Eurasia Journal of Mathematics, Science & Technology Education, 2016, **12**(2), 233-247

Student Motivation in Constructivist Learning Environment

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•*Received 20 January 2015• Accepted 25 May 2015 • Published online 27 Oct 2015*

The purpose of this study was to investigate the relation between constructivist learning environment and students' motivation to learn science by testing whether students' self-efficacy in learning science, intrinsically and extrinsically motivated science learning increase and students' anxiety about science assessment decreases when more opportunities for personal relevance, student negotiation, shared control, critical voice, and uncertainty for scientific knowledge is provided. Constructivist Learning Environment Survey and Science Motivation Questionnaire were administered to 243 elementary school students. The hypothesized model for students' motivation to learn science in their perceived learning environment was tested via LISREL. The results revealed that the students were negatively motivated to learn science in more constructivist learning environment. On the other hand, the findings indicated that the students were more motivated to learn science when they had more opportunities in relating science with the real world issues. Therefore, science educators should emphasize more on the connectedness of science at school to real life for motivating students to learn science.

Keywords: constructivist learning environment, motivation to learn, science education

INTRODUCTION

> "The most important attitude that can be formed is that of desire to go on learning."
>
> John Dewey (Experience and Education)

The notion of a constructivist learning environment originates from the instructional imperatives of the likes of John Dewey, Jean Piaget, Lev Vygotsky, and Howard Gardner. It is hypothesized that based on constructivism, learning is an active process of constructing knowledge based on learner's experiences (von Glaserfield, 1989; pg.162-163) and this construction of knowledge is done subjectively and metacognitively. Constructivism theory focuses on the learner's experiences of the real world, prior knowledge, mental structures and beliefs, emphasize knowledge construction, and meaningful context (Jonassen, 1991). Therefore, the constructivist learning environment enhances learners to interact with knowledge and each other using various tools and emphasizes on the learning

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doi: 10.12973/eurasia.2016.1399a

ISSN: 1305-8223

environment where learning occurs rather than instruction itself (Wilson, 1996). Wilson (1996, p.6) also stated that in a constructivist learning environment the teacher is to act as a facilitator and guide learners to achieve learning goals.

The studies investigated the association between student outcomes and their perceptions of the classroom environment have revealed consistently associated student outcomes with the classroom environment (Goh & Fraser, 2000). The vision of the science education curriculum in Turkey is to educate students as scientific literate citizens. A science-literate person is a capable of understanding the fundamental scientific concepts; know how to find and assess scientific information, collaborative, self-confident with the attitudes knowledge, perceptions, skills, and values (Science Education Program, 2013). In order to determine students' perceptions of their classroom environment the Constructivist Learning Environment Survey (CLES) was considered to be an ideal instrument to administer in the current study because of measuring the critical dimensions of constructivist learning environment: personal relevance in their studies, shared control over their learning, feel free to express concerns about their learning, interaction with each other to improve their learning, scientific knowledge is viewed as ever changing (Taylor, Fraser, & Fisher, 1997). Fraser (2001) made an emphasis on the importance of student perceptions of the classroom environment and promote to the use of the questionnaires. Pintrich, Marx and Boyle (1993) explained the learning environment structures which are task structures, authority structures, evaluation structures, classroom management, teacher modeling and teacher scaffolding. These structures quite similarly correspond to constructivist learning environment dimensions.

If the aim of science education is to go beyond rote memorization and enable meaningful understanding, student motivation must be also concerned in the constructivist learning environment. It is stated that there was a relationship between students' perceptions of classroom environment and student cognitive and affective outcomes (McRobbie & Fraser, 1993; Pintrich, Marx, & Boyle, 1993; Pintrich & Schunk, 2002) such as attitudes towards science (Aldridge & Fraser, 2008; Fraser, 2012; Simpson & Oliver, 1990). In this environment through constructivist teaching approaches, learners freely voice their own thoughts and share their opinions. Lately, studies have focused on the affective domain of learning such as motivation along with the cognitive domain such as student conceptions. Palmer (2005) mentioned that motivation is both pre-requisite and co-requisite for learning based on the constructivism. In this manner, Brophy (1998) stated that

State of the literature

- The studies in science education have revealed that student motivation affects their science learning.
- The studies in science education have also revealed that constructivist learning environment is effected on students' science learning.
- Yet there is a gap in science education literature that whether these constructs are related to each other; therefore, this study aims to reveal the relation between constructivist learning environment and students' motivation to learn science by testing whether students' self-efficacy in learning science, intrinsically and extrinsically motivated science learning increase and students' anxiety about science assessment decreases when more opportunities for personal relevance, student negotiation, shared control, critical voice, and uncertainty for scientific knowledge is provided.

