşamıyla ilişkilendirmede, düşüncelerini sınıf içinde özgürce ifade etmede ve sınıf içinde iletişim kurmada rahat hissettiğini göstermiştir. Tüm bu sonuçlar sürpriz olmayıp öğrenme ortamları (Arisoy, 2007; Kizilgunes et al., 2009; Lau et al., 2008; Sungur & Gungoren, 2009; Yerdelen, 2013) ve epistemolojik inançlar (Cavallo et al., 2003; Hofer, 1994; Kizilgunes et al., 2009; Paulsen & Feldman, 1999; Schutzet al., 1993) açısından literatürle örtüşür vaziyettedir. Öğrenme ortamı algısıyla ilgili sonuçlar öğreten boyutunda da bu yöndedir ancak bu kısımda öğrenme ortamında planlamaya dâhil olma algısının olumsuz bir etki yaptığı görülmüştür. Bu faktör ile ilgili negatif algı, epistemolojik inançlarda ve öz-yeterlikteki ile paralel bir şekilde öğrenme yaklaşma hedefleri içinde geçerli görülmüştür. Öğretmenin, öğrenciyi yeterince sınıf için karar mekanizmalarına dâhil etmemesinin bir neticesi olduğu düşünülmektedir.

Performans yaklaşma hedefleri açısından sonuçlar incelendiğinde, öğrencilerin kendi yeteneklerini ve başarılarını göstermek için hedeflerine yönelmeleri, hem bilginin gerekçelendirilmesinde ve gelişiminde sofistike hem de bilginin değişmezliğindeki naif epistemolojik inançları ile pozitif ilişkili çıkmıştır. Kızılgüneş ve diğerleri (2009) buna benzer bir sonuç bulmuştur. Öte yandan öğrencilerin sınıf içerisinde öğrendikleri bilimsel bilgileri kendi hayatlarıyla ilişkilendirme konusundaki algıları ile performans yaklaşma hedefleri de pozitif ilişkili bulunmuştur. Church ve diğerleri (2001) ve Yerdelen (2013)'te genel anlamda öğrenme ortamına ait pozitif algıların, öğrencinin hedeflerinde performans yaklaşma hedef yönelimlerine kaymaya sebep olabileceği vurgulanmıştır.

Öğrenme kaçınma hedefleri ise öğrenme ortamı algılarından sadece iletişim kurmayı öğrenme alt boyutu ve epistemolojik inançların tüm alt boyutları tarafından tahmin edilmiştir. Bu sonuçlara göre öğrenirken yanlış anlamaktan kaçınan öğrenciler sınıf içerisinde iletişim kurmaya dönük bir ortamı daha pozitif algılıyorlar. Yine hem naif hem de sofistike epistemolojik inançlara sahip öğrenciler, fen konularını öğrenirken daha çekingen davranıp yanlış anlamaktan veya anlayamamaktan kaçınmışlardır. Performans kaçınma hedef yönelimlerinde ise öğrenciler dünyayı öğrenme, bilimi öğrenme ve iletişim kurmayı öğrenme konularında daha pozitif bir algıya sahipler. Bu tip öğrencilerin diğer arkadaşları karşısında kötü veya başarısız görünme kaygısı taşıdıkları düşünülürse bu sonuçlar beklenti dışında gerçekleşmiştir. Öte yandan genellikle naif epistemolojik inançlar performans kaçınma hedefleri ile doğru orantılı çıkmıştır. Kaçınma hedef yönelimleri ve epistemolojik inançlar ile ilgili genel sonuçlara bakıldığında ise naif epistemolojik inançlar bu tip hedef yönelimlerini destekler yönde bulunmuştur. Bu sonuçlar Braten ve Stromso (2004) ve Chen (2012)'nin sonuçları ile tutarlılık göstermektedir.

Hedef yönelimleri ile ilgili öğretmen değişkenlerinin etkileri incelendiğinde, öğretmenlerin uzmanlık yaklaşma hedef yönelimleri ve bilginin gerekçelendirilmesi konusundaki sofistike inançları öğrencilerin performans kaçınma hedeflerini daha az benimsemeleri ile ilişkilendirilmiştir. Bu konuda çok fazla araştırma olmamakla birlikte, yeni çalışmalara ihtiyaç olduğu Yerdelen'in (2013) çalışmasında tavsiye edilmiştir. Bu çalışma sonucunda da görülmüştür ki, öğrencilerin hedef yönelimlerini açıklamada öğretmen değişkenlerinin çok ciddi bir etkisi olmamakla birlikte yeni çalışmalarla daha derinlemesine incelenmesine ihtiyaç vardır.

