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Relations of Approaches to Learning with Perceptions of Learning Environment and Goal Orientations

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Abstract

This study aimed to investigate the relationships among high school students' approaches to learning science, perceptions of classroom learning environment, and achievement goals. The participants of the study included 800 high school students from 9th to 12th grade in three public schools. A conceptual model constructed based on literature were tested with structural equation modeling. The analysis of the data collected in this study supported the hypothesized model. The findings revealed that students' perceptions of classroom environment and mastery-approach goals affected positively their deep approaches to learning science. In this study, the mediated effect of mastery-approach goals was observed. Mastery–approach goals increased the effect of the perceptions of classroom learning environment on deep approaches to learning science. Moreover, it was found that performance-approach, performance-avoidance and mastery-avoidance goals were positively associated with surface-approaches to learning science. Finally, in this study, the positive effect of students' perceptions of classroom learning environment on their mastery-approach goals was observed. The implications of the study for teaching and learning were discussed.

Keywords

Approaches to learning science
Goal Orientations
Perceptions of learning environment
Structural equation modeling.

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Introduction

Approaches to Learning Science

Students learn the new knowledge in different ways, pace, and amount. The examination of the factors influencing learning is critical for increasing and enriching students' learning. Due to differences in individuals and contextual features, learners go through diverse ways while they are learning (Chin & Brown, 2000). The approaches that learners adopt influence their learning results as well (Biggs, 1978, 1979; Hazel, Prosser & Trigwell, 2002; Marton & Saljo 1976; Watters & Watters, 2007). According to Biggs (1979), approaches to learning are defined as "the ways a particular student has of going about selecting and learning" (p 381). According to Biggs (1988), an approach to learning is as a combination of motive and congruent strategies employed for dealing with a particular task.

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Marton and Saljo (1976) are the first researchers who stated that learners could use different approaches for learning from their study with college students. Marton and Saljo (1976) examined the qualitative differences of individuals' view of outcome of learning. Results revealed that although the same content taught to the learners, *what is learned* and *how much is learned could vary.* The results of the study made them further dig into the differences among the individuals regarding the process of learning the content. The authors identified two levels of processing, namely, *deep-level* and *surface level.* Marton and Saljo (1976) described surface level process of learning as "the students directs his attention towards learning the text itself (*the sign),* i.e., he has a 'reproductive' conceptions of learning which means he has more or less forced to keep to a rote-learning strategy."(p.7, italics are in original) Students who have deep level processing "is directed towards the intentional content of the learning material (*what is signified)* i.e., he is directed towards comprehending what the author wants to say about, for instance, a certain scientific problem or principle. (p. 7-8, italics are in original). Results of the study revealed that students who adopted deep strategy (e.g., focusing on understanding rather than memorizing, paying attention the application of knowledge and inquiring) received better scores and outcomes than who do not (Chin & Brown, 2000; Yang & Tsai, 2010). Related to this topic, Lee and his colleagues stated that research "offers potential insight for science educators because it demonstrates the importance of highlighting the feature of "understanding and seeing in a new way" for science education." (p. 214).

In the late 1980s, in addition to Marton and Saljo's levels of processing, Biggs (1987) stated that learning approach has two components, namely, motive and strategies. A learner with deep approach has an intrinsic motivation and "searches for understanding and meaning inherent in the task, sees the task as meaningful to his or her own experience and to the real world, and relates parts of the task into a whole and with previous knowledge." (Chin & Brown, 2000, p.173) Surface approach, however, is related to extrinsic motivation. Learners adopting surface approach focus on the goals to be reached such as passing a test not to the learning content or relating the new content to the old ones (Biggs, 1988; Chin & Brown, 2000). Therefore, deep strategy was associated with meaningful learning whereas the surface one related to rote learning. To conclude, learning approaches theoretical framework is 2x2 one and includes deep motive, surface motive, deep strategy, and surface strategy sub-components. To conclude, the framework has two fundamental aspects, namely, depth and motivation. Both of them have two sub-components, namely, deep and surface, and motive and strategy, which makes 2x2 framework. To be clearer, this framework has four sub-components: deep motive, deep strategy, surface motive, and surface strategy.

The Variables related to Approaches to Learning Science and the Examination of the Relations among them

Previous research stated that learners' goal setting (Cano & Berben, 2009; Elliot, McGregor, & Gable, 1999; Watters & Watters, 2007) and their perceptions of learning environment (Almeida, Teixeira-Dias, Martinho, & Balasooriya, 2011, Prosser, Trigwell, & Waterhouse, 2000; Özkal, Tekkaya, Cakiroglu, & Sungur, 2009) have an influence on learners' approaches to learning science. In this part of the article, the research related to the variables mentioned (i.e., learners' goal setting, perceptions of learning environment, and approaches to learning science) will be summarized.

The relation between approaches to learning science and perceptions of learning environment. Researchers claimed that students' approaches to learning are context-dependent (Biggs, 1978, Broekkamp & Van Hout-Wolters, 2007; Case & Marshall, 2004; Hayes & Richardson, 1995; Laurillard, 1979; Laird, Shoup, Kuh, & Schwarz, 2008). The same students can adopt different approaches in different contexts in terms of the demands of learning tasks, their perceptions of the content and context (Edmund, 2009), nature of an assessment whether it requires surface-level or deep level processing. For example, Laurillard (1979) interviewed with 30 undergraduate science students for about average, three one-hour sessions regarding some learning tasks that they were carrying out as part of their course. She argued that:

'the reason the student is doing the task', and 'what he is aiming to get out of it' are key factors that affect students' adaptation of a particular kind of approach. If these are intrinsically oriented-- the student is doing the task for its own sake - then he will take a deep level approach. If his orientation is extrinsic - towards external pressures to do it, for example - his approach is more likely to be surface level (Laurillard, 1979, p. 401).

Considering the context-dependence of learning approaches, the studies indicated that when students perceive learning environment as productive for deep level learning, they tend to use deep approaches to learning (Campbell, et al., 2000, Dart et al., 2000, Karagiannopoulou & Christodoulides, 2005; Nijhuis, Segers, & Gijselaers, 2008). For example, Dart et al. (2000) found that when students perceived classrooms as highly personalized, they adopted investigative skills and strategies, which affected their use of deep approaches to learning. Prosser et al. (2000) investigated the relations among first year students' prior understandings in physics, perceptions of the context and approaches to learning in that context. They found that the relationship between students' perception of learning environment and approach to learning in physics was dependent on their prior understanding in physics.

When including students' prior knowledge as a variable, for a group of students having very low-level prior understandings, the relation between perceptions of learning environment and approaches to learning disintegrates, and becomes incoherent. This group of students viewed the context as requiring both surface and deep approaches, and used both surface and deep approaches for the same context. In other words, no meaningful relationship is got for the whole group. For the group of students with sound prior knowledge, Prosser et al. (2000) found systematic relationship between their perceptions of the context and their approaches to learning. Hazel et al. (2002) made similar study in first year university biology courses and received similar results.