Contribution of this paper to the literature

- The relation between constructivist learning environment and students' motivation to learn is not clear in literature. It is hypothetically stated that constructivist learning environment is student-centered therefore students should be more motivated to learn science; this study focuses to state a proof for this hypothesis via modeling approach.
- Constructivist Learning Environment Scale and Science Motivation Questionnaire were used to gather the data from elementary school students. These two instruments were used to test the hypothesis.
- The model puts forth the science education literature that student motivation to learn science is affected by student perceptions of learning environment and makes a contribution to the research literature in this field.

when students are concentrated on the tasks rather than fear of failure, they would be more motivated to learn content; since students involve actively in learning process and they use their prior knowledge, interests and goals for meaningful learning in the constructivist learning approaches, students' fear of failure decrease with increasing self-efficacy.

Students often think that science they learn at school is not related to their everyday life. When learning is related real world issues, student motivation may increase to learn science since they own these issues and dilemmas. In other words, motivation is sustained through real world issues and projects (Barron et al., 1998; Doppelt, 2003; Jorde & Dillon, 2012; Krajcik, Blumenfeld, Marx, Bass, Fredricks, & Soloway, 1998). Similarly, in a constructivist learning environment, students are encouraged thoughtful reflection on experience, learn to analyze real world issues, learn how to investigate, enhance social negotiation, develop their collaboratively learning and inquiry skills, build communication skills, apply and integrate the content of different subjects, improve their learning strategies skills, and reach a collective outcome over a period of time (Author, 2012; Banchi & Bell, 2008; Yager, 2000). Therefore, based on the studies in the science education literature, it is hypothesized that the constructivist learning environment enhances student motivation to learn by consisting of student-centered approaches. Most of research on science learning has mainly focused on student conceptions (cognitively) rather than their motivation to learn (affectively). This research has been informative for science education literature by giving empirical evidences that student motivation to learn is affected by classroom environment.

Based on self-determination theory proposed by Ryan and Deci (2000) three fundamental and universal needs of people are the needs for competence, autonomy, and relatedness; and satisfaction of these needs provides the nutriments for motivation. Therefore, social environments that support these needs may enhance the development of motivation. Ryan and Grolnick (1986) reported that when students perceived more autonomy support in class, they have higher self-worth, cognitive competence, internal control, and mastery motivation. Giving control to the students helps to maintain students' interest and motivate them to take responsibility for their own learning. As constructivist learning environment dimensions are taken into consideration, which are personal relevance, shared control, student negotiation, and critical voice, the dimensions apparently cover the needs for motivation to learn.

According to Ryan and Deci (2000) for intrinsic motivation autonomy is crucial; in the constructivist learning environment studies students were actively involved in the activities, felt free in participation and involved in decision making procedure. Intrinsically motivated students seek out challenges and have aspiration to explore and learn. If a student believes that knowledge of science is important socially as well as academically, it is more likely for the student to have desire to learn scientific topics. Student negotiation enhanced in constructivist learning environment decreases student anxiety and students learn from one another with less anxiety. Learning science in constructivist learning environment is often challenging, but when students become responsible for their own learning, they learn how to motivate themselves. Extrinsically motivated students tend to engage in academic tasks that do not require deep understanding since they seek rewards or look for social approval, do not prefer challenging issues in fact prefer easy ones, and depend on teachers for feedback (Pintrich & DeGroot, 1990; Meece, Blumenfeld, & Hoyle, 1988; Ryan & Deci, 2000).

Student learning is affected by motivation, student give importance for the information that will be valuable in the future (Bandura, 1997; Bouillion & Gomez, 2001; Crawford, 2000). Self-efficacy, one of the basic constructs in student motivation, is affected on student's choice of activity, persistence and effort (Bandura, 1997; Schunk, 1995). It was defined as "beliefs in one's capabilities to organize and execute courses of action required to produce given attainments" (Bandura, 1997, p. 3). Students are more likely to engage in activities in which they feel efficacious. In other words, students need self-efficacy for learning material before they will engage in strategic effort (Schunk, 1995). When students have high self-efficacy and feel that they will be successful in tasks, they become more motivated to reach the goals. As Pintrich and DeGroot (1990) reported students with high self-efficacy tend to persist more toward achieving their goals. In addition, it has been reported that self-efficacy is one of the strong predictors of academic performance within the motivational constructs (Bandura, 1997, 2000; Schunk, 1995; Wigfield, 1994; Zimmerman, 1998). As Hampton and Mason (2003) support that students in a learning environment embedded with real-life issues tend to express positive self-efficacy beliefs on that curriculum subject. Furthermore, as Linnenbrink and Pintrich (2003) stated for meaningful learning and improved self-efficacy, students should be motivationally engaged in learning process as well as cognitively and behaviorally engagement.

