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Background: There are attempts to integrate learning environment research with motivation and self-regulation research that considers social context influences an individual's motivation, self-regulation and, in turn, academic performance.

Purpose: This study explored the relationships among constructivist learning environment perception variables (personal relevance, uncertainty, shared control, critical voice, student negotiation), motivational beliefs (self-efficacy, intrinsic interest, goal orientation), self-regulation, and science achievement.

Sample: The sample for this study comprised 802 Grade 8 students from 14 public middle schools in a district of Ankara in Turkey.

Design and methods: Students were administered 4 instruments: Constructivist Learning Environment Survey, Goal Achievement Questionnaire, Motivated Strategies for Learning Questionnaire, and Science Achievement Test. LISREL 8.7 program with SIMPLIS programming language was used to test the conceptual model. Providing appropriate fit indices for the proposed model, the standardized path coefficients for direct effects were examined.

Results: At least one dimension of the constructivist learning environment was associated with students' intrinsic interest, goal orientation, self-efficacy, self-regulation, and science achievement. Self-efficacy emerged as the strongest predictor of both mastery and performance avoidance goals rather than the approach goals. Intrinsic value was found to be significantly linked to science achievement through its effect on self-regulation. The relationships between self-efficacy and self-regulation and between goal orientation and science achievement were not significant.

Conclusions: In a classroom environment supporting student autonomy and control, students tend to develop higher interest in tasks, use more self-regulatory strategies, and demonstrate higher academic performance. Science teachers are highly recommended to consider these findings when designing their lessons. For the creation of such a learning environment, teachers can design open-ended inquiry activities in which students have opportunities to take responsibility, reflect on their views, and accomplish challenging tasks.

Keywords: constructivist learning environment; motivational beliefs; middle school students; science achievement; self-regulation

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1. Introduction

Learning environment is the social context in which learning takes place. Generally, it includes students, teacher, classroom and instructional materials (Johnson and McClure 2004). Because students experience different learning environments and spend most of their in-school time in the classroom, their perceptions and experiences about the classroom learning environment have a vital role in their learning process (Fraser 2007). Several studies have indicated significant associations between students' perceptions of classroom environment and their cognitive and affective learning outcomes in a variety of subject areas, at various grade levels and using different learning environment questionnaires (Fraser 2002, 2012).

In the relevant literature, there are attempts to integrate learning environment research with motivation and self-regulation research that considers social context influences an individual's motivation, self-regulation and, in turn, academic performance (Maehr and Midgley 1991; Velayutham and Aldridge 2013). Self-regulation and motivation are two important constructs that help to explain student achievement (Maehr and Midgley 1991; Schunk 2005). Indeed, several studies have demonstrated the relationship between academic performance and other constructs, including self-efficacy, goal orientation, intrinsic interest and self-regulation (Pintrich and De Groot 1990; Dethlefs 2002; Üredi and Üredi 2005). However, there is little research integrating learning environment perceptions with motivational and self-regulatory variables and with science achievement at the middle school level (Sungur and Güngören 2009). In this study, a conceptual model including the relationships among classroom learning environment perceptions, motivational beliefs and self-regulation has been hypothesized.

1.1. Constructivist learning environment

Constructivism is a learning theory emphasizing students' construction of their own understanding of the world that they live in by reflecting on their individual or social experiences (Toh et al. 2003). Rather than the old view of knowledge, which is thought to be fixed and independent of the learner, constructivist view positions knowledge in the interaction of learner's existing knowledge and beliefs with their new experiences (Airasian and Walsh 1997). There are different interpretations for constructivism. While developmental theorists of constructivism (e.g., Piaget) put emphasis on universal structures of knowledge, which are thought to be developmentally organized, social-constructivists (e.g., Vygotsky) give more importance to social and cultural influences on the learning process (Airasian and Walsh 1997). Radical constructivism emphasizes individual experiences with the world, as a result of which learners construct subjective knowledge with interaction of the social environment (von Glasersfeld 1991). Critical constructivism adds a critical dimension – it suggests revealing the social and cultural myths of context, leading to questioning, critical self-reflection and action for change, therefore shaping learners' own conceptions (Taylor 1998). In the light of these definitions, a constructivist learning environment needs to cover some particular aspects. The main tenet of constructivism is active role of individuals in their knowledge construction process. Individuals activate their current knowledge to interpret new information, and attempt to integrate new information into their existing knowledge structures (Loyens and Gijbels 2008). The second characteristic of the constructivism is the contribution to learning of sociocultural factors (Loyens, Rikers, and Schmidt

2007). Within the classroom environment, both teachers and students are authorities of knowledge, and meaning is shared through individual, group or whole-class negotiations, which allow students exchange ideas and make meaning from more than one point of view (Hand, Treagust, and Vance 1997). Another assumption of constructivism is the importance of self-regulated learning (Zimmerman 1989). Using a set of cognitive and metacognitive strategies, and having goals and motivation to attain those goals, are essential factors for effective learning. As a final feature, constructivist theorists focus on the situated aspect of learning – using real-life or authentic learning tasks in the classroom facilitates student learning and transfer of knowledge (Herrington and Oliver 2000). Briefly a constructivist learning environment can be defined as 'a place where learners may work together and support each other as they use a variety of tools and information resources in their guided pursuit of learning goals and problem solving activities' (Wilson 1996, 5). In a constructivist learning environment, teachers are expected to foster and support students' learning by providing them with authentic and meaningful activities, enabling learners to determine goals and to access to information resources and tools (Wilson 1996).

In order to measure the extent to which a classroom environment is consistent with the constructivist learning environment, researchers developed the Constructivist Learning Environment Scale [CLES] (Taylor and Fraser 1991; Taylor, Fraser, and Fisher 1997; Johnson and McClure 2004). Since the constructivist learning environment is a multidimensional construct, CLES provides multidimensional assessment on five dimensions, including personal relevance (i.e., the degree to which learning is connected to students' everyday experiences), uncertainty (i.e., the degree to which students view scientific knowledge as evolving), shared control (i.e., the degree to which students share with the teacher control of the learning environment), critical voice (i.e., the degree to which students feel that it is legitimate to express a critical view) and student negotiation (i.e., the degree to which students share their own ideas) (Taylor, Fraser, and Fisher 1997). Past studies with CLES have included associations between student outcomes and the perceptions of the learning environment, the use of CLES dimensions as criterion variables in the evaluation of educational programs, teachers' practical attempts to improve their classroom environment and cross-national studies (Fraser 2012).

In a cross-national study, Aldridge et al. (2000) investigated students' perceptions about the constructivist learning environment in their science classes in Taiwan and Australia. They found that Taiwanese students perceived personal relevance, uncertainty and shared control as occurring more frequently, while Australian students perceived more emphasis on critical voice and student negotiation.

