Eur J Psychol Educ (2016) 31:557–577
DOI 10.1007/s10212-016-0303-z

The contribution of perceived classroom learning environment and motivation to student engagement in science

Yasemin Tas[1]

Received: 19 August 2015 / Revised: 9 April 2016 / Accepted: 14 April 2016 /
Published online: 30 April 2016

Abstract This study investigated middle school students' engagement in science in relation to students' perceptions of the classroom learning environment (teacher support, student cohesiveness, and equity) and motivation (self-efficacy beliefs and achievement goals). The participants were 315 Turkish sixth and seventh grade students. Four hierarchical multiple regression analyses were conducted on the dependent variables of cognitive, behavioral, emotional, and agentic engagement. The results indicated that engagement components were positively predicted by most of the perceived learning environment variables, while motivational factors had some differential predictive effects on engagement components. The predictor variables explained 26, 28, 33, and 30 % of the variance in the cognitive, behavioral, emotional, and agentic engagement components, respectively.

Keywords Engagement · Perceived classroom learning environment · Motivation · Science · Middle school students

Introduction

Student engagement is important because it increases students' learning and achievement (Fredricks, Blumenfeld, and Paris 2004). This study conceptualizes a multi-dimensional view of engagement encompassing its behavioral, emotional, cognitive, and agentic aspects (Reeve 2012; Sinatra, Heddy, and Lombardi 2015). *Behavioral* engagement refers to the student's effort exerted and their concentration on learning activities (Skinner and Belmont 1993). *Emotional* engagement refers to the student's positive emotional reactions to learning such

✉ Yasemin Tas
tasyase@gmail.com

[1] Department of Elementary Science Education, Kazim Karabekir Faculty of Education, Ataturk University, 25249 Erzurum, Turkey

as feeling interest, enjoyment, enthusiasm, and curiosity (Reeve and Tseng 2011; Skinner and Belmont 1993). *Cognitive* engagement consists of the student's investment in learning to understand and master skills (Newmann, Wehlage, and Lamborn 1992). Reeve and Tseng (2011) recently proposed *agentic* engagement, which refers to students' active contribution to the flow of instruction such as asking questions, offering suggestions, and expressing opinions. The dimensions of engagement are interrelated (Reeve 2012), and students having a high degree of one of the engagement dimensions may also experience the other dimensions simultaneously (Sinatra et al. 2015).

Agentic engagement can explain a unique variance in student academic achievement that other aspects cannot (Reeve 2013; Reeve and Tseng 2011). Agentic engagement also conceptually differs from the other three aspects of engagement because it is proactive and transactional (Reeve 2013). For instance, during a learning activity, rather than passively receiving information from the teacher, students can communicate their preferences to the teacher concerning the content. By acting on these preferences, the teacher can enrich the students' learning experience. During learning activities, students are proactive and intentional by making suggestions (Reeve 2012). If students communicate on the personal relevance of the activity and how it challenges them, this can bring about changes in instruction, which in turn can affect students' engagement (Reeve 2013). Thus, agentic engagement is distinct from other aspects of engagement because in order to improve the learning environment for themselves, agentically engaged students intentionally contribute to the instruction (Reeve 2013). In most of the previous studies, however, engagement was restricted to its cognitive, emotional, and behavioral components (e.g., Ferrell 2012), therefore more research on agentic engagement is needed (Sinatra et al. 2015).

Domain specificity is an important issue in student engagement (Sinatra et al. 2015), and previous research has found contextual differences in student engagement; for example, students' use of cognitive strategies differs in different domains (e.g., Wolters and Pintrich 1998). This study aimed to investigate middle school students' cognitive, behavioral, emotional, and agentic engagement in the science domain in relation to their perceptions of the learning environment (teacher support, student cohesiveness, and equity) and motivational factors (self-efficacy beliefs and achievement goals).

Student engagement in relation to the classroom learning environment

According to the theory of self-determination, conditions in the learning environment can encourage or discourage the individuals' development and performance (Deci and Ryan 1985; Ryan and Deci 2000). In the student-teacher dialectical framework within the self-determination theory, relationships with teachers and with peers are important features of the learning environment for students' motivation and engagement (Reeve, 2012). Teacher support refers to students' perceptions that the teacher is interested in them, friendly, considers their feelings, and helpful when they have problems with their schoolwork (Fraser et al. 1996). A number of research studies showed that teacher support is related to student outcomes (e.g., Wang and Holcombe 2010). Students are likely to be more invested in learning if they perceive that their teacher cares about them and is interested in their learning (Goodenow 1993). Teacher support is positively associated with student engagement, such as their participation in school-related activities (e.g., Battistich, Solomon, Watson, and Schaps 1997; Wang and Holcombe 2010) and identification with school (an emotional component referring to school belonging and valuing) (Wang and Holcombe 2010). Student cohesiveness, on the other hand, refers to the relationships between students, and this assesses the extent that students in the class help and support each other (Fraser et al. 1996). Patrick et al. (2007) found that student academic support was positively associated with self-regulation strategies and task-related interaction. In another study (Fredricks et al. 2002), peer support was correlated with the behavioral, emotional, and cognitive engagement of primary school students. Therefore, empirical evidence also suggests that teacher support and student support are positively associated with student engagement. However, there is need for more research to examine how these learning environment features relate to the separate components of engagement, including recently proposed agentic engagement.

Furthermore, according to the student-teacher dialectical framework, a central feature of the learning environment is the teacher's support of student autonomy (Reeve 2012). In a longitudinal study with eighth grade students, Jang, Kim, and Reeve (2012) examined relationships among perceived autonomy support, motivation, and engagement. They found that perceived autonomy support measured at the beginning of the semester positively predicted students' mid-semester motivation, which in turn positively predicted students' engagement measured at the end of the semester. Thus, teacher's autonomy supportive motivating style, such as providing students with choices and options and encouraging students to ask questions, fosters student motivation and functioning. Newmann et al. (1992) suggest that together with providing choices and encouraging students, *equity* is also important. The equitable allocation of opportunities for learning, such as the teacher demonstrating a high interest in all students, distributing rewards equally among students, and having high expectations of all students, is recommended in order to advance student academic engagement. Secada, Gamoran, and Weinstein (1996) also point out the significance of equity emphasizing the need for providing all students with equal learning opportunities. In the current study, equity is conceptualized as students' perceptions that their teacher treats them equally, reflected in giving feedback, praise, and opportunities for learning (Fraser et al. 1996). Although there is minimal direct research evidence to show that equity is associated with student engagement, equity has been positively related to students' attitudes towards scientific inquiry (Telli, Cakiroglu, and den Brok 2006; Wolf and Fraser 2008), science achievement (Wolf and Fraser 2008), metacognitive self-regulation in science (Yerdelen 2013), and enjoyment of science lessons (Telli et al. 2006).

Student engagement in relation to classroom learning environment and student motivation

Besides the learning environment, student motivation is highly related to student engagement (Reeve 2012). One of the important motivational constructs that influence student engagement is self-efficacy (Linnenbrink and Pintrich 2003), which can be defined as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura 1986, p. 391). During learning activities, students receive cues that help them make judgments about their efficacy. For instance, their performance in activities and similarities to others who successfully perform activities are used to appraise their efficacy (Schunk 1987). Individuals who feel efficacious are expected to participate in an activity more readily, whereas those who believe they are not capable of succeeding may avoid the activity (Schunk 1991). Studies show that self-efficacy is positively related to student engagement (e.g., Ferrell 2012, Hidiroglu 2014).