Research question of the study

Although learning environment is closely related to student motivation, there is a gap in science education literature that whether constructivist learning environment and students' motivation to learn science variables are related to each other; hence, this study aims to reveal the relation between constructivist learning environment and students' motivation to learn science by testing whether students' self-efficacy in learning science, intrinsically and extrinsically motivated science learning increase and students' anxiety about science assessment decreases when more opportunities for personal relevance, student negotiation, shared control, critical voice, and uncertainty for scientific knowledge is provided. Accordingly, the research question of the study is as the following:

- What is the relation between students' motivation to learn science and their perceptions of learning environment?

METHODOLOGY

Sample

The sample of the study consisted of 243 elementary school students from a public school in Turkey. Three different grade level students participated into the study (Table 1); the number of sixth graders was 115 (47.3%), seventh graders were 57 (23.5%), and eighth graders were 71 (29.2%). In the current study, the school was selected conveniently. The students' socioeconomic level was similar and their age range was between 12-14 years old.

There were three science education teachers in the elementary school. All teachers have nearly same years of experience in teaching, about 10-15 years. They use the same curricula while teaching science which is based on the constructivist approach (Science Education Program, 2013).

Table 1. The number of students across their grade level and gender

	Grade Level			
Gender	**6**	**7**	**8**	**Total**
Female	52	24	32	108
Male	63	33	39	135
Total	115	57	71	243

Instruments

Constructivist Learning Environment Survey (CLES)

The survey was developed by Taylor, Fraser and Fisher (1997) to assess constructivist classroom environment and the revised form of the instrument by Johnson and McClure (2004) was used in this study with 20 items considering five dimensions: Personal Relevance (PR), Shared Control (SC), Student Negotiation (SN), Critical Voice (CV), and Uncertainty (UN). PR dimension aimed to assess student perceptions of the classroom environment with their everyday experiences. SC dimension illustrated students' involvement in constructivist learning environment and express their thoughts about shared control in learning process. SN dimension focus to assess students' opportunities of student-student interaction for improving their learning. CV dimension illustrated student perceptions about social climate in the classroom environment to ask questions and express their thoughts or concerns about learning. And lastly, UN dimension aimed to assess student perceptions about tentative nature of science and their experience in uncertainty of scientific knowledge. The following sample items are from CLES instrument, each item representing a different dimension:

a) In this science class, I learn about the world outside the school. (PR)
b) In this science class, I help the teacher to plan what I am going to learn. (SC)
c) In this science class, I ask other students to explain their ideas. (SN)
d) In this class, it is OK to ask the teacher 'Why do we have to do this?' (CV)
e) In this science class, I learn that views of science have changed over time. (UN)

The responses were in five-point scale: Almost Never, Seldom, Sometimes, Often, and Almost Always; and they were scored from 1 to 5, respectively. Using the CLES, the elementary science students were expected to express their thoughts about their science classroom environment. The higher score in each dimension showed more constructivist learning environment. This CLES instrument has been validated in several countries including Australia (Taylor, Fraser, & Fisher, 1997), Korea (Lee & Taylor, 2001), the USA (Nix, Fraser, & Ledbetter, 2003), Taiwan and Australia (Aldridge, Fraser, Taylor, & Chen, 2000), and Turkey (Uysal, 2010). The Turkish translated and adapted version of the instrument by Uysal (2010) was conducted to elementary school students in this study.

Confirmatory factor analysis (CFA) was conducted to provide evidence for the construct validity of the instrument whether the expected five dimensions of the survey (PR, SC, SN, CV and UN) were confirmed with the study of the data. Structural equation modeling technique was used to evaluate the proposed model (Jöreskog & Sörbom, 1993). The point estimate of RMSEA was found as .0, which was below 0.05 and the upper confidence limit was .059. The other fit indices were SRMR= .039, GFI= .97, and AGFI= .91. Another indication that the model fitted well was that the ECVI for the model (0.10) was less than the ECVI for the saturated model (0.12). Therefore, it could be concluded that the model fitted well and represented a reasonably close approximation in the population. Reliability analysis with regard to the internal consistency yielded Cronbach alpha coefficients of .62 for the PR, .64 for the SN, .73 for the SC, .61 for the CV, and .56 for the UN, indicating satisfactory reliability.