In another study, conducted by Nix and Fraser (2011), the influence of a teacher professional development program, based on computer assisted teaching in a middle-school classroom environment, was evaluated through the administration of CLES to 845 students of 17 teachers. Science classrooms of the participating teachers were perceived to be significantly more positive in personal relevance, shared control, critical voice and student negotiation when compared to other classrooms within the same schools.

Kim, Fisher, and Fraser (1999) assessed the effect of a constructivist-oriented science curriculum on students' perceptions of the learning environment after testing the validity and reliability aspects of the Korean version of CLES. It was shown that students exposed to new curriculum perceived a more constructivist learning environment and that perceptions of personal relevance, shared control and student negotiation subscales contributed to the development of a positive attitude toward science. In a Turkish context, Ozkal et al. (2009) explored the relationships among constructivist learning environment perceptions, epistemological beliefs and learning approaches. Positive significant relationships were detected among the perceptions of constructivist learning environment, the tentative nature of knowledge and meaningful learning.

The CLES has been used extensively in a variety of studies investigating the associations between students' perceptions of the learning environment and various student-related variables, including attitude toward science (Kim, Fisher, and Fraser 1999; Aldridge et al. 2000), self-efficacy (Dorman 2001) and epistemological beliefs and learning approaches (Ozkal et al. 2009). The present study builds upon, and extends, the learning environment field by studying the associations between classroom environment, self-regulation and motivational beliefs (i.e., goal orientation, intrinsic interest and self-efficacy).

1.2. Relationships among self-regulation, self-motivational beliefs and achievement

Self-regulation is described as 'self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals' (Zimmerman 2000, 14). There are three cyclical phases of self-regulatory processes, namely, forethought, performance or volitional control, and self-reflection. The forethought phase involves processes and beliefs that come before efforts to learn, the performance or volitional control phase refers to processes that occur during performance efforts and influence attention and action, and the self-reflection phase includes processes that occur after each learning effort and affect a person's response to that action.

Self-motivational beliefs act as an energizing agent for an individual's self-regulatory behaviors and influence the implementation of self-regulatory knowledge and skills appropriately through the enhancement of learning motivation and the quality of the selection and use of learning strategies (Torrano Montalvo and Gonzales Torres 2004). Self-motivational beliefs include self-efficacy, intrinsic interest and goal orientation (Zimmerman 2000). *Self-efficacy* is known as beliefs about one's own abilities to perform a task successfully (Bandura 1994). Self-efficacy beliefs influence goal setting, the effort needed to master a task, the persistence to cope with a threatening situation and resistance to failure. Highly self-efficacious people set themselves challenging goals and exert a persistent effort to accomplish challenging tasks. In case of failure, they attribute failure to insufficient effort or deficient knowledge. Research on the relationship between self-efficacy and self-regulation has revealed that higher levels of self-efficacy are associated with higher levels of self-regulation (Pintrich and De Groot 1990; Pintrich, Roeser, and De Groot 1993; Iverach and Fisher 2008; Velayutham and Aldridge 2013). Accordingly, in the present study, we propose a positive relationship between students' self-efficacy and their self-regulation in science.

Besides individuals' beliefs to achieve a task, their interests in the learning task have an influence on their achievement behaviors. *Intrinsic value* or *interest* refers to 'enjoyment the individual gets from performing the activity or the subjective interest the individual has in the subject' (Eccles and Wigfield 2002, 120). There is a close link between self-efficacy and intrinsic interest (Pintrich 2005). As the strength of self-efficacy beliefs increases, the interest shown in activities becomes greater. A strong positive relationship was also detected between intrinsic value and self-regulation (Pintrich and De Groot 1990; Pintrich, Roeser, and De Groot 1993; Iverach and Fisher 2008). Thus, in the present study, we anticipate the association between intrinsic interest and self-regulation to be positive.

Individuals always have some reason or purpose for their engagement in achievement tasks. Goal orientation is defined as 'behavioral intentions that determine how students approach and engage in learning activities' (Meece, Blumenfeld, and Hoyle 1988, 514). Early research on achievement goals categorized the goals as performance and mastery goals (Ames 1992). Later, the distinction between approach and avoidance goals was added (Elliot and Harackiewicz 1996; Elliot and Church 1997). Students pursuing *performance approach goals* engage in activities to demonstrate their competence and desire to be better than others, while those having *performance avoidance goals* shun demonstrating their incompetence. Likewise, students adopting *mastery approach goals* engage in tasks to develop their abilities and broaden their knowledge, while those having *mastery avoidance goals* shun doing worse than they have done before or the possibility of not meeting high standards (Elliot and Harackiewicz 1996; Schunk 2005). Generally, studies have shown that mastery goal orientation is positively related to adaptive patterns of learning, such as high self-efficacy (Middleton and Midgley 1997; Bong 2001), while performance avoidance goal orientation is related to maladaptive patterns of learning, such as low self-efficacy (Middleton and Midgley 1997; Skaalvik 1997). However, Iverach and Fisher (2008) found that the mastery approach and performance avoidance goals were positively associated with self-regulation, while the mastery avoidance and performance approach goals were negatively associated with self-regulation.

Some studies have revealed inconsistent results about the relationship between goal orientation and self-efficacy. For example, the performance approach goal in Middleton and Midgley's (1997) study was not significantly related to self-efficacy, but it was positively related to self-efficacy in other studies (Wolters, Yu, and Pintrich 1996; Elliot and Church 1997; Skaalvik 1997; Bong 2001). Relationships of performance avoidance goal orientation with self-efficacy were also ambiguous. For example, Skaalvik (1997) reported a non-significant relationship between performance avoidance goals and self-efficacy, while other studies have reported a negative relationship between them (Elliot and Church 1997; Middleton and Midgley 1997). On the other hand, performance avoidance goals demonstrated a non-significant relationship with self-efficacy in a high school context, but a positive relationship with self-efficacy in a middle school context (Bong 2001). Studying high school students, Iverach and Fisher (2008) demonstrated that self-efficacy had (1) significant positive associations with mastery avoidance and both performance approach and avoidance goals and (2) non-significant associations with mastery approach goals. Despite inconsistent results on the relationships among goal orientations and adaptive outcomes, several researchers (e.g., Elliot and Church 1997; Pintrich 2005; Schunk 2005) consistently reported that individuals oriented to approach goals demonstrated higher self-efficacy and self-regulation than those oriented to avoidance goals. Therefore, we anticipated positive relationships among approach goals, self-efficacy and self-regulation, but negative relationships among avoidance goals, self-efficacy and self-regulation.