The relation between learning approaches and goal orientations. In addition to perceptions of learning environment, students' goal settings have influence on their choice of learning approaches. First of all, to ensure the understanding real meaning of the construct, it would be useful to introduce what goal setting and the types of goals are. In goal setting literature, two types of goals (i.e., mastery goals and performance goals) have been studied frequently. Mastery goals refer to goals that "are focused on the development of competence through task mastery" while performance goals refer to goals that "are focused on the demonstration of competence relative to others (Elliot & McGregor, 2001 p. 501). In 2X2 achievement goal framework proposed by Elliot and McGregor (2001), these goals are called mastery-approach and performance-approach goals to distinguish them from other two achievement goals, performance-avoidance and mastery-avoidance goals. Performance-avoidance goals refer to goals that are "focused avoidance of incompetence relative to others" (Elliot, McGregor, & Gable, 1999, p. 549). Similarly, mastery-avoidance goals refer to goals that are focused avoidance not mastering task (Elliot & McGregor, 2001). This framework is 2x2, which means that it has two basic components that are goal types (i.e., performance and mastery goals), and dealing the goals (i.e., avoidance and approach). To sum up, it has four sub-components: performance approach and performance avoidance goals, and mastery approach and mastery avoidance goals.

Studies generally revealed that positive relationships between students' approaches to learning and goal orientations (Elliot, et al., 1999; Elliot & McGregor, 2001; Watters & Watters, 2007). For instance, Elliot et al. (1999) found that students adopting mastery goal orientation reported to use deep processing strategies while those having performance-approaches reported to employ surface processing strategies. Furthermore, they found performance-avoidance goals positively related to surface strategies whereas it negatively associated with deep strategies. Likewise, Elliot and McGregor (2001) noticed that mastery-approach goals positively predicted deep processing strategies. However, surface-processing strategy was predicted positively by performance-approach and performance-avoidance goal orientation. In their study, performance approach and mastery-avoidance goals did not significantly predict deep processing strategies. Additionally, mastery-approach and mastery-avoidance goals were not significant predictors of surface processing strategies. The studies conducted in science revealed similar results. For example, Watters and Watters (2007) investigated the factors affecting students' approach to learning biology. According to findings of the study, students' setting performance approach goals preferred to use surface approaches to learning. For instance, those students employed memorization strategy to get higher scores in exams.

The relation between perception of learning environment and goal orientations. In the literature, there are some studies examining the relation between learners' perceptions of classroom learning environment and their goal orientation as well. Learning environment is one of the important factors influencing learners' opinion about learning and the purpose of why they learn (Koul, Roy, & Lerdpornkulrat, 2012; Urdan, 2004). Koul et al. (2012) collected data from more than 1500 high school students in Thailand, and revealed that there is a positive and significant correlation between learners' mastery approach goal orientation and their view of classroom environment. Koul et al. (2012) specifically studied on biology and physics classes. For both courses, when the content taught is meaningful to the learners, they have a tendency to have mastery approach goal orientation. Tapola and Niemivirta (2008) focused on the relation between the two constructs by examining the perception of classroom environment of the learners who have different goal orientations. Results revealed that learners with diverse orientations perceived the classroom environment differently. Analysis showed that there is a positive and significant relation between learning orientation and learners' perceived emphasis on learning, individualistic work and task variety in the class. On the contrary, there is a positive and significant correlation between performance orientation and individualistic work, and task variety. Moreover, learners who have different orientations favor to participate in different experience. For instance, learning orientation significantly related to preferred emphasis on learning, individualistic work, task variety, and the preference for autonomy and choice. However, results showed that there is a negative correlation between avoidance orientation and the preferred emphasis on learning and individualistic work.

In the present study, the literature for the selection of learners' approaches to learning, perception of learning environment and goal orientation, the reasons of the selection of them, and the literature forming a foundation of model were provided below.

- Learners' positive perceptions of learning environment influence their embracement of deep approaches to learning (Dart et al., 2000, Karagiannopoulou & Christodoulides, 2005; Nijhuis, et al., 2008).
- Learners' goal orientations play a role in their choice of learning approaches (Cano & Berben, 2009; Elliot, et al., 1999; Watters & Watters, 2007). Performance-approach and performance-avoidance goals have positive impact on surface approaches to learning while mastery-approach goals have positive effect on deep approaches to learning (e.g., Azar, Lavasani, Malahmadi, & Amani, 2010; Cano & Berben, 2009).
- There were relationships between learners' mastery related goal orientation and their perceptions of learning environment (Cano & Berben, 2009; Koul et al., 2012).
- Learners' deep motives are related their deep strategies while surface motives related to their surface strategies (Lee, Johanson, & Tsai, 2007).

To conclude, learners' approaches to learning play important roles in the quality of their learning products. Thus, determining other variables affecting students' approaches to learning and how they are related to each other are important. After the literature review, the variables influencing learning approaches more than others were determined. Among those variables, the most important ones are learners' perception of learning environment and goal orientation. Therefore, this study focused on them.

The Significance of the Study

In Turkey, there have been reforms in science education. In 2005, elementary science education curriculum has been revised in light of the Constructivist view. Then, high school curriculum has been modified and new textbooks were published in order to help learners relate science topics to daily-life and the previous knowledge that they learned. However, due to the high-stake exams in Turkey, many students, parents, schools, and teachers focus on the exam results rather than quality of learning. Hence, in this context, learners' approaches to learning science should be examined because it is one of the important variables influencing learners' achievement (Chiou et al., 2012).

The examination of approaches to learning science and the factors influencing them will be also useful for both educational policy makers and researchers in understanding to what extend the reforms made in Turkey have shaped learners' approaches. Additionally, the results of the relation among learning approaches, learning environment perception and goal orientation will be useful in solving learners' difficulties. The relations mentioned above were studied commonly using simple correlation analyses or regression analyses. In this study, we put these variables all together in a structural model to investigate direct and indirect relations among mentioned variables, which led us to determine mediating variables.

With this in mind, the main research question focused in this study:

How learners' approaches to learning science, perceptions of learning environment, and goal orientation are associated with each other?

Sub-research questıons:

1. How are high school students' deep approaches to learning associated with their perceptions of learning environment?
2. How are high school students' deep approaches to learning associated with their goal orientation?
3. How are high school students' surface approaches to learning associated with their goal orientation?
4. How are high school students' goal orientations associated with their perceptions of learning environment?
5. How are high school students' goal orientations associated with each other?

Method

The research type of the study is correlational research method that is one of quantitative research methods. This study includes two parts. In the first part, Approaches to Learning Science scale was adapted into Turkish while in the second part, the relations among students' approaches to learning, perceptions of learning environment and goal orientations were investigated using structural equation modeling (SEM).

Study Group

800 students from three different high schools in Van, Turkey participated into the study. For the different parts of the study, we studied with different samples. 423 students participated in the adaptation study and 377 students participated in the second part. Table 1 shows the gender and the grade levels of the participants. The participants' ages ranged from 14 to 20. Their socioeconomic status (SES) ranged from low to high while most of students had low or medium SES.