Science Motivation Questionnaire (SMQ)

The translated and adapted version of SMQ, which was developed by Glynn and Koballa (2006) to assess their motivation to learn science, was used in the present study (Authors, 2015). There are four motivational constructs covering the SMQ: self-efficacy in learning science (SE), anxiety about science assessment (Anx), extrinsically motivated science learning (ExM), and intrinsically motivated science learning (InM). The questionnaire consisted of 30 items in five-point scale: Never, Rarely, Sometimes, Usually, and Always; and they were scored from 1 to 5, respectively. The following sample items are from SMQ instrument, each item representing a different construct:

a) I believe I can master the knowledge and skills in the science course. (SE)
b) I become anxious when it is time to take a science test. (Anx)
c) Earning a good science grade is important to me. (ExM)
d) I find learning the science interesting. (InM)

Motivation is defined by Glynn et al. (2009):

> The internal state that arouses, directs, and sustains students' behavior towards achieving certain goals. In studying the motivation to learn science, researchers attempt to explain why students strive for particular goals, how intensively they strive, how long they strive, and what feelings and emotions characterize them in this process. (p. 128)

Self-efficacy construct was focused on students' confidence about their ability to succeed in science. Anxiety about science assessment dimension illustrated student anxiety in science assessment. Intrinsically motivated students to learn science feel the joy of learning that occurs when they are concentrated intensely on the task at hand, but extrinsically motivated students to learn science may be more concentrated to receive an award such as high grade.

The CFA was conducted to test the proposed model with the expected four constructs of the questionnaire (SE, Anx, ExM, and InM). The point estimate of RMSEA was found as 0.0. The other fit indices were SRMR= .024, GFI= .99, and AGFI= .97. Another indication that the model fitted well was that the ECVI for the model (0.074) was less than the ECVI for the saturated model (0.083). Therefore, it could be concluded that the model fitted well and represented a reasonably close approximation in the population. Reliability analysis with regard to the internal consistency yielded Cronbach alpha coefficients of .89 for the SE, .63 for the Anx, .76 for the ExM, and .44 for the InM indicating moderated satisfactory reliability.

Analysis of the data

The sample size used in this study is 243; which is adequate based on either considering the rule of 10 (the calculated minimum sample size is 90 for the analysis in this method) or the ratio of indicators to latent variables (the calculated minimum sample size is 88 for the analysis in this method) (Westland, 2010). The data gathered from both instruments (CLES and SMQ) were entered into the statistics software by coding within students' responses to the items. For getting descriptive and inferential statistics, SPSS was used. Inferential statistics gives the results about the effectiveness and significance of variables such as science achievement, grade level and gender on students' perceptions of learning environment and their motivation to learn science. Based on these results, the variables to be set in the hypothesized model was determined. In order to test the hypothesis, the Structural Equation Modeling was conducted by using LISREL 8.7. Model generating strategy was taken into account for testing the hypothesized model; by this strategy, modifications is set when there is inappropriateness until having meaningful interpretations between the variables (Jöreskog & Sörbom, 1993).

RESULTS

Results on CLES

Descriptive statistics related to the CLES is presented in Table 2. The possible maximum score for each dimension was 20 and the minimum was 5. The highest

Table 2. Descriptive statistics about the dimensions of the CLES and science achievement

	PR	SN	SC	CV	UN	SCIENCE
N	240	240	242	240	242	237
Mean	16.18	13.64	12.22	15.38	14.47	3.88
Standard deviation	2.71	3.34	3.66	3.03	3.01	.79
Skewness	-.87	-.24	-.19	-.442	-.34	-.40
Kurtosis	.89	-.33	-.48	-.36	.45	.11

Table 3. The mean scores of the CLES dimensions across gender and grade level

		6th grade	7th grade	8th grade	Total
PR	Female	16.90	15.75	16.62	16.55
	Male	16.67	15.85	15.00	15.95
SN	Female	13.73	12.87	14.00	13.61
	Male	13.83	13.70	13.72	13.76
SC	Female	12.65	12.29	11.37	12.17
	Male	11.91	12.82	12.12	12.22
CV	Female	15.48	15.25	16.25	15.66
	Male	15.23	14.83	15.46	15.19
UN	Female	15.02	13.58	14.47	14.52
	Male	14.49	14.27	14.13	14.33

score within dimensions was for the PR, which indicated that the students were aware of the science they have learned in school was quite related to the world outside the classroom. The revised science education curriculum made an emphasis on real-life events in science education; therefore this emphasis on relevance with real-life had an effect on classroom environment. The lowest score was for the SC, which indicated that the students were not much involved in the design of the instruction; on the other hand, the mean score of the dimension was above the half-point and it could be said that the students viewed their classroom environment somewhat constructivist but not as much as the other four dimensions. Therefore, it could be concluded that since the mean scores of the five dimensions were above the half-point, the view of the students about their classroom environment were more constructivist considering all dimensions; PR, SN, SC, CV, and UN.