As well as self-efficacy, achievement goals are motivational constructs associated with student engagement (e.g., Greene, Miller, Crowson, Duke, and Akey 2004). Achievement goal theory is concerned with students' reasons for engaging in achievement behavior (Ames 1992; Dweck 1986). Students who are mastery goal-oriented are interested in improving their learning, extending their understanding, and developing their skills. However, students who pursue performance-approach goals are concerned with demonstrating their abilities and showing others that they are competent (Pintrich 2000a). Research has shown that students' goal orientation is related to cognitive, affective, and behavioral student outcomes (Anderman and Midgley 2004; Pintrich and Schunk 2002). Although mastery goals are generally positively associated with student engagement (e.g., Greene et al. 2004), there are inconsistent findings regarding the effect of performance-approach goals on student engagement (e.g., Kahraman and Sungur 2011; Wolters, Yu, and Pintrich 1996).

Greene et al. (2004) examined the relationships between self-efficacy, achievement goals, and cognitive engagement in a group of 220 high school students attending an English course. Cognitive engagement was addressed as the student's use of strategy. Path analysis showed that the students' self-efficacy beliefs ($\beta = 0.14$) and mastery goals ($\beta = 0.40$) were significantly and positively linked to their strategy use; however, no link was depicted between performance-approach goals and engagement. In their study, Kahraman and Sungur (2011) examined the contribution of elementary school students' ($n = 115$) motivational beliefs to their use of metacognitive strategy. Multiple linear regression analysis showed that while self-efficacy ($\beta = 0.65$) and mastery goals ($\beta = 0.22$) were significant and positive predictors of metacognitive strategy use, performance-approach goals ($\beta = -0.07$) were unrelated to the criterion variable. On the other hand, some other studies found positive relationships between performance-approach goals and student engagement (e.g., Lau, Liem, and Nie 2008; Wolters et al. 1996). Therefore, previous research indicates that the relationship between performance-approach goals and engagement is not as consistent as the relationship between mastery goals and engagement.

Using Turkish students' responses to the Programme for International Student Assessment (PISA) 2003 mathematics questionnaire, Yildirim (2012) examined relationships among perceived teacher support, motivational beliefs (i.e., self-efficacy, anxiety, intrinsic value, and instrumental value), and learning strategy use. Hierarchical linear modeling analysis revealed that perceived teacher support positively predicted self-efficacy, intrinsic value, and instrumental value and negatively predicted anxiety. Furthermore, perceived teacher support and motivational beliefs were positive predictors of the use of learning strategies. In another study, Ferrell (2012) examined fourth grade students' ($n = 77$) engagement in mathematics in relation to the motivational and learning environment variables. The motivational variables of mastery goals and self-efficacy were hypothesized to mediate the relationship between learning environment variables (teacher support and student support) and student engagement (behavioral, emotional, and cognitive engagement). Path analysis showed that teacher support and student support both significantly and positively predicted motivational variables. Furthermore, mastery goals were significantly linked to the three engagement components. On the other hand, self-efficacy was only significantly related to cognitive engagement, but unrelated to behavioral and emotional engagement. In another study, Reeve and Tseng (2011) examined the predictive effect of psychological need satisfaction (i.e., perceived autonomy, competence, and relatedness) on engagement aspects. Path analysis showed that the satisfaction of psychological need significantly and positively predicted agentic, behavioral, cognitive, and emotional engagement.

In line with the aforementioned studies, the current study anticipated that teacher support and student cohesiveness would positively predict student engagement in science.

Furthermore, the teacher's equitable treatment of students, such as giving them the same amount of help and attention and distributing questions equally, may encourage students to contribute to instruction, participate in activities, show emotional reactions, and exhibit willingness to learn complex ideas and skills. Thus, a positive relationship between equity and engagement aspects was expected. Moreover, it was anticipated that students who were more efficacious and pursued more mastery and performance-approach goals would be highly engaged in the science class. Performance-approach goal orientation was hypothesized as a positive predictor because engagement in science class might be a way for students to demonstrate their abilities.

Student engagement in relation to student background

Previous research has demonstrated that engagement was connected to gender and prior achievement. Studies generally show that girls and high academic achievers were more engaged than boys and low academic achievers, respectively (e.g., Lee and Smith 1993; Marks 2000; Reyes et al. 2012). However, it should be noted that these studies focused on the more traditional aspects of student engagement (i.e., cognitive, behavioral, and emotional) and not on agentic engagement. Research examining the relationship between gender and agentic engagement found that girls and boys did not differ regarding agentic engagement (e.g., Reeve 2013; Reeve and Lee 2014; Reeve and Tseng 2011). Gender and prior achievement were used as the control variables in this study. Based on previous research findings, it was expected that girls would be more engaged in terms of the three traditional engagement aspects but there might be no gender difference concerning agentic engagement.

Purpose and research questions of the study

The purpose of the current study was to investigate middle school students' cognitive, behavioral, emotional, and agentic engagement in science in relation to perceived classroom learning environment variables and motivational factors together with factors concerning their background. In other words, this study aimed to provide empirical evidence about various dimensions of engagement including agentic engagement and explore the distinct nature of the engagement dimensions in regard to their relationships with learning environment perceptions (teacher support, student cohesiveness, and equity) and motivational factors (self-efficacy, mastery goals, and performance-approach goals). Furthermore, the current study considered the relative role of the predictor variables in explaining student engagement. In order to analyze the contribution of background factors, the students' perceptions of learning environment, and motivation variables in predicting engagement components, predictor variables were entered in the model in order. The student's gender and prior achievement were the control variables and were entered in the model as the first set of predictors. Based on the reviewed literature, perceived learning environment variables may influence student motivation (e.g., Ferrell 2012; Jang et al. 2012), thus teacher support, student cohesiveness, and equity were considered as the second set of predictors. Among the motivational variables, self-efficacy is the strongest predictor for engagement (Linnenbrink and Pintrich 2003) and was examined in the next set, which was followed by goal orientation variables as the final set of predictors. The research questions of the study were as follows:

- Do the perceived learning environment variables of teacher support, student cohesiveness, and equity predict student engagement, after accounting for gender and prior achievement?

- Does self-efficacy predict student engagement after accounting for gender, prior achievement, and perceived learning environment variables?
- Do mastery and performance-approach goals predict student engagement after accounting for gender, prior achievement, perceived learning environment variables, and self-efficacy?

Methods

Sample

The study sample consisted of 315 middle school students attending one of two public schools in an urban area in eastern Turkey. The distribution of the participants was as follows: 131 (41.6 %) sixth graders and 184 (58.4 %) seventh graders. There were 183 (58.1 %) girls and 132 (41.9 %) boys. Their mean age was 12.69 ($SD = 0.61$).

Context of the study

Compulsory education in Turkey is free in public schools and has a duration of 12 years (divided equally across primary, middle, and high school). Science is one of the core subjects, and students begin science courses in the third grade. Each week, students have 3 h of science classes in grades three and four and 4 h in grades five through eight. The Ministry of National Education (MONE) has recently revised the science curriculum with the aim of developing scientifically literate citizens who possess science process skills, analytical thinking skills, and problem solving skills and feel responsible for social issues. The new curriculum emphasizes students' responsibility for their learning and gives students active roles in their learning through inquiry, argumentation, and cooperation (Ministry of National Education 2013). The Turkish education system is highly competitive and examination-oriented. To enroll in elite high schools and universities, students must have good grade point averages and attain high scores in the national examinations.