Table 1. Gender and the Grade Levels of the Participants

	Gender		**Grade**			
	Female	**Male**	**9th**	**10th**	**11th**	**12th**
Adaptation	219	201	234	83	60	46
Main study	164	213	51	122	154	50

Instruments Used for Data Collection

In this study, we used three different scales, namely, Approaches to Learning Scale (ALS) (Lee et al., 2008), Achievement Goals Measure (AGM) developed by Elliot and McGregor (2001), and Constructivist Learning Environment (CLES) developed by Taylor and Fraser (1991) and revised Johnson and McClure (2004). AGM was adapted into Turkish by Şenler and Sungur (2007). CLES was adapted into Turkish by Yılmaz-Tüzün, Çakıroğlu, and Boone (2006). Details about the scales were given in the following part. Turkish versions of all instruments were administered in this study.

Approaches to Learning Science Scale

In the first part of the study, ALS developed by Lee et al. (2008) was adapted into Turkish. This version of the scale was stated as a new version of the scale developed by Kember, Biggs, and Leung (2004) (Revised Learning Process Questionnaire (R-LPQ-2F). ALS is a 5-Likert-type instrument (i.e., 1-totally disagree, 5-totally agree). ALS has four factors (i.e., deep motive, deep strategy, surface motive, and surface strategy) and 24 items. Details about the factors were provided in Table 2.

Table 2. Details about the factors, descriptions, and items

Factor	Description	# of items under the factor	Item # in Turkish version	Example items
Deep Motive (DM)	Students have intrinsic interest about learning science	8	1, 2, 5, 8, 9, 15, 16, 20	I work hard at studying science because I find the material interesting
Deep Strategy (DS)	Students use deep strategies to learn more	6	6, 12, 14, 18, 21, 23,	I try to relate what I have learned in science subjects to what I learn in other subjects.
Surface motive (SM)	Students have superficial interest about learning science	5	3, 7, 10, 17, 19	I want to get a good achievement in science subject so that I can get a better job in the future.
Surface Strategy (SS)	Students use shallow strategies for learning science	5	4, 11, 13, 22, 24	I generally will restrict my study to what is specially set as I think it is unnecessary to do anything extra in learning science topic.

In the original study, Lee et al. (2008) calculated the Cronbach's alpha coefficients .90, .89, .84, .84 for DM, DS, SM, and SS, respectively. The overall alpha was .89. Explanatory Factor Analysis (EFA) showed that the KMO index was .88, and Bartlett's test of sphericity was significant (χ^2 (276, n= 240)= 3,383.59, p< .0001). All the values were in the desired range.

The Adaptation of the Approaches to Learning Science Scale into Turkish

Adaptation procedure is detailed process including not only translation but also the checking the construct's meaning in the translated language, and the equivalence of the original and translated versions (Hambleton, 2005). In this process, as Hambleton (1993) suggested, we studied with experts in science education, scale adaptation, and terminology. The instrument was originally in English. The adaptation procedure started with taking permission from Lee and his colleagues. First, the items were translated into Turkish by the authors who are bilingual science educators with Ph.D. degree from secondary science education doctoral program. After the translation, we came together to compare and contrast the translation of the items from English to Turkish. After having consensus on the translation, we requested two of our colleagues to review the translation of the items. In light of their feedback, necessary changes were made. Then, another colleague who is expert in Turkish Language Education checked the translated version of the items regarding the terminology and grammar issues. Finally, the authors examined the items again and formed the final version of the instrument.

Turkish version of ALS was photocopied and administrated to the high school students after adaptation process. Data collected were entered to SPSS package program and analyzed by the use of LISREL program. Cronbach's Alpha reliability values, mean inter-item correlation (MIIC) for each item, Lambda-X (λ) factor loading values, and four-factor ALS in Turkish were t values and squared multiple correlations for X-variables (R^2) values for the items were calculated. The Cronbach's Alpha value was as calculated as 0.74 for overall. The Cronbach's Alpha value should be at least .70 (Büyüköztürk, 2013). For the factors, the reliability coefficients were provided in the Table 3.

Table 3. The Cronbach Alpha reliability values for the factors

Factor	Number of Items	Cronbach's Alpha
Deep motive (DM)	8	0.8
Deep strategy (DS)	6	0.7
Surface Motive (SM)	5	0.6
Surface Strategy (SS)	5	0.5

As Table 3 revealed, for the SM and SS factors were lower than the desired value. Regarding this problem, Pallant stated "Cronbach Alpha values are, however, quite sensitive to the number of items in the scale. With short scales (e.g., scales with fewer than ten items), it is common to find quite low Cronbach's Alpha values" (2007, p.95). To address this problem, Briggs and Checks (1986) suggested to look at optimal range for the inter item correlation which should be between .2 and .4. Therefore, when we look at the mean inter-item correlation (MIIC) value that is independent from the number of items (table 4).

Table 4. MIIC values for the factors of the Approaches to Learning Science Scale

Factor	MIIC values
Deep motive (DM)	.30
Deep strategy (DS)	.30
Surface Motive (SM)	.30
Surface Strategy (SS)	.20

Note: As Table 4 shows, all of the MIIC values are in the desired range.

Confirmatory factor analysis (CFA) was conducted with the data obtained in this part of the present study. Multiple fit indices were used to test whether CFA models and the hypothesized model fits the data. These indices were Chi-square/ degrees of freedom ratio, Root-Mean-Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Goodness-of-fit Index (GFI), Adjusted Goodness-of-fit Index (AGFI) (Jöreskog & Sörbom, 1993, Schermelleh-Engel, Moosbrugger, & Müller, 2003). Table 5 indicates the ranges of fit indices suggested by Schermelleh-Engel et al. (2003) for good and acceptable fit of a model.

Table 5. The Ranges of Goodness-of-fit Indices in Model Testing

Fit Indices	Good Fit	Acceptable Fit
χ^2/df	$0 \leq \chi^2/df \leq 2$	$2 < \chi^2/df \leq 3$
RMSEA	$0 \leq RMSEA \leq .05$	$.05 < RMSEA \leq .08$
SRMR	$0 \leq SRMR \leq .05$	$.05 < SRMR \leq .10$
GFI	$.95 \leq GFI \leq 1.00$	$.90 \leq GFI < .95$
AGFI	$.90 \leq AGFI \leq 1.00$	$.85 \leq AGFI < .90$

Note: The table adapted from Schermelleh-Engel et al. (2003)

CFA results provided evidence about the validity of Turkish version of Approaches to Learning science. CFA results supported a four-factor structure of the instrument. Fit indices were within acceptable range considering recommendations of Schermelleh-Engel et al. (2003), Hu and Bentler (1999) and Kline (2005) (χ^2(246, N = 423) = 543.04, χ^2/df = 2.21 *GFI* = .90, *AGFI* = .88, RMSEA = .05 (90 % *CI* = .05, .06), SRMR = .06, CFI = .93, NFI = .88, NNFI = .92).