Regarding the relationship between intrinsic interest and goal orientation, individuals with higher personal interest in a topic or those who view the learning task as important tended to adopt mastery goals (Pintrich and De Groot 1990; Elliot and Church 1997; Iverach and Fisher 2008). The relationship of intrinsic interest with the performance approach goal was positive in the study of Hidi and Harackiewicz (2000), but non-significant in the study of Elliot and Church (1997). Iverach and Fisher (2008) further demonstrated that intrinsic interest was not related with avoidance goals. Although studies have shown some inconsistent results about the relationships among the goals and adaptive outcomes, in the present study we considered the results consistently shown in the literature and, accordingly, expected that approach goals would display positive relationships with intrinsic interest, self-efficacy and self-regulation, but that avoidance goals would display negative relationships with those constructs.

The relationships among these motivational constructs and achievement have been studied extensively. Pintrich and De Groot (1990) reported that self-efficacy, intrinsic interest and self-regulation were positively related to students' academic performance. Relevant literature indicated that self-efficacy beliefs have an effect on academic achievement, either directly or indirectly, through mediating the influence of other variables (e.g., mental ability, previous knowledge) that predict academic achievement (Pajares and Schunk 2001; Üredi and Üredi 2005) Studies examining the relationship between goal orientation and achievement produced mixed results. Wolters, Yu and Pintrich (1996) found that adoption of mastery goals was positively related to achievement, while other research revealed a null relationship between these two variables (Elliot and Church 1997; Skaalvik 1997). Some studies found a negative relationship between performance avoidance goal orientation and achievement (Skaalvik 1997; Elliot and McGregor 2001), but others found a null relationship between them (Elliot and Church 1997). On the other hand, performance goal orientation was found to be positively related to academic achievement (Elliot and Church 1997; Skaalvik 1997), or not significantly related to achievement (Wolters, Yu, and Pintrich 1996). It appears that approach goals are better predictors of achievement than avoidance goals. In the present study, we expected self-efficacy, intrinsic value, self-regulation and approach goals to be positively linked to achievement and avoidance goals to be negatively linked to achievement.

1.3. Relationships among constructivist learning environment perceptions and self-regulation, motivational beliefs and achievement

According to social cognitive theorists, besides personal and behavioral processes, environmental factors influence individuals' motivation and self-regulation (Zimmerman 1989). Pintrich, Roeser and De Groot (1993) demonstrated that learning environments in which students were provided with opportunities for choosing tasks and for working with others related to higher levels of self-efficacy, self-regulated learning and mastery focus of learning. Recently, Sungur and Güngören (2009) found positive correlations among classroom environment perceptions, motivational beliefs, goal orientations and cognitive strategy use in middle school students. However, there was not a direct link between classroom environment perceptions and science achievement – the influence of classroom environment perceptions on science achievement was mediated through motivational beliefs and goal orientations. Iverach and Fisher (2008) found significant associations among constructivist learning environment dimensions, achievement goals and self-regulation. Furthermore, Dethlefs (2002) investigated the relation of constructivist learning environment perceptions with student achievement, self-efficacy, intrinsic value and learning strategies in high school students. Her results indicated that there were inconsistent relationships between the dimensions of CLES and achievement in different content areas. In sum, the studies investigating the relation of CLES variables with self-efficacy, intrinsic value, goal orientation, self-regulation and achievement have demonstrated that at least one subscale of CLES is positively associated with those constructs. Therefore, direct paths from all dimensions of CLES to intrinsic value, self-efficacy, goal orientation, self-regulation and achievement were proposed in this study.

In light of these research results, it can be concluded that little research has examined the interaction of student science achievement with constructivist learning environment perceptions, achievement goals and motivational beliefs in a Turkish context (e.g., Sungur and Güngören 2009). Turkish students' achievement levels in science are low in two international studies – the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA). It is crucial to determine the relationships among science achievement and other constructs in order to provide students with more suitable learning environments. Most research has been conducted in Western countries, and the relationships may be different in non-Western countries because cultural values, beliefs and orientations play a crucial role in the development of learners' cognitive, motivational and self-regulatory processes (Pajares 2007). Individuals hold different views of the self across different cultures. For example, individualistic cultures (e.g., the USA) hold an independent view of the self, while collectivist cultures (e.g., Asian countries) hold an interdependent view of the self. In an independent view, one's own thoughts, feelings and actions are considered important in determining behavior. However, from an interdependent perspective, others are considered important in shaping one's own behavior (Markus and Kitayama 1991). Previous research has demonstrated differences in students' goal orientations (e.g., Elliot et al. 2001) and use of self-regulatory strategies (e.g., Purdie and Hattie 1996) across different cultures. For example, Elliot et al. (2001) demonstrated the variation of the adoption of avoidance goals (relative to approach goals) across different cultures. Asian Americans reported more avoidance goals than non-Asian Americans and people from collectivist countries (Russia and South Korea) reported more avoidance goals than those from an individualistic country (the USA). The authors further investigated the link between avoidance goals and subjective well-being and found avoidance goals as a negative predictor of subjective well-being in individualistic cultures but a positive predictor of subjective well-being in collectivist cultures. Turkish culture displays some but not all characteristics of collectivism (Goregenli 1997) because Turkey represents an unusual situation, a country located at the crossroads of Europe and Asia, and accordingly influenced by both Western and Eastern cultures (Yalvac et al. 2007). Therefore, it is worth investigating the relationships among the variables of interest in a sample that is representative of such a culture. Moreover, the educational system in Turkey has some unique features of structured and a highly competitive learning environment and test-driven curriculum. Although the Turkish science and technology curriculum (Ministry of National Education 2004) has been revised recently to meet the expectations of a constructivist learning environment, Turkish students generally experience more structured learning environments in which they are given clear directions about what to do (Akyol, Sungur and Tekkaya 2010). Importantly, Turkish students must compete in order to be successful in national examinations to enroll in elite secondary schools. These contextual influences may affect the relationship of interests and, thus, deserve investigation. For example, studying Turkish high school students, Sungur and Senler (2009) showed that avoidance goals were positively related to adaptive student outcomes and explained this finding within the Turkish educational system. Thus, relationships among the variables of interest in a Turkish sample may not be the same as the relationships found in other studies due to the contextual and cultural factors. Accordingly, the current study aims to describe relationships among constructivist learning environment perceptions, motivational beliefs, self-regulation and science achievement in one study in a more comprehensive way, considering contextual and cultural factors (see Figure 1 for the hypothesized model).