Araştırma Sorusu 5: Değer Verme Algılarını Yordama

Bu araştırma sorusunda öğrencilerin verilen görevlere atfettikleri değerler, onların epistemolojik inançları, yapılandırıcı öğrenme ortamı algıları ve öğretmenlerinin bazı özellikleri (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları) tarafından tahmin edilmeye çalışılmıştır. HLM sonuçları öğrencilerin verilen görevlere atfettikleri değerler açısından sınıflar arasında anlamlı bir varyasyon olduğunu göstermiştir.

Öğrencilerin verilen görevlere atfettikleri değerlerin yüksek olması, onların öğrenme ortamlarını dünyayı öğrenme, düşünceleri ifade etmeyi öğrenme, iletişim kurmayı öğrenme açısından pozitif algılamalarıyla doğru orantılı bir çizgi çizmiştir. Buna göre öğrencilerin sınıf içerisinde öğrendikleri bilgileri günlük hayatlarıyla ilişkilendirmede, düşüncelerinin özgür bir şekilde ifade etmede ve diğer arkadaşlarıyla herhangi bir konu üzerinde tartışmalara girmede hissettikleri rahatlık onların verilen görevlere ve katıldıkları aktivitelere verdikleri değerle paralel olarak artmaktadır. Yani öğretmenin, öğrencilerine yapılandırıcı öğrenme ortamı sunması, onların ödevlere veya aktivitelere önem verme seviyesini artırmaktadır. Bu sonuçlar çalışmanın beklentileri dâhilinde olup Arısoy (2007)'nin sonuçları ile paralellik göstermektedir.

Epistemolojik inançlar incelendiğinde ise sadece bilginin gerekçelendirilmesi alt boyutunun, görevlere ve ödevlere verilen değerlerle pozitif bir ilişki içinde olduğu görülmektedir. Buna göre deneylerin ve veri toplamanın bilginin gerekçelendirilmesinde öneminin farkında olan öğrenciler, doğal olarak yapılan aktivitelere de değer vermektedir. Bu bulgular Paulsen ve Feldman'ın (1999) sonuçları ile aynı doğrultuda olup herhangi bir sürpriz içermemektedir. Öğretmen değişkenleri açısından ise herhangi bir anlamlı sonuç bulunamamıştır.

Araştırma Sorusu 6: Üst Bilişsel Öz Düzenleme Becerilerini Yordama

Bu araştırma sorusunda öğrencilerin üst bilişsel öz düzenleme becerileri, onların epistemolojik inançları, yapılandırıcı öğrenme ortamı algıları ve öğretmenlerinin bazı özellikleri (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları) tarafından tahmin edilmeye çalışılmıştır. HLM sonuçları öğrencilerin üst bilişsel öz düzenleme becerileri açısından sınıflar arasında anlamlı bir varyasyon olduğunu göstermiştir.

Öğrencilerin üst bilişsel öz düzenleme becerilerinin, onların yapılandırıcı öğrenme ortam algıları ile ilişkisi incelendiğinde, öğrenme ortamı algısının tüm alt boyutlarının üst bilişsel öz düzenleme becerileri üzerinde etkili bir faktör olduğu görülmektedir. Buna göre üst bilişsel öz düzenleme becerileri yüksek olan öğrenciler, sınıf ortamlarının, öğrendikleri bilimsel bilgileri yaşamlarıyla ilişkilendirmede, bilimin değişken yapısını kavramada, sahip oldukları fikirleri sınıf içerisinde beyan etmede, kendi öğrenme ortamlarını tasarlayacak fikirler belirtmede ve herhangi bir bilimsel konuda arkadaşları ile tartışmalara dahil olmada kendilerine fırsatlar verdiğini ve kendilerini bu gibi davranışları göstermede özgür kıldığını düşünmektedirler. Yapılandırıcı öğrenme ortamının ve üst bilişsel düzenleme becerilerinin bu tarz ortamlardaki muhtemel etkilerini dikkate alınca, bu bulguların beklenti dahilinde ve literatür ile de uyumlu olduğu görülmektedir (örn. Ozkal ve diğerleri, 2009; Sungur & Gungoen, 2009, Yerdelen, 2013; Yilmaz-Tuzun & Topcu, 2010). Öte öğrenme ortamı algısının etkisine, sınıf ortalamaları düzeyinde bakıldığında da benzer sonuçlar görülmektedir.