Regarding the Lambda-X (λ) factor loading values for the ALS with four factors, standardized coefficients for the four-factor ALS were given in Table 6. The loading values .40 or above show adequate loadings (Stevens, 2002). As Table 6 shows, it can be stated that all items loaded to the factors as intended.

Table 6. Lambda-X (λ) factor loading values for four-factor ALS

Factor Loadings (λ)				
Items	**DM**	**DS**	**SM**	**SS**
1	0.72	-	-	-
2	0.658	-	-	-
3	-	-	0.492	-
4	-	-	-	0.515
5	0.651	-	-	-
6	-	0.610	-	-
7	-	-	0.477	-
8	0.706	-	-	-
9	0.621	-	-	-
10	-	-	0.717	-
11	-	-	-	0.613
12	-	0.743	-	-
13	-	-	-	0.373
14	-	0.727	-	-
15	0.602	-	-	-
16	0.501	-	-	-
17	-	-	0.404	-
18	-	0.698	-	-
19	-	-	0.875	-
20	0.768	-	-	-
21	-	0.685	-	-
22	-	-	-	0.657
23	-	0.682	-	-
24	-	-	-	0.694

Deep Motive (DM), Deep Strategy (DS), Surface Motive (SM), and Surface Strategy (SS)

Other evidences supporting the validity of four-factor ALS in Turkish were *t* values and squared multiple correlations for X-variables (R^2) values for the items (Table 7). *t* values should be higher than 2 (Pallant, 2007). All of the t values shown are statistically significant (p< .05). According to Cohen and Cohen's (1983) rules of thumb criteria, all R^2 are changing between medium and high effect size.

Table 7. *t* and R^2 Values for the Items Under Four Factors of ALS

Item	Factor	t- values	R^2
1	DM	12.531	0.369
2	DM	10.760	0.285
3	SM	5.910	0.118
4	SS	5.779	0.142
5	DM	10.245	0.264
6	DS	10.047	0.254
7	SM	5.919	0.121
8	DM	10.981	0.299
9	DM	9.560	0.235
10	SM	10.451	0.361
11	SS	6.545	0.185
12	DS	13.651	0.423
13	SS	4.461	0.085
14	DS	11.817	0.339
15	DM	10.038	0.259
16	DM	7.563	0.154
17	SM	5.170	0.091
18	DS	10.832	0.290
19	SM	11.487	0.451
20	DM	12.004	0.349
21	DS	12.228	0.363
22	SS	7.599	0.258
23	DS	12.834	0.388
24	SS	6.406	0.177

To sum up, the results of the analysis showed that Turkish version of ALS has four factors as in the original version of the instrument. Descriptive statistics for the factors were given in Table 7.

Table 8. Descriptive Statistics for ALS' the Factors

	DM	**DS**	**SM**	**SS**
N (valid)	383	386	399	408
Mean	25.7	20.9	10.7	16.5
Median	26.0	22.0	10.0	17.0
Std. Deviation	6.1	4.7	4.1	3.9
Minimum	8.0	6.0	5.0	5.0
Maximum	40.0	30.0	24.0	25.0

In the second part of the study, ALS that was adapted into Turkish by the authors was used. Confirmatory Factor Analysis (CFA) was conducted for the data collected for the second part of the research (i.e., the data used for this part were collected from a different sample). Second CFA results supported four-factor structure of ALS. Fit indices were within an acceptable range ($\chi^2(246, N = 377) = 493.09$, $\chi^2/df = 2.00$, $GFI = .90$, $AGFI = .88$, RMSEA = .05 (90 % CI = .05, .06), SRMR = .06). It was observed that all items had statistically significant factor loads. Reliability coefficients were also higher than the desired values (i.e., >.70).

Achievement Goals Measure Scale

AGM scale developed by Elliot and McGregor (2001) and adapted into Turkish by Şenler and Sungur (2007) was used to determine students' goals. AGM is a 5-Likert-type instrument with has four factors including 15 items. Şenler and Sungur (2007) revealed Cronbach's Alpha value for mastery approach goal scale as .81; for performance approach goal as .69; for mastery avoidance goal as .65, and for performance avoidance goal as .64.

The CFA performed with the data collected in the second part of this study also showed that AGM has four factors (χ^2(84, N = 377) = 210.15, χ^2/df = 2.50, *GFI* = .93, *AGFI* = .90, RMSEA = .06 (90 % *CI* = .05, .07), SRMR = .05). All items loaded to the factors. The reliability coefficients for the factors were higher than the desired value.

Constructivist Learning Environment Scale (CLES)

CLES developed by Taylor and Fraser (1991) and revised by Johnson and McClure (2004) was used to determine students' perception of learning environment. Yılmaz-Tüzün, Çakıroğlu, and Boone (2006) adapted CLES into Turkish. CLES is 5-Likert-type instrument with 20 items under five factors. Yılmaz-Tüzün et al. (2006) revealed reliability coefficients as: .79 for personal relevance, .74 for uncertainty, .86 for critical voice, .72 for shared control, and .78 for student negotiation. This adapted scale has been used by other researchers for science courses as well (Özkal, Tekkaya, & Çakıroğlu, 2019; Uysal, 2010).

In this study, CFA results supported CLES' four-factor structure (χ^2(160, N = 377) = 338.02, χ^2/df = 2.11, *GFI* = .92, *AGFI* = .89, RMSEA = .05 (90 % *CI* = .05, .06), SRMR = .05). All indexes are in the acceptable range. When the factor loadings were examined, 2nd items that supposed to be under uncertainty factor did not have a desired factor loading. Therefore, this item was not included in the analysis. Table 9 showed the scales, scales' factors, item numbers under the factor, and example items.

Table 9. The scales used in the study, scales' factors, item numbers under the factor, and example items

Instrument	Factors and # of items under factors	Example items
ALS	Deep Motive (8)	I always greatly look forward to go to science class.
	Deep Strategy (6)	I try to relate what I have learned in science subjects to what I learn in other subjects.
	Surface Motive (5)	I want to do well in science subjects so I can please my family and the teacher.
	Surface Strategy (5)	I see no point in learning science materials that are not likely to be on the examinations.
AGM	Mastery Approach (3)	I want to learn as much as possible from this class.
	Performance Approach (3)	My goal in this class is to get a better grade than most of the other students.
	Mastery Avoidance (3)	I worry that I may not learn all that I possibly could in this class.
	Performance Avoidance (6)	My goal in this class is to avoid performing poorly.
CLES	Personal Relevance (4)	I learn about the world inside and outside of school.
	Uncertainty (3)	I learn that science has changed over time.
	Shared Control (4)	I help the teacher to decide what activities I do.
	Critical Voice (4)	I feel safe questioning what or how I am being taught.
	Student Negotiation (4)	Other students ask me to explain my ideas.

Data Collection and Analysis

All instruments of the present study were administered to students by the researchers under control of their teachers in their classes. The students completed the instruments in about 30 minutes.