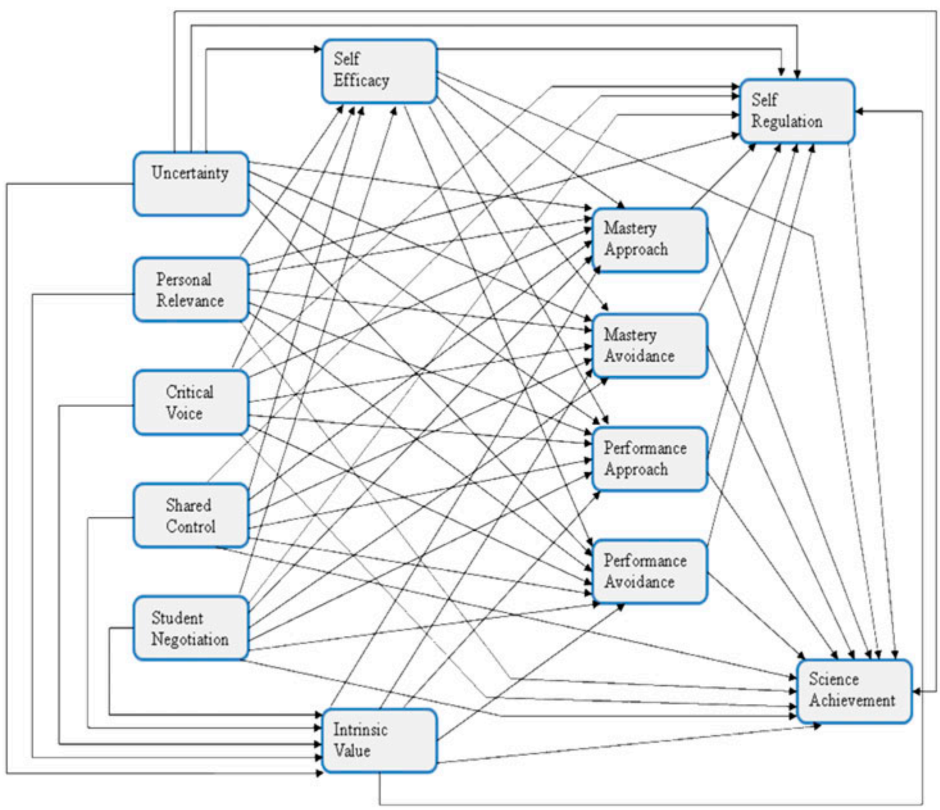

Figure 1. Proposed model of the study.

2. Methods

2.1. Study context

Public schools in Turkey are under the control of the Ministry of Education and they are required to implement the standard nationwide curriculum. In 2012, a revision was conducted in the education system, which increased compulsory education to 12 years composed of primary (Grade 1–4), middle (Grade 5–8) and high school (Grade 9–12). However, when the present study was conducted, primary and middle schools were integrated and compulsory education was 8 years. The sample for this study comprised 802 Grade 8 students from 14 public middle schools in a district of Ankara in Turkey. The mean age of students was 14.08 years, ranging from 13 to 16 years. Of these students, 58.2% ($n = 467$) were female and 41.8% ($n = 335$) were male. They were from middle-class families. The sample was selected by a convenience-sampling method that considered time, cost and transportation.

2.2. Instruments

2.2.1. Constructivist learning environment survey (CLES)

The CLES was used to determine the students' perceptions of a constructivist learning environment. It was originally developed by Taylor (1991), based on the constructivist perspective and later it was revised by the incorporation of the critical theory into the constructivist perspective (Taylor, Fraser, and Fisher 1997) because social and cultural context influences the learning environment (Aldridge et al. 2000). The CLES was subsequently shortened and revised by Johnson and McClure (2004). In this revised version of CLES, the original items were retained but the number of items under each subscale was reduced from six to four and some of the original items were rephrased, which makes it easier and quicker to administer. The 2004 version was translated into Turkish and adapted for use there by Yilmaz-Tuzun, Cakiroglu and Boone (2006).

The CLES now consists of 20 items in five scales and a 5-point Likert-type frequency response (1 = almost never; 5 = almost always): personal relevance (e.g., 'In this science class, I learn how science is a part of inside- and outside-of-school lives' $n = 4$), uncertainty of science (e.g., 'In this science class, I learn that science cannot always provide answers to problems' $n = 4$), shared control (e.g., 'In this science class, I help the teacher to decide which activities work best for me' $n = 4$), critical voice (e.g., 'In this science class, I learn better when I am allowed to question what or how I am being taught' $n = 4$) and student negotiation (e.g., 'In this science class, I explain my ideas to other students' $n = 4$). The validity of the Turkish version of the scale was provided by Yilmaz-Tuzun, Cakiroglu and Boone (2006). Ozkal et al. (2009) revised the scale and conducted confirmatory factor analysis, which supported the 5-factor structure of the instrument (GFI = .93, CFI = .97, NFI = .97, SRMR = .05) and Cronbach's alpha coefficients for the subscales ranged from .57 to .74. In the present study, confirmatory factor analysis was conducted to validate the proposed factor structures for the current data and results revealed good model fit (GFI = .94, CFI = .97, NFI = .96, SRMR = .04) supporting proposed factor structures for the current sample. Reliability coefficients of the subscales found in the present study are given in Table 1.

Table 1. Descriptive statistics for the four instruments.

	M	*SD*	Skewness	Kurtosis	Alpha coefficient
Constructivist Learning Environment Survey					
Personal relevance	3.98	.79	−.75	.16	.68
Uncertainty	3.59	.74	−.27	−.14	.52
Critical voice	3.73	.81	−.43	−.45	.63
Shared control	3.00	.97	−.08	−.69	.73
Student negotiation	3.41	.86	−.37	−.29	.67
Achievement Goal Questionnaire					
Mastery approach	4.25	.79	−1.09	.60	.73
Performance approach	4.01	.92	−.95	.54	.70
Mastery avoidance	3.20	.99	−.18	−.50	.70
Performance avoidance	3.40	.93	−.43	−.37	.77
Motivated Strategies for Learning Questionnaire					
Self-efficacy	5.21	1.19	−.60	−.17	.88
Intrinsic value	5.52	.99	−.92	.96	.79
Self-regulation	4.83	.94	.01	−.22	.61
Science Achievement Test	11.44	4.04	−.07	−.59	.74

2.2.2. Achievement goal questionnaire (AGQ)

Students' goal orientations for science achievement were assessed using a 5-point Likert-type instrument. The AGQ is a self-report instrument developed by Elliot and McGregor (2001) and translated into Turkish and adapted for use there by Sungur and Senler (2009). Fifteen items measure students' goals for mastery approach (e.g., 'It is important for me to understand the content of this course as thoroughly as possible' $n = 3$), mastery-avoidance (e.g., 'I worry that I may not learn all that I possibly could in this class' $n = 3$), performance-approach (e.g., 'It is important for me to do better than other students' $n = 3$) and performance-avoidance (e.g., 'I just want to avoid performing worse than others' $n = 6$). Senler and Sungur (2007) demonstrated that the Turkish version of the AGQ was a valid instrument for measuring middle school students' achievement goals. Confirmatory factor analysis conducted during its validation supported a 4-factor structure of the instrument (GFI = .92, CFI = .92, NFI = .90, SRMR = .07) and Cronbach's alpha coefficients ranged from .64 to .84. In the present study, confirmatory factor analyses conducted also revealed good model fit (GFI = .91, CFI = .94, NFI = .93, SRMR = .07), supporting the proposed factor structures for the current sample. The reliabilities of these subscales computed for the present study were displayed in Table 1.