Instruments

Learning environment variables

The subscales for teacher support, equity, and student cohesiveness from What is Happening in This Class? (WIHIC, Fraser et al. 1996) were used to assess students' perceptions of the classroom learning environment. A study by Waldrip, Fisher, and Dorman (2009) examined more than 3000 middle school students and their perceptions of science classroom learning environment using the WIHIC questionnaire. The results showed that teachers whose students had high scores on WIHIC were also perceived to create favorable learning environments according to the interviews with students. Hence, these classroom environment dimensions were associated with exemplary science teachers. WIHIC was developed based on contemporary classroom environment dimensions (Fraser 1998) and is considered to be consistent with Turkey's science curriculum and appropriate for examining the science learning environment (Yerdelen 2013). The WIHIC consists of a five-point Likert scale scored from 1, "almost never," to 5, "almost always." It was translated and adapted into Turkish by Telli et al. (2006). The reliabilities for the Turkish version's teacher support, equity, and student cohesiveness subscales were 0.86, 0.88, and 0.75, respectively (Telli et al. 2006).

The teacher support (*8 items*) subscale of the WIHIC assesses the teacher's support as helping and taking an interest in their students. Sample items include "The teacher takes a personal interest in me" and "The teacher helps me when I have trouble with the work."

The student cohesiveness (*8 items*) subscale assesses the extent to which students help each other, support each other, and are friendly. Sample items include "In this class, I get help from other students" and "I am friendly to members of this class".

The equity (*8 items*) subscale assesses the teacher's equitable treatments in giving help, attention, praise, and opportunities for learning. Sample items include "I have the same amount of say in this class as other students" and "I receive the same encouragement from the teacher as other students do."

Motivational variables

The subscales for mastery goal orientation, performance-approach goal orientation, and academic efficacy from the Patterns of Adaptive Learning Scales (PALS, Midgley et al. 2000) were used to assess student motivation. PALS is a five-point Likert scale scored from 1, "not at all true," to 5, "very true". It was translated and adapted into Turkish by Tas and Tekkaya (2010). Confirmatory factor analysis (CFA) showed that the proposed factor structure fits the data obtained from Turkish students (standardized root mean square residuals (S-RMR) = 0.042, root mean square error of approximation (RMSEA) = 0.046, GFI = 0.91, AGFI = 0.90, comparative fit index (CFI) = 0.96). The Cronbach alpha reliabilities for the self-efficacy, mastery goals, and performance-approach goals subscales were 0.74, 0.73, and 0.74, respectively (Tas and Tekkaya 2010).

The mastery goal orientation (*5 items*) subscale assesses the student's purposes of engaging in academic behavior to develop their competence and improve their understanding. Sample items include "One of my goals in class is to learn as much as I can" and "It's important to me that I improve my skills this year."

The performance-approach goal orientation (*5 items*) subscale assesses the student's reasons for engaging in academic behavior to demonstrate their competence. Sample items include "One of my goals is to show others that I'm good at my class work" and "It's important to me that I look smart compared to others in my class."

The academic efficacy (*4 items*) subscale assesses the student's perceptions of their competence in performing class work. Sample items include "I'm certain I can figure out how to do the most difficult class work" and "I can do even the hardest work in this class if I try."

Engagement variables

The agentic, behavioral, emotional, and cognitive engagement subscales used by Reeve and Tseng (2011) were utilized to assess student engagement. The items used by Reeve and Tseng (2011) were translated and adapted into Turkish by Hidiroglu (2014); the four-point Likert scale is scored from 1, "completely disagree," to 4, "completely agree." CFA indicated a good model to data fit (GFI = 0.93, CFI = 0.99, RMSEA = 0.05, SRMR = 0.04), and the subscale reliabilities ranged from 0.82 to 0.88 (Hidiroglu 2014).

The agentic engagement (*5 items*) subscale was developed by Reeve and Tseng (2011). It assesses the student's contribution to the instruction. Sample items include "I offer suggestions about how to make the class better" and "I let my teacher know what I'm interested in."

The behavioral engagement (*5 items*) subscale is based on Miserandino's (1996) task involvement questionnaire (Reeve and Tseng 2011). It assesses the student's effort, on-task attention, and participation in the activities. Sample items include "I listen carefully in class" and "I try very hard in school."

The emotional engagement (*4 items*) subscale is based on Wellborn's (1991) conceptualization of emotional engagement (Reeve and Tseng 2011). It assesses the student's positive reactions and energized emotional states such as interest. Sample items are "When I am in class, I feel curious about what we are learning" and "When we work on something in class, I feel interested."

The cognitive engagement (*7 items*) subscale is based on Wolters' (2004) learning strategies questionnaire (Reeve and Tseng 2011). It assesses the student's use of sophisticated learning strategies and metacognitive self-regulation strategies such as planning and monitoring. Sample items include "When I study, I try to connect what I am learning with my own experiences" and "As I study, I keep track of how much I understand, not just if I am getting the right answers."

The CFA and reliability analysis results for these instruments for the current study are presented in the Results section.

Personal background variables

Gender and prior achievement were used as personal background variables. To assess prior achievement, students were asked to write down their previous year's science grades in the report card. The grades on a scale of 100 were based on classroom examinations prepared by the science teachers.

Results

Confirmatory factor analysis using LISREL 8.8 was conducted to confirm the factor structure proposed by the instruments used in the current study. CFA was conducted on all 59 items used in the study to test the proposed ten-factor structure (three learning environment, three motivational, and four engagement variables). While evaluating the model fit, the use of various fit indices is recommended. The RMSEA and S-RMR lower than 0.08 and the CFI and non-normed fit index (NNFI) greater than 0.90 indicate good model fit (Kelloway 1998; Kline 2004). In the current study, RMSEA was 0.047, S-RMR was 0.065, CFI was 0.935, and NNFI was 0.931, which showed that the data was a good fit with the proposed factor structure. After gaining support for the factor structure, factors (teacher support, student cohesiveness, equity, mastery goals, performance-approach goals, etc.) were generated by averaging related items. Descriptive statistics including means, standard deviations, minimum and maximum values, and Cronbach alpha reliabilities for the measures used in the study are shown in Table 1. An examination of zero-order correlations among variables, shown in Table 2, demonstrated that students' perceptions of learning environment variables and motivational variables were positively related to engagement aspects.

Table 1 Descriptive statistics for variables of the study ($n = 315$)

Variables	*M*	*SD*	Min–max	α
Teacher support	3.86	0.88	1.00–5.00	0.86
Student cohesiveness	4.02	0.75	1.75–5.00	0.78
Equity	4.14	0.73	1.00–5.00	0.82
Self-efficacy	4.29	0.68	1.25–5.00	0.69
Mastery goals	4.43	0.67	1.00–5.00	0.76
Performance-approach goals	3.81	0.80	1.00–5.00	0.67
Cognitive engagement	3.30	0.50	1.29–4.00	0.74
Behavioral engagement	3.52	0.52	1.80–4.00	0.80
Emotional engagement	3.49	0.51	1.50–4.00	0.59
Agentic engagement	3.28	0.62	1.00–4.00	0.75

M mean, *SD* standard deviation, α Cronbach alpha coefficient

Hierarchical multiple regression analyses were conducted to examine the predictive effect of the learning environment and motivation variables on student engagement in the science class. The variables were entered into the model in the following order: (a) gender and prior achievement, (b) perceived classroom learning environment, (c) self-efficacy, and (d) goal orientation variables.