Descriptive statistics about the students' academic science achievement were also presented in Table 2. The lowest grade in the grading system is 1 and the highest grade is 5. The students' previous semester's science scores were asked to get science scores.

The mean scores of the CLES dimensions across gender and grade level were presented in Table 3. Gender was coded with 1= female (n=108) and 2= male (n=135). Multivariate analysis of variance was generated to check the students' differences in student perceptions of the learning environment by academic achievement, gender and grade level. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity, with no serious violations noted. The results of multivariate analysis revealed a significant main effect for science achievement (Wilks' Lambda= .845, $F(15,555)=2.32$, $p=.003$, partial $\eta 2=.054$), suggesting that the students at different science achievement differed on a linear combination of the five dimensions of the CLES. The partial eta squared of .054 would be interpreted as a medium effect (Cohen, 1988). When the results for the dependent variables were considered separately, the only difference to reach statistical significance was PR, SN, and CV dimensions on student science achievement.

The follow-up univariate analysis indicated that there was a significant mean difference among the students' science achievement scores on the PR dimension, $F(3, 205)= 5.84$, $p=.001$, partial $\eta^2=.079$. The students with the highest science achievement score of five (M= 17.36, SD= 1.90) were more aware of the science they learn in school was relevant into their everyday life than the students with science score of two (M= 14.11, SD= 4.11) and the students with science score of three (M= 15.40, SD= 2.81). In addition, there was a significant mean difference among the students' science achievement scores on the SN dimension, $F(3, 205)= 5.20$, $p=.002$, partial $\eta^2=.071$. The students with the highest science achievement score of five (M= 14.84, SD= 2.99) perceived more student-centered learning environment in which they interact with each other than the students with science score of two (M= 10.89, SD= 4.28). Also, there was a significant mean difference among the students' science achievement scores on the CV dimension, $F(3, 205)= 5.50$, $p=.001$, partial $\eta^2=.074$. The students with the highest science achievement score of five (M= 16.52, SD= 2.57) felt more free to ask questions or explanations than the students with science score of three (M= 14.55, SD= 3.31). Furthermore, the main effect neither for gender ($F(5,201)= .612$, $p= .691$, partial $\eta^2=.015$) nor for grade level ($F(10,402)= 1.353$, $p= .200$, partial $\eta^2=.033$) were significant. There were no significant interaction between science score and gender (Wilks Lambda= .923, $F(15,555)= 1.097$, $p= .356$, partial $\eta^2=.027$), science score and grade level (Wilks Lambda= .894, $F(25,748)= .912$, $p= .589$, partial $\eta^2=.022$), gender and grade level (Wilks Lambda= .962, $F(10,402)= .787$, $p= .641$, partial $\eta^2=.019$) , and science score, gender, and grade level (Wilks Lambda= .890, $F(25,748)= .957$, $p= .524$, partial $\eta^2=.023$).

Results on SMQ

Descriptive statistics related to the SMQ is presented in Table 4. The possible maximum score for each dimension was 65 and the minimum was 4. The highest score within dimensions was for the ANX, which indicated that the students felt low anxiety about science assessment (4.67 out of 5). This dimension includes reverse coded items; higher scores are interpreted as low anxiety about science assessment. The lowest score within dimensions was for the InM (3.8 out of 5), indicating that the students were less intrinsically motivated to learn science; in other words, they were less concern about their learning science. As the other dimensions of the SMQ were examined, it could be interpreted that the students were generally quite motivated to learn science.