Structural Equation Modeling (SEM) was employed to test the hypothesized model constructed based on the literature review on the variables of the study. Figure 1 shows this model. In the model, a latent variable is represented in a circle and the observed variables are represented in rectangles. SEM was carried out using LISREL (Jöroskog & Sörbom, 2006).

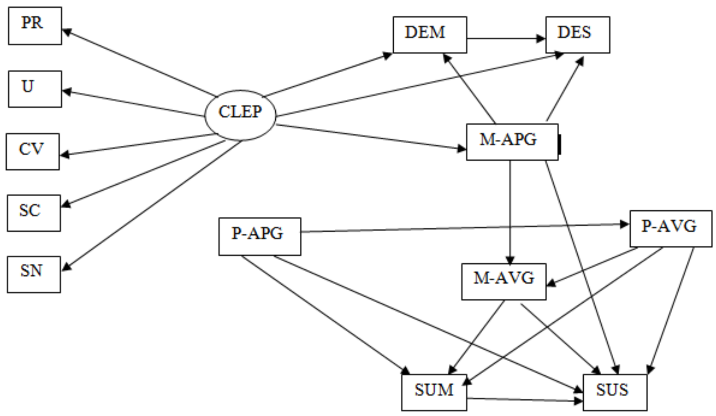

Figure 1. The hypothesized model in this study

PR: Personal relevance, U: Uncertainty, CV: Critical voice, SC: Shared control, SN: Student negotiation, CLEP: Constructivist learning environment Perception, DEM: Deep motive, DES: Deep strategy, SUM: Surface Motive, SUS: Surface Strategy, M-APG: Mastery approach goals, P-APG: Performance-approach Goals, M-AVG: Mastery avoidance goals, P-AVG: Performance Avoidance goals

No significant differences were found between male and female students and among school and grade levels on variables of this study. Therefore, gender, school and grade were not included in the model as related variables.

The magnitude of effect sizes of relations among the variables in the model was evaluated using thresholds proposed by Kline (1998). According to these thresholds, a regression coefficient that is smaller than .10 is considered as small, that which is bigger than .30 is taken as medium and that which is larger than .50 is considered as large. The level of significance (α-level) was used to test whether the relations between the variables are statistically significant was .05.

Results

In this section, first, descriptive statistics were presented. Based on these statistics whether required assumptions to conduct SEM are met on the data of the current study was discussed. Then, the findings related to the testing of measurement model of the perceptions of learning environment were introduced. Finally, the results related to testing of the hypothesized model in this study were presented.

Table 10 shows descriptive statistics for observed variables of the present study and the values of reliability coefficients. For reliable test scores, the magnitude of Cronbach's alpha is suggested to be at least .70 (Büyüköztürk, 2013, Pallant, 2001). Some of the variables' Cronbach's alphas are less than this value. On the other hand, since the value of Cronbach's alpha relies on the number of items in a scale, the short scales having less than 10 items commonly have small Cronbach's alphas. When the number of items increases, the magnitude of Cronbach's alpha increases as well (Pallant, 2001; Briggs & Cheeks, 1986) as long as the added items are consistent with the existing ones and relied on content validity. Briggs and Cheeks (1986) argued for small scales, mean inter-item correlation (MIIC) can be used for reliability checks since it does not depend on the number of items in a scale. They suggested that when MIIC changes between .20 and .40, the scale can be considered as reliable. When the value of the MIIC is less than .10 it can be said that single score in the scale does not represent the complexity of the items (Briggs & Cheeks, 1986) According to these explanations, all MIIC values of the variables were in acceptable range. Thus, it can be said that the observable variables of the study are reliably measured.

Table 10. Descriptive Statistics for Observed Variables

Observed variables	N	Mean	5% trimmed mean	SD	Skewness.	Kurtosis	α	MIIC
1.Personal relevance	377	14.78	14.94	3.60	-.48	-.23	.73	.40
2.Uncertainty	377	10,66	10,72	2.49	-.25	-.27	.53	.27
3.Critical voice	377	13.60	13.62	3.31	-.08	-.55	.61	.28
4.Shared control	377	9.83	9.68	3.93	.27	-.69	.77	.45
5.Student negotiation	377	11.90	11.92	3.66	-.13	-.47	.72	.34
6.Deep Motive	377	27.09	27.13	5.21	-.17	-.01	.70	.23
7.Deep Strategy	377	22.12	22.27	4.36	-.53	.24	.76	.35
8.Surface Motive	377	19.76	19.99	3.77	-.74	.20	.60	.24
9.Surface Strategy	377	12.18	12.07	4.04	.39	-.29	.61	.24
10.Mastery Approach	377	13.15	13.36	2.12	-1.26	1.21	.63	.37
11.Performance-Approach	377	11.74	11.98	3.04	-.94	.25	.72	.46
12.Mastery-Avoidance	377	10.50	10.62	2.90	-.46	-.29	.66	.39
13.Performance Avoidance	377	19.49	19.61	5.67	-.38	-.43	.76.2	.35

α = Cronbach's alpha, and MIIC = Mean Inter-Item Correlations.

Required Assumptions for the SEM

Sample size is important for SEM studies. Schreiber, Stage, King, Nora, and Barlow (2006) argued that SEM can be thought as confirmatory factor analysis and multiple linear regression. Stevens (2002) recommends at least 15 participants per each predictor in a multiple linear regression model for reliable analysis. In this study, there were 13 observed variables in the hypothesized model, which means minimum 195 participants are necessary. Moreover, Barrett (2007) recommends the sample size for reliable SEM to be minimum 200. Considering these suggestions, sample of this study appears to be appropriate to conduct a reliable SEM.

For normality assumption, skewness and kurtosis values were checked. All values are within the range from -2.00 to 2.00 (George & Mallery, 2003); thus, the variables of the study were normally distributed. Outliers are not issue in the current study since differences between actual means and 5% trimmed means of the variables are small compared to standard deviations of the variables. This result was also support that the variables were normally distributed. Multicollinearity is not issue as well since correlations among variables ranged from -.41 to .57 and were less than .90 (Pallant, 2001).

Testing Measurement Model of Perceptions of Learning Environment

Before testing the hypothesized structural model as whole, the measurement model for perceptions of learning environment was tested considering recommendations of Anderson and Gerbing (1988), and, Jöreskog and Sörbom (1993). By doing this, we can find out more easily whether non- fitting model is owing to a measurement model or structural model itself. Confirmatory factor analysis was carried out on five indicators of perceptions of learning environment. According to this analysis, the measurement model of perceptions of learning environment did not fit the data ($\chi^2(5, N = 377) = 75.32$, $p < .05$, RMSEA = .19, GFI = .93; AGFI = .78; SRMR = .06). According to modification indices, error terms of Personal Relevance and Uncertainty, and Student Negotiation and Shared Control were let to be correlated. Since these variables estimate the same construct (perceptions of learning environment) they are related to each other based on the theory of perceptions of learning environment. That the error terms of these related indicators are also related to each other is an expected result based on the theoretical framework. Thus, making these modifications were considered to be suitable. After this, the good fitting of the measurement model of the CLES to the data was observed ($\chi^2(3, N = 377) = 6.46$, $p > .05$, RMSEA = .04 (90 % *CI* = .0.0, .11), GFI = .99; AGFI = .97; SRMR = .02).