2.2.3. Motivated strategies for learning questionnaire (MSLQ)

Students' motivational beliefs were measured by the MSLQ, which was developed by Pintrich et al. (1991) and translated into Turkish and adapted for use there by Üredi and Üredi (2005). The MSLQ is a 44-item scale with a 7-point Likert response range (1 = not at all true of me–7 = very true of me) and two main sections of motivation and learning strategy. The motivation section is comprised of three subscales: self-efficacy (e.g., 'Compared with other students in this class, I expect to do well' $n = 9$), intrinsic value (e.g., 'I prefer class work that is challenging so I can learn new things' $n = 9$) and test anxiety (e.g., 'I am so nervous during a test that I cannot remember facts I have learned' $n = 4$). The learning strategy section includes two subscales: self-regulation (e.g., 'I ask myself questions to make sure I know the material I have been studying' $n = 9$) and cognitive strategy use (e.g., 'When I study for a test, I try to put together the information from class and from the book' $n = 13$). The factor structure of the MSLQ for its use with Turkish middle school students was validated by Üredi and Üredi (2005) through exploratory factor analyses and cronbach's alpha reliabilities for the subscales of MSLQ ranged from .81 to .92. In the present study, only three subscales of MSLQ – self-efficacy, intrinsic value and self-regulation – were used for path analysis. Confirmatory factor analysis was conducted using data from the current sample and results supported the proposed factor structure of the MSLQ (GFI = .87, CFI = .97, NFI = .96, SRMR = .05). Subscale reliabilities found in the current study are presented in Table 1.

2.2.4. Science achievement test (SAT)

The SAT is composed of 20 multiple-choice items selected from translated questions from TIMSS (1999). Science questions were developed and translated through consensus and input from disciplinary experts and were selected based on concepts covered in the Turkish Grades 6 and 7 science curriculum. The four areas of performance expectations were: understanding simple information ($n = 12$), understanding complex information ($n = 4$), theorizing, analyzing and solving problems ($n = 3$) and investigating the natural world ($n = 1$). Following a pilot study, changes to the alternatives of two items with daily words were considered necessary. The reliability of the SAT was calculated with KR20 formula and found to be .74. Two middle school science teachers analyzed the relevance of each test item to the instructional objectives covered in the Turkish Grades 6 and 7 science curriculum.

3. Results

3.1. Descriptive statistics

Descriptive statistics for each variable to be integrated in the model are presented in Table 1. Examination of skewness and kurtosis values indicated normal distribution of all observed variables. Mean values of constructivist learning environment variables were high. In particular, the mean values for personal relevance, uncertainty, critical voice and student negotiation were above the mid-point of the 5-point Likert scale, while the lowest mean was for shared control. Accordingly, it can be said that students perceived their science classes as being related to their everyday life, emphasizing the evolving nature of scientific knowledge and giving opportunities to question and discuss ideas with friends while sometimes thinking they share control with their teacher about class activities. Descriptive statistics on achievement goals suggested that students pursued high levels of achievement goals. The means for approach goals, however, were higher than their avoidance counterparts, which implies that students were more focused on learning and demonstrating competence than they were concerned with avoiding misunderstanding and looking incompetent. The mean values for MSLQ were well above the mid-point of the 7-point Likert scale, indicating that students had high efficacy in their ability to perform science

Table 2. Direct effects of the variables in the model on each other.

Effect	Standardized Coefficients	*SE* of the estimates	*T*	R^2
On Intrinsic value of:				.34
Personal relevance	.17*	.01	5.67	
Uncertainty	.10*	.06	2.81	
Critical voice	.13*	.06	3.58	
Shared control	.23*	.06	5.92	
Student negotiation	.20*	.04	5.78	
On Self-efficacy of:				.05
Personal relevance	−.16*	.01	−4.43	
Uncertainty	.02	.05	.37	
Critical voice	.08	.06	1.71	
Shared control	−.00	.05	−.07	
Student negotiation	.12*	.04	2.92	
On Mastery approach of:				.44
Personal relevance	.02	.01	.61	
Uncertainty	.10*	.04	2.82	
Critical voice	.04	.04	1.06	
Shared control	.27*	.04	7.36	
Student negotiation	.29*	.03	8.71	
Self-efficacy	.03	.03	1.06	
Intrinsic value	.15*	.02	4.57	
On Performance approach of:				.09
Personal relevance	.00	.04	.11	
Uncertainty	.12*	.25	2.88	
Critical voice	.03	.27	.77	
Shared control	.04	.26	.87	
Student negotiation	−.00	.20	−.06	
Self-efficacy	.02	.17	.59	
Intrinsic value	.18*	.16	4.28	
On Mastery avoidance of:				.38
Personal relevance	.01	.04	.17	
Uncertainty	.04	.22	1.01	
Critical voice	.07	.24	1.83	
Shared control	−.01	.23	−.28	
Student negotiation	−.02	.18	−.56	
Self-efficacy	.49*	.15	17.20	
Intrinsic value	.31*	.14	9.02	
On Performance avoidance of:				.23
Personal relevance	−.03	.03	−.96	
Uncertainty	.02	.18	.45	
Critical voice	.05	.20	1.20	
Shared control	−.02	.19	−.39	
Student negotiation	.10	.14	2.43	
Self-efficacy	.44*	.12	13.72	
Intrinsic value	.01	.12	.17	
On Self-regulation of:				.52
Personal relevance	−.02	.01	−.74	
Uncertainty	.18*	.04	5.58	
Critical voice	.01	.04	.20	
Shared control	.08*	.04	2.35	
Student negotiation	.01	.03	.40	
Self-efficacy	.06	.03	1.71	
Intrinsic value	.52*	.03	15.98	
Mastery approach	.01	.04	.26	

(*Continued*)

Table 2. (*Continued*).