Multivariate analysis of variance was generated to check the students' differences in student motivation to learn science by academic achievement, gender and grade level. The mean scores of the SMQ dimensions across gender and grade level were presented in Table 5. Preliminary assumption testing was conducted and no serious violations detected. The results of multivariate analysis revealed no significant

Table 4. Descriptive statistics about the dimensions of the SMQ

	SE	Anx	ExM	InM
N	235	235	240	237
Mean	23.11	16.80	15.68	9.48
Standard deviation	8.04	4.56	4.97	2.93
Skewness	1.12	.13	.56	.29
Kurtosis	1.46	-.45	.09	-.01

Table 5. The mean scores of the SMQ dimensions across gender and grade level

	6th grade		7th grade		8th grade	
	Female	Male	Female	Male	Female	Male
SE	21.75	23.31	25.08	22.21	21.06	25.72
ANX	16.31	17.78	17.46	17.94	14.72	16.26
INM	15.29	15.76	17.39	15.22	14.62	16.31
EXM	9.39	9.53	11.08	9.64	8.72	9.05

interaction between science score and gender (Wilks Lambda= .961, $F(12,500)=.627$, $p= .820$, partial $\eta^2=.013$), science score and grade level (Wilks Lambda= .922, $F(20,627)= .774$, $p= .747$, partial $\eta^2=.020$), gender and grade level (Wilks Lambda= .960, $F(8,378)= .977$, $p= .454$, partial $\eta^2=.020$) , and science score, gender, and grade level (Wilks Lambda= .917, $F(20,627)= .829$, $p= .679$, partial $\eta^2=.021$). Because there were no significant interactions, the main effect scores were explored. There was a significant main effect for science achievement (Wilks' Lambda= .747, $F(16,578)=3.626$, $p=.000$, partial $\eta^2=.070$), suggesting that the students at different science achievement differed on a linear combination of the four constructs of the SMQ with a medium effect. In addition, the main effect neither for gender ($F(4,189)= .961$, $p= .430$, partial $\eta^2=.020$) nor for grade level ($F(8,378)= .860$, $p= .551$, partial $\eta^2=.018$) were significant. When the results for the science achievement was considered separately, the differences to reach statistical significances (using a Bonferonni adjusted alpha level of .0125) were self-efficacy in learning science ($F(4,192)= 8.827$, $p=.000$, partial $\eta^2=.155$), anxiety about science assessment ($F(4,192)= 5.083$, $p=.002$, partial $\eta^2=.76$), and extrinsically motivated science learning ($F(4,192)= 3.911$, $p=.004$, partial $\eta^2=.075$). Based on the post-hoc comparisons using Bonferroni tests contradictory results were obtained between students' self-efficacy in learning science and their science grade, an inspection of the mean scores indicated that the students with the score of two (M=30.44, SD= 11.23), with the score of three (M=24.79, SD= 7.31), and with the score of four out of five (M=23.08, SD= 8.05) were more self-efficacious in learning science than the students with the score of five (M= 18.70, SD= 4.79). In addition, the post-hoc comparisons using Bonferroni test for anxiety about science assessment indicated that the mean score for the students with the science score of two (M=15.22, SD= 6.34) and the mean score for the students with the science score of four (M=16.25, SD= 4.84) were significantly different from the students with the science score of five (M=18.66, SD= 4.10); in other words pointing out that the successful students were less anxious about science assessment.

To sum up the results, there were three independent variables in the analysis, the students' science achievement scores, gender, and grade level. The results indicated that only the students' science achievement scores was effective variable both on the CLES and SMQ. In other words, the students' perceptions of learning environment and motivation to learn science did not differed by gender or grade level; only the success on science was effective variable that made difference on the students' perceptions of learning environment and motivation to learn science.

A model between constructivist learning environment and motivation to learn science

Analysis via LISREL for Windows with SIMPLIS command language of the hypothesized structural model revealed a GFI of .86, a CFI of 1.00, an AGFI of .77 and a RMSEA of .00. These indices indicate a reasonable fit of the model with the data (See Table 6 for goodness-of-fit indices). The χ^2 analysis also suggested that the hypothesized model fits the data reasonable well, ($\chi^2=170.75$), the division of χ^2 by

Table 6. Goodness-of-fit indices of the constructivist learning environment and student motivation to learn science

Index	Value	Cutoff criteria
NFI	.98	≥.95
NNFI	1.05	≥.95
GFI	.86	≥.95
AGFI	.77	≥.95
RMSEA	.00	<.05
SRMR	.13	<.08