Standardized regression coefficients, t-values and explained variances for the dimensions of perceptions of learning environment are presented in Table 11. All *t* values were statistically significant ($p < .05$). Moreover, all R^2 values had large effect size (Cohen & Cohen, 1983). In sum, based on these results, that the perceptions of learning environment scale has a four-factor structure was statistically confirmed.

Table 11. Standardized coefficients, standard errors, *t*-values, and explained variances for the measurement model of perceptions of learning environment.

Sub-Dimensions	Standardized Coefficient	Standard Error	*t*-value	R^2
1.Personal relevance	0.62	.19	11.82	.38
2.Uncertainty	0.60	.13	11.40	.36
3.Critical voice	0.89	.17	17.49	.79
4.Shared control	0.59	.21	11.17	.35
5.Student negotiation	0.63	.19	12.00	.39

Testing Hypothesized Model

The final measurement model tested above was extended to the structural model by adding other variables in hypothesized model and then, this model was tested. The model fitted the data. All fit indices were acceptable (χ^2 (53, N =377) = 140.81; $p < .05$; $\chi^2/df = 2.65$ GFI = .95; AGFI = .91; RMSEA = .07 (90 % *CI* = .05, .08); SRMR = .06). Figure 2 indicates the structural model together with standardized path coefficients and explained variances on the dependent variables (R^2). Insignificant paths between the variables were indicated as dashed lines.

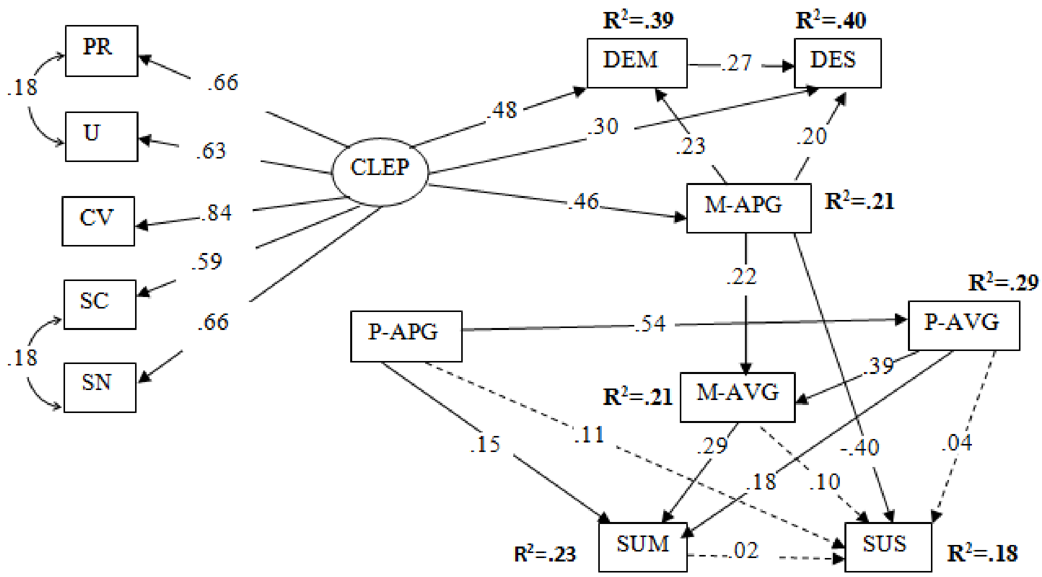

Figure 2. The final model tested in this study.

PR: Personal relevance, U: Uncertainty, CV: Critical voice, SC: Shared control, SN: Student negotiation, CLEP: Constructivist learning environment Perception, DEM: Deep motive, DES: Deep strategy, SUM: Surface Motive, SUS: Surface Strategy, M-APG: Mastery approach goals, P-APG: Performance-approach Goals, M-AVG: Mastery avoidance goals, P-AVG: Performance Avoidance goals.

Table 12 shows direct, indirect and total effects for the variables in the model in additions to t-values, standard errors and standardized regression coefficients for these effects. Direct effects are the path coefficients given on the lines in Figure 2. Total effects are sum of direct effect and indirect effect indicting the relations of a variable to another variables through other variable(s). The values on Table 12 were interpreted in the following sections.

Table 12. Regression coefficients, standard errors and *t*-values of direct, indirect and total relations among the variables

Variables		**DEM**			**DES**			**SUM**			**SUS**			**MAPG**			**MAVG**			**PAVG**		
		Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
CLEP	β	.48	.11	.59	.30	.25	.55		.03	.03		-.18	-.18	.46		.46		.10	.10			
	SH	.29	.13	.27	.27	.17	.23		.03	.03		.12	.12	.11		.11		.07	.07			
	t	8.71	4.33	11.49	4.89	6.37	10.62		3.41	3.41		-5.89	-5.89	8.63		8.63		4.18	4.18			
DEM	β				.27		.27															
	SH				.05		.05															
	t				4.98		4.98															
SUM	β										.02		.02									
	SH										.06		.06									
	t										.38		.38									
MAPG	β	.23		.23	.20	.06	.26		.06	.06	-.40	.02	-.38				0.219		0.219			
	SH	.12		.12	.05	.04	.10		.03	.03	.09	.02	.09				.06		.06			
	t	4.66		4.66	4.09	3.32	5.18		3.71	3.71	-8.33	1.86	-8.04				4.78		4.78			
PAPG	β							.15	.16	.31	.11	.05	.16					.21	.21	.54		.54
	SH							.07	.04	.08	.08	.04	.06					.03	.03	.08		.08
	t							2.80	4.80	6.44	1.92	1.62	3.38					7.05	7.05	12.43		12.43
MAVG	β							.29		.29	.10	.01	.11									
	SH							.07		.07	.08	.02	.07									
	t							5.86		5.86	1.83	.37	2.02									
PAVG	β							.18	.11	.29	.04	.05	.09				.39		.39			
	SH							.04	.02	.04	.04	.02	.04				.02		.02			
	t							3.05	4.84	5.20	.73	1.95	1.59				8.57		8.57			

The relations of deep learning approaches (deep motive and deep strategy) to the perceptions of learning environment. In the model, it is hypothesized that students' perceptions of classroom learning environment have influence on their deep approaches to learning. The results of SEM analysis showed the direct relation of students' deep motive to their perceptions of learning environment (β = .48, p < .05) was statistically significant. The effect size of this relation to their perceptions of learning environment is medium according to thresholds of effect size for regression coefficient suggested by Kline (1998).