Effect	Standardized Coefficients	*SE* of the estimates	*T*	R^2
Performance approach	.11*	.01	4.16	
Mastery avoidance	.01	.01	.22	
Performance avoidance	.04	.01	.01	
On Achievement of:				.41
Personal relevance	.05	.01	1.86	
Uncertainty	−.06	.04	−1.64	
Critical voice	.03	.05	.81	
Shared control	.16*	.04	4.08	
Student negotiation	−.00	.04	−.04	
Self-efficacy	−.12*	.04	−3.24	
Intrinsic value	.19*	.03	4.67	
Mastery approach	.01	.04	.33	
Performance approach	.05	.01	1.78	
Mastery avoidance	.04	.01	1.18	
Performance avoidance	−.06	.01	−1.82	
Self-regulation	.36*	.04	9.10	

Note. *Relationship is significant at the .05 level of significance.

activities, these activities were enjoyable and they had high self-regulation. Students were able to answer approximately half of the SAT questions correctly, which corresponds to a moderate level of achievement.

The LISREL 8.7 program with SIMPLIS programming language was used to test the conceptual model. Results indicated an adequate model fit to the data. The Normal Fit Index (NFI) was found to be .97, which indicated 97% improvement in model fit over the baseline independence model. The Comparative Fit Index (CFI), which is an indicator of comparative fit irrespective of sample size, was found to be .97. The Goodness of Fit Index (GFI) was found to be .97. Values of NFI, CFI and GFI greater than .90 are taken as evidence of good fit to the data (Kelloway 1998), and the results for the present study satisfied that. The Standardized Root Mean Square Residual (SRMR) is recommended to be less than .05 for good fit to the data and in the present study it was found to be .038. The chi-square estimate was found to be significant ($\chi^2 = 192.761$, $df = 7$), which might be due to the large sample size (Tabachnick and Fidell 1996).

Providing appropriate fit indexes for the proposed model, the standardized path coefficients for direct effects were examined next. The standardized path coefficients for direct effects are presented in Table 2 and significant paths are graphically displayed in Figure 2. In the model, constructivist learning environment variables accounted for 34% of the variance in intrinsic value (see Table 2). Parameter estimates revealed that higher levels of personal relevance (γ = .17), uncertainty (γ = .10), critical voice (γ = .13), shared control (γ = .23) and student negotiation (γ = .20) were significantly and positively related to intrinsic value. This finding suggests that students who perceive that they have opportunities in their science classes to realize the link between course content and their daily lives, learn about nature of science, question the teacher about some classroom affairs, become responsible for their own learning and communicate with other students are likely to experience enjoyment while doing a science activity and show interest in science content.

Results showed that constructivist learning environment variables explained only 5% of the variance in self-efficacy. While student negotiation was found to be posi-

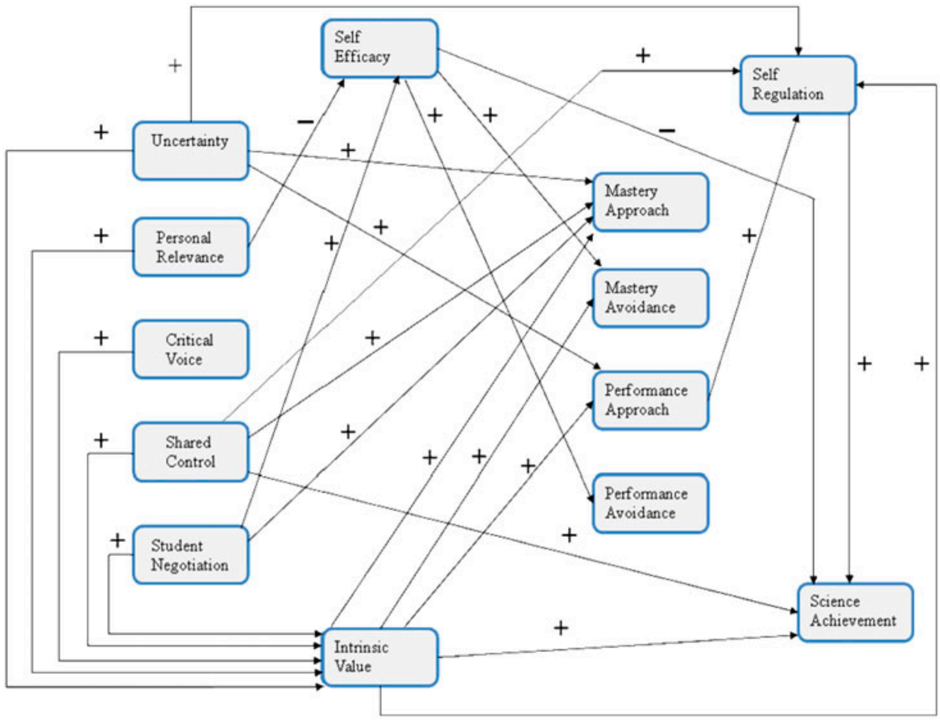

Figure 2. Path model with significant paths only.

tively linked to self-efficacy (γ = .12), personal relevance was negatively associated with this variable (γ= −.16). Direct effects of uncertainty (γ= .02), critical voice (γ = .08) and shared control (γ= −.00) on self-efficacy were not significant. These findings imply that students perceiving higher levels of student negotiation tended to be more self-efficacious in science learning. On the other hand, students perceiving higher levels of personal relevance of the classroom activities appeared to have lower levels of self-efficacy.

In the conceptual model, paths were specified from constructivist learning environment variables, self-efficacy and intrinsic value to achievement goals variables. Results revealed that these variables accounted for 44% of the variance in mastery approach goals. Parameter estimates revealed that uncertainty (γ= .10), shared control (γ= .27), student negotiation (γ= .29) and intrinsic value (β= .15) were positively associated with mastery approach goals. However, personal relevance (γ= .02), critical voice (γ= .04) and self-efficacy (β = .03) were not significantly related to students' mastery approach goals. These findings suggested that students who have opportunities to learn about the evolving nature of science, help the teacher plan learning activities, discuss scientific concepts with other students and enjoy science activities are likely to engage in activities to learn and understand scientific issues deeply.

In addition, constructivist learning environment variables, self-efficacy and intrinsic value were found to explain only 9% of the variance in performance approach goals. Uncertainty (γ = .12) and intrinsic value (β = .18) were positively related to performance approach goals, while personal relevance (γ = .00), critical voice (γ = .03), shared control (γ = .04), student negotiation ($\gamma = -.00$) and self-efficacy (β = .02) were not significant predictors. These findings imply that students who perceive high levels of uncertainty in science classes and enjoy engaging in science activities focus on demonstrating competence and getting higher grades.