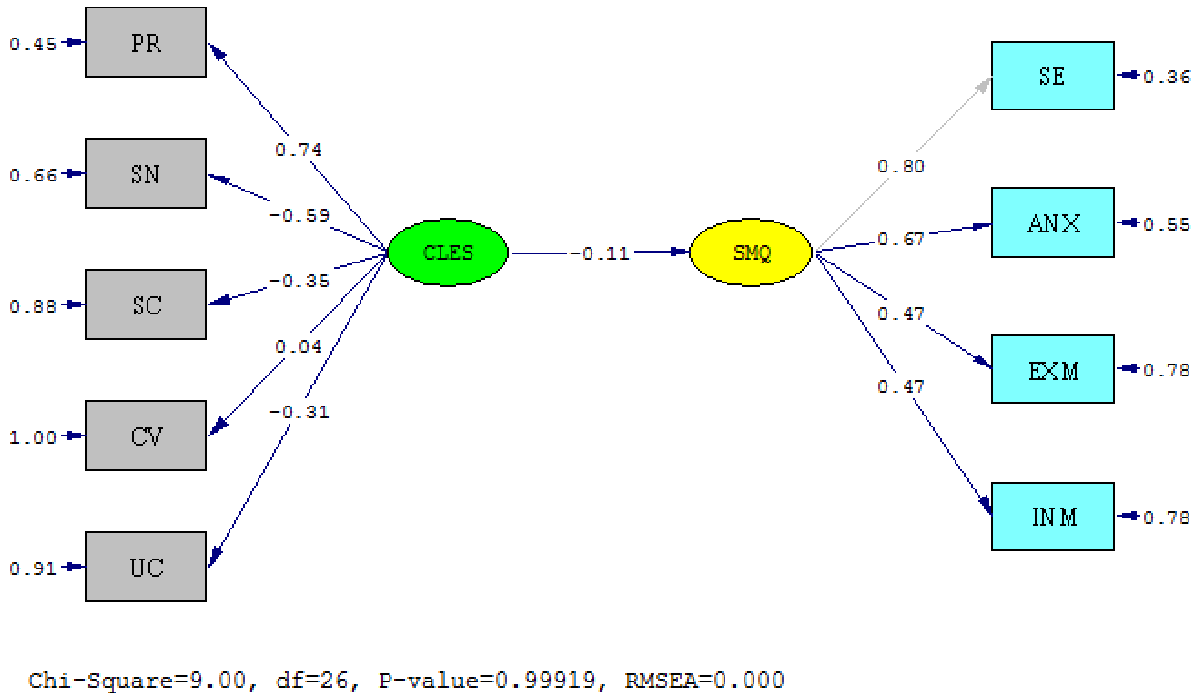

Figure 1. Path analytical model with standardized solutions

Table 7. Measurement coefficients of the model

Latent variables	Observed variables	λ
CLES	PR	.74
	SN	-.59
	SC	-.35
	CV	.04
	UN	-.31
SMQ	SE	.80
	ANX	.67
	INM	.47
	EXM	.47

the degrees of freedom (df=26) of the hypothesized structural model was suggesting the moderate fit (χ^2/d=6.57). In addition, it is found as suggested that the model AIC (47.00) and CAIC (132.37) values are smaller than independence values (504.23 and 544.67, respectively) and saturated values (90.00 and 292.19, respectively).

The path analytical model showing the relations between students' perceptions of learning environment and their motivation to learn science is shown in Figure 1. Considering student motivation to learn factor, the most effective variable with a large effect that explains this factor is self-efficacy (R^2=.64) and in terms of students' perceptions of learning environment factor, this factors is mostly explained by personal relevance variable (R^2=.55) with a large effect (See Table 7 for measurement coefficients of the model). The correlation coefficients in the model are interpreted based on Cohen's suggestions (1988). Based on his suggestions, the values of correlation coefficients less than .10 indicates a small effect, around .30 a medium effect, and above .50 a large effect. The path model gives also the effect of students' perceptions on student motivation to learn science and it can be interpreted that as the constructivist learning environment is enhanced in the classroom environment, their motivation to learn science decrease.

DISCUSSION AND IMPLICATIONS

In the constructivist learning environment, students are active learners in the learning environment, conduct activities for promoting learning, collaborate with peers during the learning process, take responsibility in the learning environment, are free to express their ideas and thoughts about classroom environment, and etc. Therefore, it was hypothesized that the constructivist teaching approaches positively affect student motivation to learn science. In order to test the hypothesized model Constructivist Learning Environment Survey (CLES) and Science Motivation Questionnaire (SMQ) was used in this study. For increasing the validity and reliability of the model, both instruments' inferential statistics were conducted. Based on these results, it was found that the students' perceptions of learning environment and motivation to learn science affected their science scores; therefore, only these factors (CLES and SMQ) was included into the model, the other variables (gender and grade level) was excluded from the model.