The indirect effect of students' perceptions of learning environment on their deep motives through their mastery approach goals is significant (β = .11, p < .05) and has small to medium effect size. This indirect effect led to total effect of perceptions of learning environment on deep motive (β = .59, p < .05) to have large effect size as it is larger than .50 (Kline (1998). Thirty nine percent of variance of students' deep motives was explained by their perceptions of learning environment and mastery approaches goals. This R^2 has large effect size (Cohen & Cohen, 1983).

The direct effect of students' deep motives on their deep strategies is significant (β = .27, p < .05). The effect size is small to medium. The direct relation of students' perceptions of learning environment to their deep strategies was significant (β = .31, p < .05) and has medium effect size. Indirect relation of students' perceptions of learning environment via their deep motives and mastery approach goals is significant (β = .25, p < .05) and the effect size of this relation is small to medium. This indirect relation makes total effect of perceptions of learning environment on deep strategies have large effect size (β = .56, p < .05). Students' perceptions of learning environment, deep motives and mastery approach goals explained 40 % of variance on deep strategies. This value has also large effect size.

The relations of learning approaches to goal orientations. Learning approaches to science were hypothesized to be related to students' goal orientations in the tested model constructed based on research studies. The results of SEM analysis showed the direct relations of students' deep motive to mastery approach goals (β = .23, p < .05) was statistically significant. According to Kline's (1998) thresholds, the effect size of regression coefficient of the path from mastery approach goals to deep motives is small to medium since it is less than .30.

The significant direct association of mastery approach goals (β = .20, p < .05) to deep strategies is found in the present study. The indirect relation of mastery approach goals to deep strategies through deep motives is significant (β = .06, p < .05) as well.

The direct relation of students' surface motives to their performance approach goals was statistically significant (β = .15, p < .05). The effect size of this direct relation is small to medium. Indirect effect of performance approach goals on surface motive through performance avoidance goals and mastery avoidance goals was significant (β = .16, p < .05) and has small to medium effect size. This indirect effect caused total effect of performance approach goals on surface motives to have medium effect size (β = .31, p < .05).

Significant direct effect of mastery avoidance goals and performance avoidance goals on the surface motives was also observed. Both relations have small to medium effect size. Indirect relation of performance avoidance goals to surface motives via mastery avoidance goals was statistically significant (β = .11, p < .05), which increased total effect of performance avoidance goals on surface motives (β = .29, p < .05). According to SEM results, the effect of surface motives on surface strategies was insignificant (β =.02, p > .05). The negative significant direct relation of mastery approach goals to surface strategies was found as result of model testing (β =-.40, p < .05). This relation has medium effect size because it is greater than .30 (Kline, 1998). However, indirect effect of students' mastery approach goals on their surface strategies through their mastery avoidance goals was insignificant (β =.01, p > .05).

The direct relation of performance approach goals to surface strategies was insignificant (β =.11, p > .05) and indirect relations via surface motives and performance avoidance goals was insignificant as well. However, this small indirect effect turned total effect of performance approach goals on surface strategies to be significant (β =.16, p < .05). Total effect has small to medium effect size. Similarly, direct and indirect effect of mastery avoidance goals on surface strategies were not significant; however, total effect was significant (β =.11, p < .05) owing to indirect effect of mastery avoidance goals via surface motives. Finally, no significant relation between surface strategies and performance avoidance goals was found in the present study.

The relation of goal orientations to perceptions of learning environment. The direct effect of students' perceptions of learning environment on their mastery approach goals was significant (β =.46, p < .05) and it has almost large effect size. Indirect effect of perceptions of learning environment on mastery avoidance goals through mastery approach goals reached statistical significance (β =.10, p < .05).

Interrelations among goal orientations. The direct relation of mastery approach goals to mastery avoidance goals was significant and positive (β =.22, p < .05). The direct effect of performance approach goals on performance avoidance goals was statistically significant (β =.54, p < .05). This relation has large effect size since path coefficient (β =.54) is bigger than .50 (Kline, 1998). Indirect effect of performance approach goals on mastery avoidance goals through performance avoidance goals was significant (β =.21, p < .05). Finally, significant direct relation of performance avoidance goals to mastery avoidance goals was seen (β =.39, p < .05) which has medium effect size.

Discussion, Conclusion, and Suggestions

The results of the present study focusing on the relation among learners' approaches to learning science, perceptions of classroom environment, and goal orientations revealed that students' perceptions of classroom environment influence positively their deep approaches to learning. This result is compatible with results of other studies (e.g. Campbell, et al., 2000, Dart et al., 2000, Karagiannopoulou & Christodoulides, 2005; Nijhuis et al., 2008). On the other hand, this study extended results of other studies in terms of showing indirect positive impact of students' perceptions of learning environment through their mastery- approach goals on their deep approaches to learning. According to findings of this study, when students perceive their learning environment have more constructivist elements, they adopt mastery-approach goals, which increases possibility of students' preference of deep approaches to learning. The internalization of deep learning approaches will influence learning outcomes positively. In this study, it was also observed that students possessing mastery approach goals embraced deep approaches to learning similar to findings of the studies conducted by Elliot et al. (1999), and Elliot and McGregor (2001).

In terms of surface approaches to learning, the results of the present study confirmed the other studies' findings (e.g., Elliot, et al., 1999; Elliot & McGregor, 2001) that performance approach and performance avoidance goals can lead students to adopt surface approaches to learning. Furthermore, our results demonstrated that students endorsing mastery approaches goals reported less use of surface strategies. Moreover, according to result of the present study, students having mastery-avoidance goals preferred to use surface approaches to learning.

Interrelations among goal orientations were also investigated in this study, which is also important with respect to adding more information about Elliot and McGregor's (2001) 2X2 framework. We also observed that students with mastery approach goals also embraced mastery-avoidance goals. That is, students aiming to learn content deeply also concerned about not being able to learn the content completely. Similarly, students with performance-approaches goals adopted performance-avoidance goals. In other words, students aiming to get higher grades than those of their peers concerned about getting lower grades than those of other students as well. Finally, students' embracement of performance- avoidance goals led them to prefer mastery-avoidance goals. That is, students being afraid of getting worse grades than others' also were afraid of not understanding adequately the content.

This study proposed some implications for teachers, curriculum developers, and researchers. In this research, we adapted the Approaches to Learning Science (ALS) scale into Turkish in order to determine high school students' learning approaches. Learners' approach to learning is important regarding the amount of the knowledge to be learned and remembered. The strategies used for meaningful learning is better for learners in using the knowledge learned in daily-life and recalling it when they need to relate the new knowledge with the existing one (Driscoll, 2005). To help students develop deep motives and strategies, to support their learning, and make changes in their approaches, first, science educators have to examine the existent motives and strategies. In this regard, ALS will be helpful to diagnose which type of strategies and motives Turkish students have in learning science. With the help of the analysis of existing approaches adopted by students, necessary precautions will be held, and suggestions for politicians and teachers will be provided. Furthermore, in the future research, researchers will be able to use the scale for examining the relations between the students' approaches and other variables (e.g., epistemological beliefs and metacognitive beliefs), and for making international comparisons and comparisons among disciplines (e.g., physics, chemistry, and biology). It is also important to have the scale in Turkish education system that is dominated by the exams that direct students to adopt surface motives.