Regarding mastery avoidance goals, the variables predicted 38% of the variance. Self-efficacy (β = .49) and intrinsic value (β = .31) were positive predictors of mastery avoidance goals. Personal relevance (γ = .01), uncertainty (γ = .04), critical voice (γ = .07), shared control ($\gamma = -.01$) and student negotiation ($\gamma = -.02$) were not significantly related to mastery avoidance goals. These findings suggest that students who believe in their ability to succeed in science activities and experience enjoyment while doing activities succeed in learning in science.

Moreover, constructivist learning environment variables, self-efficacy and intrinsic value accounted for 23% of the variance in performance avoidance goals. Parameter estimates revealed the single significant predictor was self-efficacy, and it was positively related to performance avoidance goals (β = .44). Personal relevance ($\gamma = -.03$), uncertainty (γ = .02), critical voice (γ = .05), shared control ($\gamma = -.02$), student negotiation (γ = .10) and intrinsic value (β = .01) were not significantly related to mastery avoidance goal orientation. These results imply that students who are highly self-efficacious in science are concerned with avoiding looking incompetent and inferior.

Results reveal that constructivist learning environment variables, self-efficacy, intrinsic value and goal orientations account for 52% of the variance in self-regulation. Among constructivist learning environment variables, uncertainty (γ = .18) and shared control (γ = .08) were positively related to self-regulation, while personal relevance ($\gamma = -.02$), critical voice (γ = .01) and student negotiation (γ = .01) were not significantly related. Self-efficacy (γ = .06) was not significantly associated with self-regulation. On the other hand, intrinsic value (β = .52) was significantly positively related to self-regulation. Among achievement goals, only performance approach (β = .11) was positively related to self-regulation, while mastery approach (β = .01), mastery avoidance (β = .01) and performance avoidance (β = .04) were not significantly related. These results suggest that students who experience the evolving nature of science in their classes, have responsibility in design of science activities, enjoy science activities and show interest in science content and are focused on demonstrating their competence to others and looking competent have high levels of self-regulation.

Constructivist learning environment variables, goal orientations, self-efficacy, intrinsic value and self-regulation were found to explain 41% of the variance in science achievement. Among constructivist learning environment variables, only shared control (γ = .16) was a significant positive predictor of achievement, while personal relevance (γ = .05), uncertainty ($\gamma = -.06$), critical voice (γ = .03) and student negotiation ($\gamma = -.00$) were not significant predictors. None of the achievement goals was found to be significantly related to achievement. More specifically, mastery approach (γ = .01), performance approach (γ = .05), mastery avoidance (γ = .04) and performance avoidance ($\gamma = -.06$) were not found to be associated with achievement. While intrinsic value (β = .19) and self-regulation (β = .36) were positive significant predictors of achievement, self-efficacy was found to be significantly negatively related to achievement. These findings suggest that students who share control with the teacher in planning science activities, enjoy science activities and have high self-regulation performed better on the SAT. On the other hand, highly self-efficacious students performed worse on the SAT.

4. Discussion

The aim of this study was to explore the relationships among constructivist learning environment perceptions, motivational beliefs, self-regulation and science achievement. The path analysis results showed that all dimensions of constructivist learning environment were directly and positively associated with intrinsic value. This finding suggests that students who find learning tasks relevant to daily life, share control of learning environment with the teacher, view scientific knowledge as evolving, question the teacher's practice and share their ideas tend to enjoy the classroom activities and show interest in the learning task. This finding is consistent with other research that found positive interactions of intrinsic interest with personal relevance (Dethlefs 2002; Iverach and Fisher 2008) and shared control and student negotiation (Dethlefs 2002). Classroom environments supporting autonomy and control – similar to shared control – have the potential of stimulating student interest in academic tasks (Ames 1992; Sungur and Güngören 2009).

Concerning the relationship between constructivist learning environment perceptions and self-efficacy, results showed non-significant associations among all dimensions of constructivist learning environment and self-efficacy, except for student negotiation and personal relevance. While the direction of the relationship was positive for student negotiation, it was negative for personal relevance. Consistent with previous findings (e.g., Pintrich, Roeser, and De Groot 1993; Dethlefs 2002), the current study revealed that students who were interacting with each other to improve their understandings developed higher self-efficacy beliefs. On the other hand, inconsistent with related literature (e.g., Dethlefs 2002), the present study showed that students perceiving their science learning environment relevant to everyday experiences tended to have low self-efficacy beliefs. A possible reason for this finding may be the highly competitive and examination-driven Turkish educational system – for example, middle school students have to take normative examinations implemented nationwide to attend better high schools. Although the Turkish science and technology curriculum gives emphases to the implementation of alternative assessment techniques, paper-and-pencil tests are heavily used by teachers to assess students' learning. Generally, these in-class examinations are prepared so that the test questions are similar to those used in the nationwide examinations, and serve as a practice for them. Thus, students study mainly for the examinations and devote most of their study time to solving several practice tests. Also, most students use private tutors to help them prepare for examinations. In such a competitive environment, students engaging in activities that link what they learn to their daily lives may think that it is a waste of time to do such activities because it will not directly help them to be successful on the examinations. On the contrary, they may think that they should be taught for the examinations in line with its content emphasis and format. It is reasonable to conclude that students who engage in activities that are not directly parallel to the way they are assessed in terms of content and format may develop maladaptive beliefs about their capability to succeed in science classes. Although this conclusion is speculative and based on informal observations of the authors, it is worthy of further investigation to provide a better explanation for the negative association found between self-efficacy and personal relevance.

Consistent with prior research (Iverach and Fisher 2008), the model proposed in the current study showed the direct influence of constructivist learning environment perceptions on mastery approach goal orientation. Students viewing the scientific knowledge as evolving, sharing control over their learning and negotiating among themselves tended to adopt mastery goals. Indeed, the instructional practices that teachers follow within their classrooms have an effect on students' goal orientation (Meece, Blumenfeld, and Hoyle 1988). Because constructivism requires the implementation of learning-focused instructional practices and focuses on student negotiation (Hand, Treagust, and Vance 1997), a learning environment based on constructivism is likely to facilitate students' adoption of mastery goals while studying. Regarding the influence of constructivist learning environment perceptions on performance approach goals, only an association with the uncertainty dimension of the constructivist learning environment was found. Those students viewing knowledge as evolving tended to adopt performance approach goals. This finding contradicts the results of Iverach and Fisher (2008), in which the uncertainty dimension was found to be a predictor of performance avoidance goals. In the present study, none of the dimensions of the constructivist learning environment were associated with the performance and mastery avoidance goals.