Öğrencilerin epistemolojik inançlarının, üst bilişsel öz düzenleme becerileri üzerindeki tahmin edici etkisine bakıldığında ise bilimi gerekçelendirme alt boyutundaki sofistike inançlarının, öğrencilerin üst bilişsel öz düzenleme becerilerinin artması ile pozitif ilişkili olduğu görülmektedir. Beklenti dahilinde olan bu sonuç, literatür ile de uyumludur (Chan, 2003; Kardash & Howell, 2000). Ancak öğrencilerin bilginin değişmezliği konusundaki naif inançları da üst bilişsel öz düzenleme becerileri ile pozitif ilişkili çıkmıştır. Beklentilerin tersi yönde çıkan bu sonucun, öğrencilerin epistemolojik inançlarına muhtemel etkileri bulunan ailesel, kültürel veya sosyo ekonomik faktörlerin etkisiyle bu şekilde çıktığı düşülmektedir. Daha anlamlı ve kabul edilebilir açıklamalar yapabilmek için tüm bu ilişkileri inceleyen yeni çalışmalara ihtiyaç görülmektedir.

Araştırma Sorusu 7: Fen Başarısını Yordama

Bu araştırma sorusunda öğrencilerin Fen dersindeki başarıları, onların öz düzenleme becerileri, epistemolojik inançları, yapılandırıcı öğrenme ortamı algıları ve öğretmenlerinin bazı özellikleri (öz-yeterlik, hedef yönelimleri, epistemolojik inançlar, öğrenci merkezli inançlar ve pratikler ve kişisel vatandaşlık davranışları) tarafından tahmin edilmeye çalışılmıştır. HLM sonuçları, öğrencilerin Fen başarıları açısından sınıflar arasında anlamlı bir varyasyon olduğunu göstermiştir.

Çalışmanın odak noktası olan Fen başarısını, tüm öğrenci ve öğretmen değişkenleri ile tahmin etmeye çalışan bu modelde, öğrencilerin öğrenme ortamı algılarından iletişim kurmayı öğrenme alt boyutunun öğrenci başarısını artırıcı etkisi görülmektedir. Yani sınıf içerisinde herhangi bir bilimsel konuda, tartışmalara girebilen ve bu konuda kendisini özgür hisseden öğrencilerin Fen başarıları daha yüksek çıkmıştır. Bu bulgu literatürdeki diğer çalışmaların sonuçları ile de uyumludur (Allen & Fraser, 2007; Baek & Choi, 2002; Dorman, 2001; Fraser, 1989; Goh & Fraser; 1998; Roth, 1997; Snyder, 2005; Wolf & Fraser, 2008; Yerdelen, 2013). Ancak uyumlu olmayan ya da beklentiler dışında gerçekleşen sonuçlar ise, yapılandırıcı öğrenme ortam algısının diğer alt boyutlarının, Fen başarısı ile anlamlı bir ilişki içerisinde olmamalarıdır. Bu konuda öğretmenlerin sınıf içerisinde öğrencilerine sunmuş oldukları ortamın detaylı incelenmesi ve öğretme stratejilerinin incelenmesi daha açıklayıcı sonuçlar üretecektir. Bu nedenle bu konuda yeni çalışmaların yapılması uygun görülmektedir.

Öte yandan öğrencilerin epistemolojik inançlarının, onların Fen başarıları başarılarını anlamlı bir şekilde açıkladığı bulunmuştur. buna göre bilimin gerekçelendirilmesinde sofistike inançlara sahip öğrencilerin yani deneylerin, veri toplamanın bilginin ortaya çıkmasındaki önemin farkında olan öğrencilerin daha başarılı oldukları ortaya çıkmıştır. Bilginin değişmezliği konusunda ise naif inanca sahip olmayan yani bilginin zamanla değişebileceğini düşünen öğrencilerin daha başarılı oldukları ortaya çıkmıştır. Bu sonuçlar, çalışmanın beklentileri doğrultusunda olup literatürdeki diğer çalışmalarla da uyum içerisindedir (Cano, 2005; Conley ve diğerleri, 2004; Kardash & Scholes, 1996; Kizilgunes ve diğerleri, 2009; Schommer, 1990; Schommer, Crouse, & Rhodes, 1992; Schommer & Walker, 1997; Topcu & Tuzun, 2009).