Cognitive engagement was predicted in model 1 (see Table 3). In the first step, gender and prior achievement were entered as predictor variables. Both these predictors were significantly related to the criterion variable. Girls ($\beta = 0.13$, $p < 0.05$) and students with high prior achievement ($\beta = 0.18$, $p < 0.01$) reported higher cognitive engagement than did boys and students with low prior achievement. In the second step, the student's perceptions of classroom learning environment variables were entered into the model. Teacher support ($\beta = 0.13$, $p < 0.05$), student cohesiveness ($\beta = 0.17$, $p < 0.01$), and equity ($\beta = 0.16$, $p < 0.05$) all significantly and positively predicted cognitive engagement. Learning environment variables explained an

Table 2 Pearson product-moment correlations among perceived learning environment, motivation, and engagement variables

Variable	1	2	3	4	5	6	7	8	9	10
(1) Teacher support	1	0.50**	0.28**	0.21**	0.22**	0.17**	0.27**	0.25**	0.26**	0.40**
(2) Student cohesiveness		1	0.37**	0.17**	0.11	0.12*	0.28**	0.26**	0.26**	0.30**
(3) Equity			1	0.27**	0.28**	0.21**	0.30**	0.37**	0.37**	0.41**
(4) Self-efficacy				1	0.65**	0.35**	0.32**	0.25**	0.30**	0.22**
(5) Mastery goals					1	0.43**	0.36**	0.32**	0.38**	0.27**
(6) Performance-approach goals						1	0.33**	0.20**	0.32**	0.28**
(7) Cognitive engagement							1	0.31**	0.59**	0.25**
(8) Behavioral engagement								1	0.45**	0.42**
(9) Emotional engagement									1	0.27**
(10) Agentic engagement										1

*$p < 0.05$; **$p < 0.01$

Table 3 Hierarchical multiple regression analysis predicting cognitive engagement

	B	*SE* B	β
Step 1			
Constant	2.82	0.14	
Gender	0.13	0.06	0.13*
Prior achievement	0.10	0.03	0.18**
Step 2			
Constant	1.74	0.22	
Gender	0.11	0.05	0.12*
Prior achievement	0.08	0.03	0.14*
Teacher support	0.07	0.03	0.13*
Student cohesiveness	0.11	0.04	0.17**
Equity	0.11	0.04	0.16*
Step 3			
Constant	1.22	0.24	
Gender	0.10	0.05	0.11*
Prior achievement	0.07	0.03	0.12*
Teacher support	0.06	0.03	0.11
Student cohesiveness	0.11	0.04	0.16**
Equity	0.08	0.04	0.12
Self-efficacy	0.17	0.04	0.24***
Step 4			
Constant	0.93	0.25	
Gender	0.11	0.05	0.11*
Prior achievement	0.06	0.03	0.10*
Teacher support	0.05	0.03	0.10
Student cohesiveness	0.11	0.04	0.17**
Equity	0.06	0.04	0.09
Self-efficacy	0.07	0.05	0.09
Mastery goals	0.12	0.05	0.16*
Performance-approach goals	0.09	0.04	0.15*

$R^2 = 0.05$ for step 1; $\Delta R^2 = 0.12$ for step 2 ($p < 0.001$); $\Delta R^2 = 0.05$ for step 3 ($p < 0.001$); $\Delta R^2 = 0.04$ for step 4 ($p < 0.001$). Gender coded 0 = boy, 1 = girl

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

additional 12 % of the variance in the outcome variable. In the third step, self-efficacy was added to the model, which explained an additional 5 % of the variance in cognitive engagement. Students who were more efficacious reported a higher cognitive engagement in science ($\beta = 0.24$, $p < 0.001$). In the fourth and final step, goal orientation variables were added to the model, explaining an additional 4 % of the variance in cognitive engagement. When controlling for the other predictors in the model, mastery goals ($\beta = 0.16$, $p < 0.05$) and performance-approach goals ($\beta = 0.15$, $p < 0.05$) were significant and positive predictors of cognitive engagement. For each step, the R^2 change was statistically significant, which indicated an improvement in the model in each stage of the analysis. The final model accounted for 26 % of the variance in the students' cognitive engagement.

In model 2, behavioral engagement was the criterion variable (see Table 4). In the first step, gender and prior achievement were entered as predictors: girls ($\beta = 0.17$, $p < 0.01$) and students with high prior achievement ($\beta = 0.19$, $p < 0.01$) reported higher behavioral engagement than did boys and students with low prior achievement. In the second step, the learning environment variables were entered. Teacher support ($\beta = 0.12$, $p < 0.05$), student cohesiveness ($\beta = 0.11$, $p < 0.05$), and equity ($\beta = 0.29$, $p < 0.001$) were all significant and positive predictors of behavioral engagement and explained an additional 16 % of the variance in behavioral engagement. In the third step, self-efficacy was added to the model. Self-efficacy was unrelated to behavioral engagement ($\beta = 0.10$, $p > 0.05$) and did not make a significant contribution in explaining the extent that students were behaviorally engaged in the science

Table 4 Hierarchical multiple regression analysis predicting behavioral engagement

	B	*SE* B	β
Step 1			
Constant	3.01	0.14	
Gender	0.16	0.06	0.17**
Prior achievement	0.11	0.03	0.19***
Step 2			
Constant	1.81	0.21	
Gender	0.14	0.05	0.14**
Prior achievement	0.08	0.03	0.13**
Teacher support	0.06	0.03	0.12*
Student cohesiveness	0.07	0.04	0.11*
Equity	0.19	0.04	0.29***
Step 3			
Constant	1.59	0.24	
Gender	0.13	0.05	0.13**
Prior achievement	0.07	0.03	0.13*
Teacher support	0.06	0.03	0.11
Student cohesiveness	0.07	0.04	0.11
Equity	0.18	0.04	0.27***
Self-efficacy	0.07	0.04	0.10
Step 4			
Constant	1.30	0.24	
Gender	0.13	0.05	0.13**
Prior achievement	0.06	0.03	0.11*
Teacher support	0.05	0.03	0.09
Student cohesiveness	0.08	0.04	0.12*
Equity	0.16	0.04	0.24***
Self-efficacy	−0.05	0.05	−0.07
Mastery goals	0.18	0.05	0.25***
Performance-approach goals	0.04	0.03	0.06

$R^2 = 0.06$ for step 1; $\Delta R^2 = 0.16$ for step 2 ($p < 0.001$); $\Delta R^2 = 0.01$ for step 3 ($p > 0.05$); $\Delta R^2 = 0.04$ for step 4 ($p < 0.001$). Gender coded 0 = boy, 1 = girl

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

class. In the final step, goal orientations were added to the model and explained an additional 4 % of the variance in the outcome variable. Among the goal orientation variables, mastery goal orientation ($\beta = 0.25$, $p < 0.001$) emerged as a significant predictor, while performance-approach goal orientation ($\beta = 0.06$, $p > 0.05$) was not related to behavioral engagement. Except for the third step, the R^2 change was statistically significant for each step. The final model accounted for 28 % of the variance in the students' behavioral engagement.