The present study showed that intrinsic interest in academic tasks was associated with students' orientation toward mastery approach and avoidance goals and performance approach goals. Consistent with this finding, relevant research showed that students with higher personal interest in a task are likely to adopt mastery goals (Pintrich and De Groot 1990; Elliot and Church 1997; Iverach and Fisher 2008) and performance approach goals (Hidi and Harackiewicz 2000). Relevant research showed non-significant relations between intrinsic interest and performance avoidance goals (Elliot and Church 1997; Iverach and Fisher 2008). A person may show interest on the learning task for the sake of higher performance as well as learning because personal interest shown in activities might be stimulated by external factors. For example, performance feedback may promote maintenance of the interest shown in a learning task, which, in turn, may promote the adoption of performance goals (Hidi and Harackiewicz 2000).

Self-efficacy was found to be the strongest predictor of both mastery and performance avoidance goals, rather than the approach goals. This finding implies that students having higher self-efficacy beliefs tend to avoid both looking incompetent and doing worse than they had previously. This finding is consistent with prior research indicating a positive correlation between self-efficacy and performance avoidance goals (Bong 2001; Iverach and Fisher 2008) and mastery-avoidance goals (Iverach and Fisher 2008) and a non-significant relationship between self-efficacy and mastery approach goals (Iverach and Fisher 2008) and performance approach goals (Middleton and Midgley 1997). This finding is at odds with other research that demonstrated typically negative (Elliot and Church 1997; Middleton and Midgley 1997) to non-significant (Skaalvik 1997) relationships between performance avoidance goals and self-efficacy and positive relationships among self-efficacy, mastery goals and performance approach goal (Elliot and Church 1997; Skaalvik 1997; Bong 2001). The reason for the stronger relationship between avoidance goals and self-efficacy may be explained by the competitive and examination-driven nature of the educational system. In Turkey, families expect their children to be successful and to attend top schools. Both families and teachers usually rank students with respect to their success. In such a competitive environment, it is inevitable that students adopt avoidance goals rather than approach goals to sustain their self-efficacy (Sungur and Senler 2009).

Another possible reason for finding a stronger relationship between self-efficacy and avoidance goals could be cross-cultural differences. Collectivist cultures (e.g., Asian countries) demonstrate higher fear of failure compared to individualistic cultures (e.g., Western countries) because, in collectivist cultures, avoiding maladaptive outcomes is valued, while in individualistic ones, attaining adaptive outcomes is valued. Relative to individualistic cultures, collectivist cultures promote the adoption of more avoidance goals (Elliot et al. 2001). Therefore, having a collectivist culture, Turkish people are likely to adopt more avoidance goals.

Regarding the influence of constructivist learning environment perceptions on self-regulation, uncertainty and shared control dimensions of the constructivist learning environment were associated with self-regulation. Students sharing control over their learning and viewing knowledge as evolving tended to have high levels of self-regulation. A similar pattern was observed concerning the influence of constructivist learning environment perceptions – only shared control was a significant predictor of science achievement. As students share control of their learning with the teacher, they become more self-regulated learners (Dethlefs 2002; Eshel and Kohavi 2003) and their science achievement increases (Eshel and Kohavi 2003). A classroom learning environment allowing freedom and choice of task or strategies can enhance self-regulation and academic achievement (Maehr and Midgley 1991).

In the model, only the performance approach goal was the significant predictor of self-regulation – mastery goals did not predict self-regulation. However, in the literature, students adopting mastery goals were found to demonstrate higher self-regulation than those oriented to performance goals (Meece, Blumenfeld, and Hoyle 1988; Schunk 2005). In Turkey, a student's achievement relative to others is an important criterion for success. Such a competitive environment promotes the adoption of performance goals, and a focus on doing better than others might orient students toward the use of cognitive strategies (Shih 2005).

Surprisingly, in the present study, none of the achievement goals was a significant predictor of science achievement. However, prior research indicated non-significant to positive relationships among achievement and mastery goals (Wolters, Yu, and Pintrich 1996; Skaalvik 1997) and performance approach goals (Wolters, Yu, and Pintrich 1996; Skaalvik 1997), but negative relationships among achievement and performance avoidance goals (Elliot and McGregor 2001; Skaalvik 1997). Although there is not any direct relationship between goal orientation and achievement in this study, there may be some indirect relationship between them (e.g., self-regulation or intrinsic value may mediate the influence of goal orientation on achievement). Therefore, indirect effects of mastery and performance goals on achievement should be investigated in further studies.

Intrinsic value contributed significantly to both self-regulation and science achievement. This finding is consistent with previous results indicating that students who show interest in a task or view the task as important are apt to use more self-regulatory processes (Pintrich and De Groot 1990; Pintrich, Roeser, and De Groot 1993; Iverach and Fisher 2008). In the present study, self-efficacy was not significantly associated with self-regulation, but it was negatively associated with science achievement. Previous studies demonstrated that higher levels of self-efficacy were associated with higher classroom performance and greater use of self-regulatory strategies (Pintrich and De Groot 1990; Pintrich, Roeser, and De Groot 1993; Iverach and Fisher 2008; Velayutham and Aldridge 2013). In addition to its direct effect on achievement, self-efficacy beliefs may have an indirect effect on academic achievement by mediating the influence of other variables (e.g., mental ability, previous knowledge) that predict academic achievement (Pajares and Schunk 2001). Therefore, the indirect effect of self-efficacy on achievement should be investigated further.

The failure to find a positive relationship between self-efficacy and achievement may be due to the way achievement was measured. The items in the SAT used in this study were drawn from the released items of TIMSS 1999. The questions required students to use more than knowledge, based on the TIMSS 1999 results, Turkish students performed significantly below the international average in science (Gonzalez and Miles 2001). Because the testing procedure used in TIMSS 1999 is not congruent with traditional testing practice in Turkey (Wolf 1998), there may be a negative association between self-efficacy and science achievement. Moreover, consistent with prior research, self-regulation was found to be highly associated with science achievement in this study. Students using more self-regulated strategies demonstrated higher academic performance (Pintrich and De Groot 1990; Üredi and Üredi 2005).

Consequently, in a classroom environment supporting student autonomy and control, students tend to develop higher interest in tasks, use more self-regulatory strategies and demonstrate higher academic performance. Science teachers are highly recommended to consider these findings when designing their lessons. For the creation of such a learning environment, teachers can design open-ended inquiry activities in which students have opportunities to take responsibility, reflect on their views and accomplish challenging tasks. There are a few potential limitations that should be noted in the present study. One limitation of this study is the use of self-report questionnaires for measuring students' perceptions of learning environment, motivational beliefs and self-regulation, which rely on the perceived measures of these variables. Therefore, it is suggested that qualitative data (e.g., classroom observations and interviews with teachers and students) be collected to complement the quantitative information and to clarify reasons for the observed relationships (Johnson and McClure 2004). Another limitation of this study is its correlational nature. In order to establish cause-effect relationships among the aforementioned variables, experimental or longitudinal studies should be conducted (Iverach and Fisher 2008).

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