Öz düzenleme becerilerinin bileşenleri incelendiğinde ise sadece hedef yönelimlerinden performans kaçınma alt boyutunun, Fen başarısı ile ilişkili olduğu görülmüştür. Buna göre başarısız görünmemek için derse katılımdan uzak duran öğrencilerin, Fen derslerinde daha başarısız oldukları ortaya çıkmıştır ve bu sonuç literatür ile örtüşmektedir (örn. Barzager, 2012; Elliot & McGregor, 2001; Hsieh, Sullivan, & Guerra, 2007; Yerdelen, 2013).

Öğretmen boyutundaki faktörler incelendiğinde, öğrencilerini derse entegre etme konusunda kendisine güvenen öğretmenlerin ve bilginin gelişimi konusunda sofistike epistemolojik inançlara sahip öğretmenlerin öğrencileri daha başarılı bulunmuştur. Öğrencilerini derse daha iyi entegre etmeye çalışan öğretmenler öğrencileri için yeni fikirlere daha açık ve onlar için daha çok zaman harcayan bir öğretim tarzı benimserler ve dolayısıyla böyle bir ortamda eğitim gören öğrenciler daha yüksek bir başarı gösterirler (Woolfolk Hoy ve diğerleri, 2009; Yerdelen, 2013). Öte yandan bilimin gelişimi konusunda sofistike inançlara sahip öğretmenler, öğrencilerinin alternatif düşüncelerinin daha farkında ve bunu destekleyecek öğretim metotlarını benimseyen bir yapıdadır. Bu nedenle bu öğretmenlerin öğrencilerinin daha başarılı olmaları beklenmektedir. Bulgular, bu beklentiyle ve literatürle uyumlu sonuçlar vermiştir (Brownlee, Boulton-Lewis, & Purdie, 2002; Hashweh, 1996).

Araştırma Sorusu 8: Öz-düzenleme becerilerinin, yapılandırıcı öğrenme ortamı algıları ve epistemolojik inançların Fen başarısı ile ilişkisindeki aracı rolü inceleme

Bu araştırma sorusunda, öğrencilerin öz-düzenleme becerilerinin (öz-yeterlik, hedef yönelimleri, değer verme, üst bilişsel öz düzenleme becerileri), onların yapılandırıcı öğrenme ortamı algıları ve epistemolojik inançlarının Fen başarıları ile arasındaki ilişkide aracı rol rolü araştırılmıştır. Bu amaçla Fen başarıları öncelikle yapılandırıcı öğrenme ortamı algıları ve epistemolojik inançlar ile tahmin edilmeye çalışılmıştır. Bu modelde öğrencilerin, öğrenme ortamı algılarından iletişim kurmayı öğrenme alt boyutu, epistemolojik inançlarından ise bilginin kaynağı, bilginin değişmezliği ve bilginin gerekçelendirilmesi alt boyutları Fen başarısını tahmin etmiştir. Beklentiler doğrultusunda, iletişim kurma konusunda kendisini sınıf ortamında özgür hisseden öğrenciler ve deneylerin, veri toplamanın faydasına inanan öğrenciler, Fen dersinde daha başarılı sonuçlar almışlardır. Öte yandan bilginin kaynağını tartışmadan kabul eden ve bilgiyi değişmez gören öğrenciler daha düşük notlar almışlardır. Bu sonuçların üzerine model değiştirilmeden öz-düzenleme bileşenleri modele eklenmiştir. Bu eklemeden sonra öz-düzenleme bileşenlerinden öz-yeterlik anlamlı ilişkili bulunurken, epistemolojik inançlarda bilginin kaynağı ve bilginin gerekçelendirilmesi alt boyutları önemini yitirmişlerdir. Bu, öz-düzenleme becerilerinin, öğrencilerin epistemolojik inançları ile onların Fen başarıları arasındaki ilişkide bir aracı rol oynadığını göstermektedir. Burada dikkat edilmesi gereken ise bu rolde en yüksek paya öz-yeterlik inancının sahip olduğunun bilinmesidir.

Sonuç

Yapılan HLM analiz sonuçları, öğrencilerin yapılandırıcı öğrenme ortamı algılarının ve epistemolojik inançlarının, onların öz düzenleme becerilerini ve fen başarılarını tahmin etmede iyi bir yordayıcı olduklarını göstermiştir. Ayrıca öz düzenleme becerileri arasında, performans göstermeden kaçınma hedeflerinin öğrencileri başarılı olmaktan alıkoyduğunu da göstermektedir. Tüm bu sonuçlar göstermiştir ki öğrencilere oluşturulacak yapılandırıcı sınıf ortamlarının ve onların epistemolojik inançlarındaki seviyenin yükseltilmesi onların başarılarına önemli derecede katkıda bulunmaktadır.