The present study differs from other research studies investigating the relation of students' approaches to learning to their perceptions of learning environment and goal orientations in various aspects. In the related literature, relations among approaches to learning, perceptions of learning environment and goal orientations have been investigated by using simple correlation or regression analyses in different studies. On the other hand, in the current study, the relations proposed by studies were taken into account together and examined in one model. This enabled us to see direct and indirect relations among the variables of the study. Dividing relations into direct and indirect ways led us to find mediating variables out. Determining mediating variables increased the effectiveness of treatments aiming at improving the particular variables. For example, in this study, it was observed that students' goal orientations mediated the relation of their perceptions of learning environment to their approaches to science learning. Students' endorsement of mastery approach goals increased the effect of their perceptions of learning environment on their approaches to learning science. Put it differently, students perceived the learning environment to be more constructivist led students to endorse mastery approach goals which increased the possibility of using deep approaches to learning. Furthermore, this result points out that the treatment aiming at promoting students' approaches to learning by promoting students' perceptions of learning environment should consider their goal orientations as well since the success of that treatment also depends on improvement of students' goal orientations.

Researchers can design experimental studies using the results of this study. The relations observed in this study can be tested using experimental research approach. For example, as explained before, students reported that when students perceived learning environment in more constructivist way, they preferred deep approaches to learning and set mastery approach goals. These findings can be tested by investigating the impacts of the instructional methods based on constructivist learning theory. Moreover, the reforms that have been made in the last 10-15 years are based on constructivist learning theory. Based on results of the present study, the implication of the new curricula and its impacts on students' approaches to learning and goal orientations can be investigated with longitudinal studies.

As explained above, the results of this study showed the importance of promoting students' classroom learning perceptions and goal orientations in science for improving their approaches to learning science. Science instructions and curricula should provide more constructivist and student-centered learning environments to promote students' perceptions about learning context. Baeten, Kyndt, Struyven, and Dochy (2010) made a review of research studies to determine encouraging and discouraging factors in promoting the use of deep approaches to learning in student-centered learning environments. They found that when teachers are involved in students and try to change students' conceptions, students tend to use deep approaches to learning. They also pointed out that when students fulfilled with the quality of course in terms of appropriateness of workload/assessment, teaching, and clarity of goals, they adopt deep approaches to learning. Similarly, Almeida et al. (2011) suggested that for a successful constructivist-learning environment, teachers should be systematic guide to students. From this point, in pre and in-service teacher education, necessary information about the constructivist learning environment and importance of creating that environment should be provided. This type of training will also serve for a better practice of new curricular programs.

As this study and other related studies revealed, that students endorse performance-based goal orientations lead them to adopt surface approaches to learning. One reason for setting performance approach goals might be overemphasis on normative comparison of students' grades in exams. Due to the education system in Turkey, the goals of students are basically performance goals (e.g., to get a higher score than other students in the university entrance exam) rather than mastery approach ones. Focusing on the questions asked in the previous entrance exams, solving them, and studying only on the topics from which questions asked remove students from developing mastery approach goals. Teachers can help students adopt mastery-approach goals by not focusing on normative performance of students so much and they should ensure students that the most important goals in learning tasks is to learn material deeply. Asking the questions assessing deep learning of content in school-based exams can be a tool for engaging students in setting mastery approach goals. Furthermore, teachers should help students feel the joy of learning and inquiring. To be able to do that, teachers should be trained about the importance of the variables and their influence on students' learning. In the seminars given both at the beginning and end of the academic year, it can be possible to train teachers who have a direct contact with students.

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Appendix 1. The Turkish Version of Approach to Learning Science Scale

Maddeler	Kesinlikle katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle katılıyorum
1. Fen konularına çalıştığım zamanlar, gerçekten kendimi mutlu ve doyuma ulaşmış hissediyorum.					
2. Fen konuları üzerine kendi başıma çalışmayı sevdiğim için kendi sonuçlarımı oluşturur ve kendimi hoşnut hissederim.					
3. Fen sınavlarından aldığım düşük bir not cesaretimi kırar. Bu yüzden, sonraki sınav hakkında kaygılanmaya başlarım.					
4. Sınavda çıkma olasılığı düşük olan fen konularını öğrenmeyi gerekli görmem.					
5. Boş zamanımın büyük bir kısmını, fen derslerinde tartışılan ilginç konuları daha çok öğrenmek için harcarım.					
6. Fen derslerinde öğrendiklerimi diğer derslerde öğrendiklerim ile ilişkilendirmeye çalışırım.					
7. Fen sınavlarına çok çalışsam bile, sınavım çok iyi geçmeyebilir diye kaygılanırım.					
8. Gerçekten kendimi verdiğimde fen konularının son derece ilginç olabileceğini hissediyorum.					
9. Fen derslerine, zihnimde cevaplanmasını istediğim sorularla gelirim.					
10. Gelecekte daha iyi bir meslek sahibi olabilmek için fen derslerinde başarılı olmak isterim.					
11. Fen konularını öğrenirken, her bir konuyu derinlemesine çalışmayı yararlı ya da gerekli bulmam. Geçilmesi gereken çok sayıda sınav ve öğrenilmesi gereken çok fazla konu var.					
12. Fen konularına çalışırken konuyla ilgili yeni öğrendiklerimi önceden öğrendiklerimle ilişkilendirmeye çalışırım.					
13. Sınavları geçecek kadar yeterli olduğumu hissettiğim sürece, fen derslerine çalışmaya mümkün olduğunca az zaman harcarım. Zamanımı harcayabileceğim çok daha ilginç şeyler vardır.					
14. Fen derslerinde öğrendiğim konuları anlamak için kendi kendime sorular sorabilirim.					
15. Fen derslerinin içeriğini ilginç bulduğum için bu derslere çok çalışırım.					
16. Fen derslerinde olmadığım halde fen derslerinde işlediğimiz konuları devamlı gözden geçirdiğimi fark ediyorum.					
17. Fen derslerindeki performansımın, öğretmenimin beklentilerini karşılayamayabileceğinden endişe duyarım.					
18. Fen konularını öğrenirken, birbiri ile çelişen bilgileri uyumlu hale getiren teoriler kurmayı severim.					
19. Ailemi ve öğretmenimi mutlu edebilmek için fen derslerinde başarılı olmak isterim.					
20. Fen derslerine girmeyi her zaman dört gözle beklerim.					
21. Fen kitaplarında okuduklarımın ne anlama geldiğini anlamaya çalışırım.					
22. Genellikle çalışmamı ne söylendi ise onunla sınırlandırırım. Çünkü bence fen konularını öğrenmek için ekstra bir şeyler yapmak gereksizdir.					
23. Fen derslerinde öğrendiğim konuları ilişkilendirmeye çalışırım.					
24. Fen sınavlarını geçmenin en iyi yolunun çıkabilecek soruların cevaplarının ezberlemesi olduğunu düşünüyorum.					