Emotional engagement was predicted in model 3 (see Table 5). In the first step, gender ($\beta = 0.17$, $p < 0.01$) and prior achievement ($\beta = 0.22$, $p < 0.001$) were significant and positive predictors of emotional engagement. In the second step, the learning environment variables were entered into the model. Teacher support ($\beta = 0.12$, $p < 0.05$) and equity ($\beta = 0.30$,

Table 5 Hierarchical multiple regression analysis predicting emotional engagement

	B	*SE* B	β
Step 1			
Constant	2.97	0.13	
Gender	0.16	0.05	0.17**
Prior achievement	0.12	0.03	0.22***
Step 2			
Constant	1.88	0.19	
Gender	0.13	0.05	0.14**
Prior achievement	0.09	0.03	0.16**
Teacher support	0.06	0.03	0.12*
Student cohesiveness	0.06	0.03	0.09
Equity	0.19	0.04	0.30***
Step 3			
Constant	1.47	0.21	
Gender	0.12	0.05	0.13**
Prior achievement	0.08	0.03	0.15**
Teacher support	0.05	0.03	0.10
Student cohesiveness	0.05	0.03	0.08
Equity	0.17	0.04	0.27***
Self-efficacy	0.13	0.04	0.20***
Step 4			
Constant	1.15	0.22	
Gender	0.12	0.05	0.14**
Prior achievement	0.07	0.03	0.13**
Teacher support	0.04	0.03	0.08
Student cohesiveness	0.06	0.03	0.09
Equity	0.15	0.04	0.24***
Self-efficacy	0.02	0.04	0.03
Mastery goals	0.14	0.05	0.21**
Performance-approach goals	0.08	0.03	0.14**

$R^2 = 0.08$ for step 1; $\Delta R^2 = 0.17$ for step 2 ($p < 0.001$); $\Delta R^2 = 0.04$ for step 3 ($p < 0.001$); $\Delta R^2 = 0.05$ for step 4 ($p < 0.001$). Gender coded 0 = boy, 1 = girl

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

$p < 0.001$) emerged as significantly related to emotional engagement, while student cohesiveness ($\beta = 0.09$, $p > 0.05$) was unrelated to the outcome variable. In the third step, self-efficacy was added to the model explaining an additional 4 % of the variance in emotional engagement. Students who were more efficacious reported higher emotional engagement in science ($\beta = 0.20$, $p < 0.001$). In the final step, achievement goals were added to the model. Pursuing mastery goals ($\beta = 0.21$, $p < 0.01$) and performance-approach goals ($\beta = 0.14$, $p < 0.01$) significantly and positively predicted emotional engagement. Achievement goals explained an additional 5 % of the variance in emotional engagement. For each step, the R^2 change was statistically significant. The final model accounted for 33 % of the variance in the student's emotional engagement.

In model 4, agentic engagement was the outcome variable (see Table 6). In the first step of the analysis, gender and prior achievement were entered into the model. Neither gender ($\beta = -0.01$, $p > 0.05$) nor prior achievement ($\beta = 0.04$, $p > 0.05$) emerged as significant predictors of agentic engagement. In the second step, the perceived classroom learning environment variables were entered into the model. Teacher support ($\beta = 0.33$, $p < 0.001$), student cohesiveness ($\beta = 0.15$, $p < 0.01$), and equity ($\beta = 0.18$, $p < 0.01$) were all significantly and positively related to agentic engagement and explained an additional 25 % of the variance in agentic engagement. In the third step, self-efficacy was added to the model. Self-efficacy was unrelated to agentic engagement ($\beta = 0.09$, $p > 0.05$) and did not make a significant contribution to the explanation of the students' agentic engagement in science. In the final step, achievement goals were added to the model. Performance-approach goal orientation ($\beta = 0.21$, $p < 0.001$) significantly and positively predicted agentic engagement while mastery goal orientation ($\beta = -0.01$, $p > 0.05$) was unrelated to the outcome variable. Achievement goals explained an additional 4 % of the variance. The final model accounted for 30 % of the variance in the students' agentic engagement.

Discussion and conclusion

This study examined the engagement in science of middle school students in relation to perceived classroom learning environment and motivation variables. Four hierarchical multiple regression analyses were conducted with the dependent variables of cognitive, behavioral, emotional, and agentic engagement. Gender and prior achievement were the control variables. Results from the literature showed that student engagement was related to gender and prior achievement (e.g., Lee and Smith 1993; Marks 2000; Reyes et al. 2012). Lee and Smith (1993) found that girls and students with higher prior achievement have higher academic engagement than boys and students with lower prior achievement. This academic engagement was measured by the frequency of students' coming to class with appropriate supplies, time spent on homework, and students reporting feelings of boredom in school. Reyes et al. (2012) studied engagement by assessing student perceptions of effort, interest, and enjoyment. Similarly, they found that girls were more engaged than were boys. These studies addressed the more traditional aspects of behavioral, emotional, and cognitive engagement. The results from the current study also showed that girls and students with high prior achievement had higher levels of behavioral, emotional, and cognitive engagement than did boys and students with low prior achievement. Regarding agentic engagement, previous research found no gender difference (e.g., Reeve 2013; Reeve and Lee 2014). Examining Korean middle school students' agentic engagement in physical education, Reeve (2013) found no difference

Table 6 Hierarchical multiple regression analysis predicting agentic engagement

	B	*SE* B	β
Step 1			
Constant	3.23	0.17	
Gender	−0.01	0.07	−0.01
Prior achievement	0.03	0.04	0.04
Step 2			
Constant	1.54	0.24	
Gender	−0.03	0.06	−0.03
Prior achievement	−0.01	0.03	−0.01
Teacher support	0.21	0.04	0.33***
Student cohesiveness	0.11	0.04	0.15**
Equity	0.14	0.05	0.18**
Step 3			
Constant	1.13	0.27	
Gender	−0.03	0.06	−0.03
Prior achievement	−0.01	0.03	−0.02
Teacher support	0.20	0.04	0.32***
Student cohesiveness	0.11	0.04	0.14**
Equity	0.13	0.05	0.17**
Self-efficacy	0.08	0.04	0.09
Step 4			
Constant	1.12	0.27	
Gender	−0.01	0.06	−0.01
Prior achievement	−0.02	0.03	−0.03
Teacher support	0.20	0.04	0.31***
Student cohesiveness	0.10	0.04	0.14**
Equity	0.12	0.05	0.15*
Self-efficacy	0.03	0.05	0.03
Mastery goals	−0.01	0.06	−0.01
Performance-approach goals	0.14	0.04	0.21***

Notes: $R^2 = 0.00$ for step 1; $\Delta R^2 = 0.25$ for step 2 ($p < 0.001$); $\Delta R^2 = 0.01$ for step 3 ($p > 0.05$); $\Delta R^2 = 0.04$ for step 4 ($p < 0.001$). Gender coded 0 = boy, 1 = girl

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

between boys and girls in terms of agentic engagement. Likewise in the current study, agentic engagement did not vary by gender.