Öte yandan, öğretmen özelliklerinin de öğrenci başarısı, öğrenme ortamı algısı, epistemolojik inançları ve öz-düzenleme becerileri üzerinde etkisi bulunmaktadır. Bunlar arasında öz-yeterlikler ve epistemolojik inançlar en önemli öğretmen faktörleri arasında yer almaktadır. Ancak genel sonuçlar incelendiğinde öğrenci faktörlerinin öğretmen faktörlerine göre daha etkili olduğu, hatta öğretmen değişkenlerinin etkisinin beklenenden daha az olduğu görülmüştür.

Çıkarımlar

Çok düzeyli analizin yapıldığı bu çalışmada öğretmenler, öğretmen yetiştiren kurumlar, eğitim politikası geliştiren birimler ve eğitim araştırmacıları için önemli çıkarımlar olduğu düşünülmektedir. Öncelikle öğrencilerin yapılandırıcı öğrenme ortamı algıları, onların epistemolojik inançları, öz düzenleme becerileri ve fen başarıları üzerinde etkili bulunmuştur. Bu nedenle öğretmenler, öğrencilerine, öğrendikleri bilimsel bilgilerle yaşadıkları dünya arasında ilişki kurduracak, bilimi öğrenmede bilginin nasıl oluştuğuna dair çıkarımlar yaptıracak, düşüncelerini rahatlıkla ifade etmeyi sağlayacak, kendi öğrenme ortamlarını tasarlamalarına izin verecek ve bilimsel konularda arkadaşlarıyla tartışma ortamları oluşturacak bir sınıf ortamı sağlamalıdır. Bu tarz bir sınıf ortamı yaratılabilirse ve öğrencilerde bu ortamı doğru algılarlarsa, öz-yeterliklerinin, öğrenme hedeflerinin, derse verdikleri değerlerin ve üs bilişsel öz düzenleme becerilerinin daha yüksek olması beklenmektedir.

Çalışma öğrencilerin öz düzenleme becerilerinin, epistemolojik düzeylerinin ve öğrenme ortamı algılarının öneminin yanı sıra aynı zamanda öğretmen özelliklerinin de öğrencilerin öğrenmeleri üzerinde etkili olduğunu göstermiştir. Öğretmenlerin daha öz-yeterli hissetmeleri, uzmanlaşmaya dönük hedeflere sahip olmaları ve daha sofistike epistemolojik inançlara sahip olmaları için programlarda düzenlemelere gidilebilir. Öğretmen adaylarına gerçek sınıf ortamlarında daha çok şans verilebilir, alanında başarılı öğretmenleri gözlemlemeleri ve kendi öğretmen becerilerinin artırılması için pozitif dönüt almaları sağlanabilir. Bu bağlamda bu çalışma ile öğretmenlerin öz-yeterliklerine, hedef yönelimlerine ve epistemolojik inançlarına da dikkat çekilmek istenmiştir.

Son olarak bu çalışmanın motivasyon, epistemolojik inançlar, öğrenme ortamı algısıyla birlikte öğretmen özelliklerini de dahil eden kapsayıcı özelliği, eğitim psikolojisi ve fen eğitimi alanında bir önem arz etmektedir. Öğrencilere ve öğretmenlere ait birçok değişkenin ve bu değişkenlerin fen başarısındaki yerlerinin araştırıldığı bu çalışmayla eğitim araştırmacılarına yeni araştırma önerileri sunulmuştur. Öğrenci değişkenlerinin etkisinin yüksek olduğu bu çalışmada da vurgulanmıştır. Ancak önemli etkileri olduğu düşünülen öğretmen özelliklerinin, bu çalışmada incelenen kısımları dikkate alındığında beklenen etkililiğe sahip olmadığı görülmüştür. Yapılacak olan yeni araştırmalarda hem bu öğretmen özellikleri ve fen başarısına etkileri tekrar incelenebilir hem de daha farklı öğretmen özellikleri de bu araştırmalara dâhil edilebilir.