The hypothesized model was tested suggesting that students' self-efficacy in learning science, intrinsically and extrinsically motivated science learning increase; and students' anxiety about science assessment decreases as providing more opportunities for personal relevance, student negotiation, shared control, critical voice, and uncertainty for scientific knowledge. However, the hypothesized model was not approved with the collected data. The path model in this study showed that the students' motivation to learn science decreased when more constructivist learning environment was perceived by the students. The reasons of this could be varied; one of the reasons could be that the students are accustomed to learn subjects in traditional manner since primary school in the Turkish Education System where the teacher-centered instruction is oriented and negative effects on student motivation could emerge when students take more responsibility in learning environment.

On the other hand, when the path model is explored in details, it was seen that as providing more opportunities for personal relevance in classroom environment to the students, their motivation to learn science was positively affected. The personal relevance variable was the most effective variable in the model on CLES factor and its positive affect on student motivation to learn science was undeniable. The similar finding was found in the study by Ozkal, Tekkaya and Cakiroglu (2009) that the elementary school students scored at the highest rate for the personal relevance variable by giving the most emphasize to relevance to everyday life. In addition, Sjøberg and Schreiner (2012) stated that school science should be context-based; in other words some scientific issues could be applied and relevant in one context but not in another. The findings of this study also support this claim that personal relevance of students to scientific issues could be locally, appropriate local scientific issues could be discussed in classroom environment with students in order to increase their awareness to science and purpose of science learning.

Accordingly, this result is quite reasonable in terms of motivation as well since the self-efficacy variable was the most effective variable (with the large effect size) on the student motivation to learn science in this study. Student self-efficacy reflects student confidence about their ability to succeed in science and personal relevance reflects student perceptions of the classroom environment with their everyday experiences. Bandura (1997) also stated that self-efficacy beliefs influence effort and persistence. When students apprehend that science they have learnt at school is quite relevant to their everyday experiences, their negative feelings on learning science could decrease and be more confident in learning science. Therefore, science teachers (also specifically biology, chemistry and physics teachers) in schools should reveal how science at school is related to real life by conducting more activities based on everyday experiences or metacognitive strategies to increase students' self-efficacy (Kirbulut, 2012; Pintrich & Garcia, 1991; Sungur, 2007). Previous studies also revealed that students' self-efficacy beliefs are positively related to strategy use; teachers could use more constructivist teaching methods (Britner & Pajares, 2006; Kirbulut, 2012; Schunk & Zimmerman, 2003) different than the regular classroom provides such as problem-based learning (for instance Dunlap, 2005), project-based learning (for instance Barron et al., 1998; Doppelt, 2003), or inquiry-oriented activities (Banchi & Bell, 2008). When students are actively engaged in learning environment and they are able to form better connections between the science they encounter in their textbooks and the science that is required to solve real-world issues (Yager & McCormack, 1989). The study of Milner and her colleagues (2011) revealed the increase of student motivation in life science laboratories via constructivist-based teaching practices in the elementary science classrooms.

The current Science Education Curriculum in Turkey is based on constructivism where student-centered instruction is conducted but the students' perceived learning environment was less constructivist than expected in terms of student negotiation, shared control and uncertainty for scientific knowledge. The students' perceived learning environment in classrooms should be increased to be more constructivist by especially giving more opportunities for students to collaborate with each other in the learning environment. Motivation is mentioned as an important co-requisite for learning based on constructivism (Palmer, 2005). Therefore, the present results revealed that if students are aware of science at school is quite connected to their real life, they are more motivated to learn science. Furthermore, the path model also showed that providing more opportunities for student negotiation, shared control, and uncertainty for scientific knowledge in classroom environment did not affect positively on the elementary school students' motivation to learn science as expected. Specifically, the student negotiation variable had a large effect on CLES and why students' motivation to learn science was negatively affected with providing more opportunities for interacting with each other is needed to be investigated. The students are accustomed to learn science in traditional manner; in other words, they are usually passive learners, listen their teacher, take notes and not engage actively in learning process in their primary school education. Hence, in terms of student negotiation, students might not feel confident and efficacious while actively involving into learning process. The reason of this, decrease in student motivation to learn, finding could be varied and additional follow-up studies should be conducted to get detailed information, specifically conducting interviews with students would help in detecting possible causes of decreasing motivation in constructivist learning environment.

This study has also some limitations in generalizing the findings. Although the sample size of the study statistically was adequate to conduct the analysis, the study was limited to 243 elementary school students. Sample size of the study could be increased and larger data could provide different results. For further research, classroom observation in the learning environments and interviews with students and teachers are needed to be done to investigate for the students' perceived and actual learning environment. The students' perceptions of their classroom environment were only in the focus of the study and the classroom observations or student/teacher interviews were not in the scope of this study; yet for more detailed findings additional data could be collected since science teachers' expertise and teaching methods may varied.

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