Controlling for gender and prior achievement, some significant associations were found between engagement components and students' perceptions of the classroom learning environment and motivational variables. Analyses showed that students who perceived that their science teacher helped them, considered their feelings, and was interested in their problems reported high levels in all dimensions of engagement. That is, students receiving teacher support reported that they contributed to the instruction, participated in learning activities, showed positive emotional reactions, and were willing to learn complex skills and ideas. This result was expected since previous research found that students' perceptions of teacher's giving support and encouragement were associated with adaptive student outcomes such as high learning strategy use (Yildirim 2012), high self-regulated learning (Patrick et al. 2007; Ryan and Patrick 2001), low disruptive behavior (Ryan and Patrick 2001), high active participation in learning and on-task behavior (Battistich et al. 1997; Patrick et al. 2007), positive interpersonal behavior (Battistich et al. 1997), high school participation, and high school identification (Wang and Holcombe 2010). Jang et al. (2012) examined eighth grade students' ($n = 500$) perceived teacher autonomy support, student motivation measured through autonomy need satisfaction, and student engagement including the behavioral, cognitive, emotional, and agentic aspects. Multilevel structural equation analyses showed that perceived teacher autonomy support measured at the beginning of the semester was positively linked to autonomy need satisfaction measured in the middle of the semester. Furthermore, mid-semester autonomy need satisfaction positively predicted the student's engagement measured at the end of the semester. Consistent with earlier research, the present study found that students who perceived their science teacher as more interested in their students and helpful when they have problems with the work reported significantly higher levels of cognitive, behavioral, emotional, and agentic engagement in science than did students who perceived that teachers offered low levels of support.

Student cohesiveness was examined as another perceived learning environment variable acting as a predictor of student engagement. Student perception that students in the class help and support each other was positively linked to their cognitive, behavioral, and agentic engagement. This result is in agreement with previous research findings. For example, Patrick et al. (2007) found that students' perceptions that classmates care about their learning and want to help them learn (academic support) positively predicted students' planning, monitoring, and regulation of their cognition (self-regulation strategies) ($\gamma = 0.22$) and the students' responses to questions and explaining content (task-related interaction) ($\gamma = 0.28$). Similarly, Marks (2000) found social support to be positively associated with student engagement among elementary, middle, and high school students. Students engage more when they receive help with learning from peers and are not belittled or disrupted by other students. The results of the present study also suggest that student cohesiveness positively predicts students' cognitive, behavioral, and agentic engagement in science; however, student cohesiveness was not a significant predictor for emotional engagement. Therefore, student cohesiveness differentially predicted distinct components of engagement. This differential predictive effect of student cohesiveness also appeared in a study conducted by Wong, Young, and Fraser (1997). They examined the attitudes of secondary school students ($n = 1592$) toward scientific inquiry in chemistry, adoption of scientific attitudes in chemistry, and enjoyment of chemistry lessons in relation to student cohesiveness. Hierarchical linear modeling analysis showed that students' perception that classmates help and support each other significantly predicted the attitude toward scientific inquiry in chemistry and the adoption of scientific attitudes in chemistry, but it was not a significant predictor for enjoyment of chemistry lessons. Similarly, in the present study, student cohesiveness did not predict emotional engagement in science.

Another classroom learning environment variable utilized in the current study was equity which is related to the students' perception of being treated the same as their classmates, such as receiving equal amounts of help and encouragement by the teacher. Results showed that equity was positively associated with all aspects of engagement. Newmann et al. (1992) suggested that equity is important to encourage students to engage in academic work. However, there is little research evidence that equity is correlated with engagement. Marks (2000) examined the predictive effect on student engagement of school support for learning.

School support was assessed using a five-item scale measure. One of the items addressed the student's belief that "they (and friends) are treated fairly" (p. 163), which is related to equity, and other items asked whether teachers listened to them and they feel safe at school. The hierarchical linear modeling analysis of the results showed that school support for learning was positively related to student engagement. The results of the current study also showed that equity was positively related to high levels of student engagement. If students perceive equity in the science learning environment, this may help to create a more positive learning atmosphere because there is no favoritism and similar opportunities are provided to all students. In this environment, for instance, students can more readily express their opinions and preferences and thus may experience more agentic engagement.

Besides learning environment factors, the current study examined the motivational constructs of self-efficacy, mastery goals, and performance-approach goals as predictors of student engagement. It found that highly self-efficacious individuals reported more cognitive and emotional engagement in science. Previous studies showed that self-efficacy was positively related to cognitive engagement as measured by strategy use (Greene et al. 2004) and metacognitive strategy use (Kahraman and Sungur 2011). Ferrell (2012) showed that self-efficacy only significantly and positively predicted cognitive engagement, but it was not a significant predictor for behavioral and emotional engagement. However, the findings of a study by Hidiroglu (2014) demonstrated that self-efficacy was significantly and positively related to cognitive, emotional, behavioral, and agentic engagement in science. Thus, in previous studies, self-efficacy was found to be related to some or all the aspects of engagement. The present study hypothesized that self-efficacious individuals would also report higher levels of behavioral and agentic engagement than those with low self-efficacy beliefs, because students more readily participate in learning activities when they feel capable of accomplishing them (Schunk 1991). This non-significant relationship between self-efficacy and behavioral and agentic engagement should be further investigated since there may be factors other than self-efficacy that play a role in student involvement in activities. For instance, task characteristics may be important in that although students believe that they can perform the task successfully, if the task is not meaningful or relevant for them, they may not engage in the activity. Previous studies demonstrated that task characteristics, such as authentic instructional work (e.g., Marks 2000) and meaningful, attractive, and challenging classroom tasks (e.g., Hidiroglu 2014), are related to student engagement.

Furthermore, this study found that students who pursued high levels of mastery goals were more cognitively, behaviorally, and emotionally engaged, while performance-approach goal-oriented individuals reported high levels of cognitive, emotional, and agentic engagement. Previous studies generally found that mastery goals were positively associated with student engagement. For instance, Lau, Liem, and Nie (2008) examined the role of achievement goals in predicting cognitive engagement as measured by use of deep learning strategies. Path analysis showed that task-approach goals (similar to mastery goals in the present study) were significantly and positively linked to classroom attentiveness and group participation, which in turn significantly and positively predicted the use of deep learning strategies. Similarly, Greene et al. (2004) found that mastery goals were positively related to cognitive engagement as measured by strategy use. Ferrell (2012) also found that mastery goals were significantly and positively linked to cognitive, behavioral, and emotional engagement. Some studies did not depict a link between performance-approach goals and engagement (e.g., Greene et al. 2004), while other research looked for the relationship but found a non-significant relationship between performance-approach goals and metacognitive strategy use (e.g., Kahraman and

Sungur 2011). Another collection of studies demonstrated that performance-approach goals were positively associated with cognitive engagement (e.g., Lau et al. 2008; Meece, Blumenfeld, and Hoyle 1988; Wolters et al. 1996) and with self-regulation (e.g., Kingir, Tas, Gok, and Sungur Vural 2014). The present study found performance-approach goals to be associated with most of the components of engagement (cognitive, emotional, and agentic). Hence, this study suggested that students who were more efficacious and more mastery and performance-approach goal-oriented reported higher levels in particular aspects of engagement in science learning than did the students who were less efficacious and less mastery and performance-approach goal-oriented. From the multiple goal perspective, performance-approach goals are beneficial when coupled with mastery goals (e.g., Pintrich 2000b). The results of the current study showed that when predicting cognitive and emotional engagement, performance-approach goals were accompanied by mastery goals. Performance-approach goal orientation, on the other hand, was the single goal orientation that predicted agentic engagement. Therefore, to some extent, the results of this study support the multiple goal perspective. The positive relationship between performance-approach goals and agentic engagement may be explained in that for performance-approach goal-oriented students, contributing to the flow of instruction may be a means of showing their abilities to others. Students may perceive that by asking questions, expressing their preferences and ideas about the content of the course, and making suggestions to improve it, they can demonstrate to their classmates and teacher that they are competent and good at science.

In conclusion, this study found significant associations between student engagement and perceived learning environment and student motivation. Teacher support and equity were significant and consistent predictors for the cognitive, behavioral, emotional, and agentic aspects of engagement, while student cohesiveness was a significant predictor for cognitive, behavioral, and agentic engagement. Motivational variables also had differential predictive effects: self-efficacy was significantly linked to cognitive and emotional engagement; mastery goals significantly predicted cognitive, behavioral, and emotional engagement; and performance-approach goals were significantly associated with cognitive, emotional, and agentic engagement. Thus, the results of the current study show that it is important to investigate the aspects of engagement separately, rather than addressing one general construct for student engagement. Another contribution of this study is that it provides empirical evidence about agentic engagement by showing how students' perceptions of science learning environment and student motivation are related to agentic engagement. A further contribution of the current work is that the analysis results supported the idea that performance-approach goals have favorable relationships with most of the aspects of engagement. As given above, some previous research contains inconsistent findings regarding the relationships between performance-approach goals and student engagement; however, the current study supports the positive, predictive effect of these goals on cognitive, emotional, and agentic engagement. Additionally, although the relationship between students' perceptions of equity and student attitudes toward science and science achievement was previously investigated (e.g., Wolf and Fraser 2008), to our knowledge, no study has investigated student engagement in relation to equity. The findings of the current study show that students' perception that their teacher treats students equally is significantly and positively associated with all aspects of engagement.

There are the following limitations. First, it is correlational in nature and cause-effect relationships cannot be established based on its results. To investigate how contextual factors affect student engagement, experimental and longitudinal studies should be conducted. Another limitation is that this study relied on self-reported data. Students may have responded to the questionnaire in a socially desirable way, reporting high engagement, motivation, and perceptions of teacher support, equity, and student cohesiveness. Measuring student engagement in the context of science learning is known to be challenging (Azevedo 2015; Sinatra et al. 2015). Recently, Greene (2015) proposed measuring student engagement in science using multiple approaches, rather than only self-reported instruments. The advantages of observational methods (Renninger and Bachrach 2015) and self-paced reading and eye-tracking (Miller 2015) for measuring science engagement have been presented. Ryu and Lombardi (2015) adopted another approach that conceptualized student engagement in science learning from a sociocultural perspective and measured engagement using critical discourse analysis and social network analysis. In future studies, the use of multiple methods may contribute to increasing understanding of student engagement in science. Additionally, since internal consistency for the emotional engagement variable was low, results regarding emotional engagement should be interpreted cautiously.

This study addressed three dimensions of the classroom learning environment: students' perceptions of teacher support, equity, and student cohesiveness. However, there are other learning environment variables that may be related to student engagement in science learning. For instance, the associations between the dimensions of a constructivist learning environment and student engagement can be examined in future research. Another direction for future research might be to examine the relationship between equity and engagement, since this relationship is relatively new and its generalizability to students other than middle school students might be useful.

Acknowledgments The author thanks Prof. Dr. Semra Sungur for her comments which helped to improve an earlier version of this manuscript.

References

Ames, C. (1992). Classrooms: goals, structures, and student motivation. *J Educ Psychol, 84*, 261–271.

Anderman, E. R., & Midgley, C. (2004). Changes in self-reported academic cheating across the transition from middle school to high school. *Contemp Educ Psychol, 29*, 499–517.

Azevedo, R. (2015). Defining and measuring engagement and learning in science: conceptual, theoretical, methodological, and analytical issues. *Educ Psychol, 50*, 84–94.

Bandura, A. (1986). *Social foundations of thought and action: a social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

Battistich, V., Solomon, D., Watson, M., & Schaps, E. (1997). Caring school communities. *Educ Psychol, 32*, 137–151.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. NY: Plenum.

Dweck, C. S. (1986). Motivational processes affecting learning. *Am Psychol, 41*, 1040–1048.

Ferrell, A. (2012). *Classroom social environments, motivational beliefs, and student engagement*. USA: Unpublished doctoral dissertation, University of Southern California.

Fraser, B. J. (1998). Classroom environment instruments development, validity and applications. *Learn Environ Res, 1*, 7–33.

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*. New York: Paper presented at the annual meeting of the American Educational Research Association.

Fredricks, J. A., Blumenfeld, P. B., Friedel, J., & Paris, A. (2002). *Increasing engagement in urban settings: an analysis of the influence of the social and academic context on student engagement*. New Orleans: Paper presented at the annual meeting of the American Educational Research Association.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: potential of the concept, state of the evidence. *Rev Educ Res, 74*(1), 59–109.

Goodenow, C. (1993). Classroom belonging among early adolescent students: relationships to motivation and achievement. *Journal of Early Adolescence, 13*, 21–43.

Greene, B. A. (2015). Measuring cognitive engagement with self-report scales: reflections from over 20 years of research. *Educ Psychol, 50*, 14–30.

Greene, B. A., Miller, R. B., Crowson, H. M., Duke, B. L., & Akey, K. L. (2004). Predicting high school students' cognitive engagement and achievement: contributions of classroom perceptions and motivation. *Contemp Educ Psychol, 29*, 462–482.

Hidiroglu, F. M. (2014). *The role of perceived classroom goal structures, self-efficacy, and the student engagement in seventh grade students' science achievement*. Middle East Technical University, Turkey: Unpublished master's thesis.

Jang, H., Kim, E. J., & Reeve, J. (2012). Longitudinal test of self-determination theory's motivation mediation model in a naturally occurring classroom context. *J Educ Psychol, 104*, 1175–1188.

Kahraman, N., & Sungur, S. (2011). The contribution of motivational beliefs to students' metacognitive strategy use. *Education and Science, 36*(160), 3–10.

Kelloway, E. K. (1998). *Using LISREL for structural equation modeling: a researcher's guide*. Thousand Oaks, CA: Sage.

Kingir, S., Tas, Y., Gok, G., & Sungur Vural, S. (2014). Relationships among constructivist learning environment perceptions, motivational beliefs, self-regulation and science achievement. *Research in Science & Technological Education, 31*, 205–226.

Kline, R. B. (2004). *Principles and practice of structural equation modeling* (3rd ed.). NY: The Guilford Press.

Lau, S., Liem, A. D., & Nie, Y. (2008). Task- and self-related pathways to deep learning: the mediating role of achievement goals, classroom attentiveness, and group participation. *Br J Educ Psychol, 78*, 639–662.

Lee, V. E., & Smith, J. B. (1993). Effects of school restructuring on the achievement and engagement of middle school students. *Sociol Educ, 66*, 164–187.

Linnenbrink, E. A., & Pintrich, P. R. (2003). The role of self-efficacy beliefs in student engagement and learning in the classroom. *Reading & Writing Quarterly, 19*(2), 119–137.

Marks, H. M. (2000). Student engagement in instructional activity: patterns in the elementary, middle, and high school years. *Am Educ Res J, 37*, 153–184.

Meece, J. L., Blumenfeld, P., & Hoyle, R. (1988). Students' goal orientations and cognitive engagement in classroom activities. *J Educ Psychol, 80*, 514–523.

Miller, B. W. (2015). Using reading times and eye-movements to measure cognitive engagement. *Educ Psychol, 50*, 31–42.

Ministry of National Education. (2013). *Primary and middle school science curricula* (*grades 3, 4, 5, 6, 7, and 8*). Ankara.

Miserandino, M. (1996). Children who do well in school: Individual differences in perceived competence and autonomy in above-average children. *J Educ Psychol, 88*, 203–214.

Newmann, F., Wehlage, G. G., & Lamborn, S. D. (1992). The significance and sources of student engagement. In F. Newmann (Ed.), *Student engagement and achievement in American secondary schools* (pp. 11–39). New York: Teachers College Press.

Patrick, H., Ryan, A. M., & Kaplan, A. (2007). Early adolescents' perceptions of the classroom social environment, motivational beliefs, and engagement. *J Educ Psychol, 99*, 83–98.

Pintrich, P. R. (2000a). An achievement goal theory perspective on issues in motivation terminology, theory, and research. *Contemp Educ Psychol, 25*, 92–104.

Pintrich, P. R. (2000b). Multiple goals, multiple pathways: the role of goal orientation in learning and achievement. *J Educ Psychol, 92*, 544–555.

Pintrich, P. R., & Schunk, D. H. (2002). *Motivation in education: theory, research, and applications* (2nd ed.). Upper Saddle River, NJ: Prentice Hall.

Reeve, J. (2012). A self-determination theory perspective on student engagement. In S. J. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 149–172). NY: Springer.

Reeve, J. (2013). How students create motivationally supportive learning environments for themselves: the concept of agentic engagement. *J Educ Psychol, 105*, 579–595.

Reeve, J., & Lee, W. (2014). Students' classroom engagement produces longitudinal changes in classroom motivation. *J Educ Psychol, 106*, 527–540.

Reeve, J., & Tseng, C.-M. (2011). Agency as a fourth aspect of students' engagement during learning activities. *Contemp Educ Psychol, 36*, 257–267.

Renninger, K. A., & Bachrach, J. E. (2015). Studying triggers for interest and engagement using observational methods. *Educ Psychol, 50*, 58–69.

Reyes, M. R., Brackett, M. A., Rivers, S. E., White, M., & Salovey, P. (2012). Classroom emotional climate, student engagement, and academic achievement. *J Educ Psychol, 104*, 700–712.
Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol, 55*, 68–78.
Ryan, A. M., & Patrick, H. (2001). The classroom social environment and changes in adolescents' motivation and engagement during middle school. *Am Educ Res J, 38*, 437–460.
Ryu, S., & Lombardi, D. (2015). Coding classroom interactions for collective and individual engagement. *Educ Psychol, 50*, 70–83.
Schunk, D. H. (1987). *Domain-specific measurement of students' self-regulated learning processes*. Washington, DC: Paper presented at the annual meeting of the American Educational Research Association.
Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educ Psychol, 26*, 207–231.
Secada, W. G., Gamoran, A., & Weinstein, M. (1996). Pathways to equity. In F. M. Newmann et al. (Eds.), *Authentic achievement: restructuring schools for intellectual quality* (pp. 228–244). San Francisco: Jossey-Ba.ss.
Sinatra, G. M., Heddy, B. C., & Lombardi, D. (2015). The challenges of defining and measuring student engagement in science. *Educ Psychol, 50*, 1–13.
Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: reciprocal effect of teacher behavior and student engagement across the school year. *J Educ Psychol, 85*, 571–581.
Tas, Y., & Tekkaya, C. (2010). Personal and contextual factors associated with students' cheating in science. *J Exp Educ, 78*, 440–463.
Telli, S., Cakiroglu, J., & den Brok, P. (2006). Turkish secondary education students' perceptions of their classroom learning environment and their attitude towards Biology. In D. L. Fisher & M. S. Khine (Eds.), *Contemporary approaches to research on learning environments: world views* (pp. 517–542). Singapore: World Scientific.
Waldrip, B. G., Fisher, D. L., & Dorman, J. (2009). Identifying exemplary science teachers through students' perceptions of their learning environment. *Learning Environment Research, 12*, 1–13.
Wang, M.-T., & Holcombe, R. (2010). Adolescents' perceptions of school environment, engagement, and academic achievement in middle school. *Am Educ Res J, 47*, 633–662.
Wellborn, J. G. (1991). *Engaged and disaffected action: the conceptualization and measurement of motivation in the academic domain*. University of Rochester, USA: Unpublished doctoral dissertation.
Wolf, S. J., & Fraser, B. J. (2008). Learning environment, attitudes and achievement among middle-school science students using inquiry-based laboratory activities. *Res Sci Educ, 38*, 321–341.
Wolters, C. A. (2004). Advancing achievement goal theory: using goal structures and goal orientations to predict students' motivation, cognition, and achievement. *J Educ Psychol, 96*, 236–250.
Wolters, C. A., & Pintrich, P. R. (1998). Contextual differences in student motivation and self-regulated learning in mathematics, English, and social studies classrooms. *Instr Sci, 26*, 27–47.
Wolters, C. A., Yu, S., & Pintrich, P. (1996). The relation between goal orientation and students' motivational beliefs and self-regulated learning. *Learn Individ Differ, 8*, 211–238.
Wong, A. F. L., Young, D. J., & Fraser, B. J. (1997). A multilevel analysis of learning environments and student attitudes. *Educ Psychol, 17*, 449–468.
Yerdelen, S. (2013). *Multilevel investigations of students' cognitive and affective learning outcomes and their relationships with perceived classroom learning environment and teacher effectiveness*. Middle East Technical University, Turkey: Unpublished doctoral dissertation.
Yildirim, S. (2012). Teacher support, motivation, learning, strategy use, and achievement: a multilevel mediation model. *J Exp Educ, 80*, 150–172.

Yasemin Tas. Researcher and instructor in the Department of Elementary Science Education at Ataturk University in Erzurum, Turkey. Postal Address: Ataturk University, Kazim Karabekir Faculty of Education, Department of Elementary Science Education, 25249, Erzurum, Turkey. E-mail: tasyase@gmail.com

Current themes of research:

Motivation. Self-regulation. Engagement. Science education.

Most relevant publications in the field of Psychology of Education:

Tas, Y., & Tekkaya, C. (2010). Personal and contextual factors associated with students ' cheating in science. *The Journal of Experimental Education, 78*, 440–463.

Tas, Y., & Sungur, S. (2012). Effect of problem-based learning on self-regulated learning: a review of literature. *Croatian Journal of Education, 14*, 533–560.

Kingir, S., Tas, Y., Gok, G., & Sungur Vural, S. (2013). Relationships among constructivist learning environment perceptions, motivational beliefs, self-regulation and science achievement. *Research in Science & Technological Education, 31*(3), 205–226.

Tas, Y., Sungur Vural, S., & Oztekin, C. (2014). A study of science teachers' homework practices. *Research in Education, 91*, 45–64.

Tas, Y., Sungur, S., & Oztekin, C. (2016). Development and validation of science homework scale for middle school students. *International Journal of Science and Mathematics Education, 14*(3), 417–444.