Appendix F:

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Pamuk, Savaş
Nationality: Turkish (TC)
Date and Place of Birth: October 7, 1980, Gümüşhane
Marital Status: Single
Phone: +90 312 210 4059
Fax: +90 312 210 7984
e-mail: savaspamuk@gmail.com

EDUCATION

Degree	**Institution**	**Year of Graduation**
MS	Middle East Technical University, Elementary Science and Mathematics Education	2007
BS	Gazi University, Elementary Science Education	2002
High School	Ankara Kurtuluş Lisesi	1997

CERTIFICATE

2002	Gazi University, Faculty of Education	Teaching Certificate

VISITING SCHOLAR

October 2010- August 2011	Ohio State University, Educational Psychology UNITED STATES OF AMERICA	Studied with Prof. Dr. Anita Woolfolk-Hoy

WORK EXPERIENCE

2004-Present	METU, Department of Elementary Education	Research Assistant

PUBLICATIONS

1. Pamuk, S., & Peker, D. (2009). Turkish pre-service science and mathematics teachers' computer related self-efficacies, attitudes, and the relationship between these variables. *Computers & Education, 53*(2), 454-461.

PRESENTATIONS

1. **Pamuk, S.,** Oztekin, C., Teksöz, G. Kilic, D.S., & Sahin, E. (2014, September). *Sürdürülebilir bir kampüs için Geri Dönüşüm Anketi: Geçerlik-Güvenirlik Çalışması.* Paper presented at XI. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi, Adana, Turkey.

2. Sahin, E., Kilic, D.S., **Pamuk, S.,** Oztekin, C., & Tuncer, G. (2013, October). *Predictors of recycling behavior: A Turkish university campus case.* The International Organization for Science and Technology Education (IOSTE): Paper presented at The International Organization for Science and Technology Education (IOSTE 2013): Eurasia Regional Symposium & Brokerage Event Horizon 2020, Turkish Republic of Northern Cyprus.

3. Tekkaya, C., **Pamuk, S.,** Teksöz, G., Kilic, D.S., & Sahin, E. (2013, September). *To recycle or not to recycle: Accessible conditions and gender as determinants of recycling behavior.* The European Conference on Educational Research (ECER): Paper presented at The European Conference on Educational Research (ECER 2013), Istanbul, Retrieved from http://www.eera-ecer.de/ecer-programmes/print/conference /8/contribution/21035/.

4. Tekkaya, C., Kilic, D.S., Teksöz, G., **Pamuk, S.,** & Sahin, E. (2013, April). *Modeling the Relationships between Recycling Behavior and Gender.* National Association for Research in Science Teaching (NARST): Paper presented at the meeting of National Association for Research in Science Teaching (NARST 2013): The S in STEM Education: Policy, Research and Practice (pp. 1-10). Rio Grande, Porto Rico, Retrieved from NARST 2013 Conference CD.

5. Yıldırım, Ç., **Pamuk, S.,** & Elmas, R. (2012). *21. yüzyıl öğretmenleri için WEB 2.0 araçları.* Paper presented at X. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi, Niğde, Türkiye, 27-30 Haziran, p.16.

6. **Pamuk, S.,** & Peker, D. (2008). *Pre-Service Science and Mathematics Teachers' Computer Related Self-Efficacy, Attitudes, and the Relationship among These Variables.* American Educational Research Association 2008 Annual Meeting, New York, New York, March, 24-28.

7. Topcu, M. S., & **Pamuk, S.** (2006, April). *The Effect of Computer Simulation on Middle School Students' Understanding of Mendelian Genetics, Attitude and Self-Efficacy towards Computer*. In Hüseyin Yaratan & Hamit Caner (Eds), 6th International Educational Conference: Paper presented at 6th International Educational Conference (IETC 2006): Computers in Education (pp.1562-1568). Famagusta, Turkish Republic of Northern Cyprus: Eastern Mediterranean University (EMU).

SCHOLARSHIP

2010-2011	Abroad Research Scholarship for Doctoral Students Education	Turkish Higher Education Council

MEMBER

2008-2009	American Educational Research Association	Doctoral Student Member
2011-2012	The National Association for Research in Science Teaching	Doctoral Student Member

FOREIGN LANGUAGES

English

COMPUTER PROGRAMS

MS Office Tools, SPSS, HLM, LISREL, Iteman, Photoshop, Gimp.

HOBBIES

Automobiles, Car Modification, Car Design, Motorsports, Charcoal Drawings, Technological Devices.

Appendix G

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ■

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☐

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı : Pamuk
Adı : Savaş
Bölümü : İlköğretim

TEZİN ADI: Multilevel Analysis of Students Science Achievement in Relation to Constructivist Learning Environment Perceptions, Epistemological Beliefs, Self-Regulation and Science Teachers Characteristics

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 bir (1) yıl süreyle fotokopi alınamaz. ■

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: