Full research paper

RELATIONSHIP BETWEEN STUDENT PERCEPTIONS OF A CONSTRUCTIVIST LEARNING ENVIRONMENT, AND THEIR MOTIVATIONAL BELIEFS AND SELF-REGULATION OF EFFORT

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ABSTRACT

The aim of this study is twofold: first, to determine gender-related differences in students' perceptions of a constructivist learning environment, their motivational beliefs, and self-regulation of effort in a science lesson; secondly, to explore the relationship between these concepts. The correlational research was employed in this study. The sample consists of 489 students from five public middle schools in a small city in Turkey. The Constructivist Learning Environment Survey was utilized to assess students' perceptions of their classroom learning environment in constructivist-oriented ways. The Students' Adaptive Learning Engagement in Science survey was used to assess students' motivation and self-regulation of effort in their science learning. The relationships between students' perceptions of a constructivist learning environment and their motivational beliefs and self-regulation of effort were examined using canonical correlation analysis. According to the canonical analysis, middle school students' perceptions of a constructivist learning environment are significantly related to their motivational beliefs and self-regulation of effort. Implications of these findings were discussed.

KEYWORDS

Constructivist learning environment, middle school students, motivational beliefs, self-regulation of effort

HOW TO CITE

Senler B. (2022) 'Relationship Between Student Perceptions of a Constructivist Learning Environment, and their Motivational Beliefs and Self-Regulation of Effort', *Journal on Efficiency and Responsibility in Education and Science*, vol. 15, no. 2, pp. 72-81. http://dx.doi.org/10.7160/eriesj.2022.150202

Article history
Received
February 4, 2021
Received in revised form
February 1, 2022
Accepted
Februrary 19, 2022
Available on-line
June 30, 2022

Highlights

- *Middle school students' perceptions of a constructivist learning environment, their motivational beliefs do not differ in terms of their gender.*
- *Middle school students' self-regulation of effort differs in terms of their gender.*
- *Middle school students' perceptions of a constructivist learning environment associates with their motivational beliefs.*
- *Middle school students' perceptions of a constructivist learning environment associates with self-regulation of effort.*

INTRODUCTION

The learning environment is an environment where learning occurs and consists of social, psychological, and pedagogical contexts that influence student achievement and students' attitudes (Fraser, 1998). In a constructivist learning environment, students use various tools and sources of information while achieving their guided learning goals, and they work together and support each other in this process (Wilson, 1996). The teacher acts as a coach and facilitator, guiding and directing students to achieve learning goals in this student-centered environment (Wilson, 1996). Students' experiences are considered important, and knowledge is structured through interaction and collaboration. The teacher acts as a guide, encouraging students to ask questions, produce their thoughts, and reach conclusions (Richardson, 1997). Teachers also help students create their own meaning by interacting and collaborating (Brooks and Brooks, 1999).

Considering that most learning occurs within the learning environment, it is no surprise that this environment plays a vital role in student learning outcomes. The significance of the classroom learning environment has been recognized and progressively studied over the last 40 years. Students' perceptions are a crucial subject of investigation in relation to the learning environment and, indeed, many studies have indicated a relationship between students' perceptions of their classroom learning environment and their affective and cognitive outcomes (e.g., Deiso and Fraser, 2019; Medson, 2020; Ngah, Junid and Osman, 2019; Taub et al., 2020; Topolovčan and Matijević, 2017).

The literature also emphasizes the importance of the relationship between students' learning environment and their motivational beliefs (e.g., Cetin-Dindar, 2016; Korpershoek et al., 2019; Kulakow, 2020). The constructivist learning environment is said to increase students' motivation and enable them to control the learning process. For example, by giving students autonomy and responsibility, the constructivist learning environment develops adaptive motivational beliefs (Ames, 1992).

Among the crucial motivational beliefs associated with the learning process are beliefs in self-efficacy, task value and learning goals (Pintrich and Schunk, 2002). Self-efficacy is defined as the judgments of individuals about their ability to organize and execute what needs to be done to achieve their target performance (Bandura, 1986). Self-efficacy beliefs determine individuals' thoughts, emotions, motivation and behavior (Pajares, 1997) and, hence, their choice of task and the effort and persistence they apply towards that task (Pintrich and Schunk, 2002). In other words, because people take action based on the belief that they can succeed, those with high self-efficacy invest more time and effort and show greater persistence than those with low self-efficacy.

Task value and learning goals are reasons why people engage in a task (Zimmerman, 2000). Task value, a key component of the expectancy-value model of motivation, refers to the learner's perception of the learning task's value regarding its interest, utility, and costs (Eccles and Wigfield, 2002). Learners are more likely to spend effort on learning and understanding a given task if they are interested in it (Wolters and Rosenthal, 2000). Even if they are low in self-efficacy, they are more likely to participate in and continue activities they feel are valuable (Schunk and Zimmerman, 2007). Perceived value influences behavior since learners give less attention in activities that they do not value (Eccles and Wigfield, 2002). Conversely, learners who think it results in positive outcomes are more likely to attempt an activity, even if they lack the self-efficacy required to perform well.

Learning goals include learners' perceptions of the reasons for performing a learning task. Individuals with a learning-goal orientation focus on processes and strategies that can increase their competence (Schunk and Zimmerman, 2006). In particular, individuals with a learning goal orientation focus on meaningful learning, understanding, and specialization. Studies have shown that learning goals and task values directly affect achievement and are positively correlated with metacognitive strategies such as planning and organizing learning (Sungur, 2007).

Another factor that affects the learning process is self-regulation, which refers to how learners activate and retain cognition, behavior, and effect to achieve their goals. Self-regulation includes cognitive processing, metacognitive thinking, and motivational beliefs (Pintrich and Linnenbrink, 2000). Learners with self-regulation skills are cognitive, motivational, and behaviorally active in their learning, setting goals, using appropriate strategies and effort to achieve them, and evaluating their learning processes and outcomes (McCoach and Siegle, 2003). Similarly, effort regulation relates to the tendency, despite potential diversion, to maintain focus on and effort towards a goal (Corno, 1994), which explains why individuals with self-regulation skills are more successful in their learning than passive and teacher-dependent individuals (Risemberg and Zimmerman, 1992).

There has been limited research on the association between students' perceptions of the classroom learning environment and their self-efficacy beliefs (e.g., Alt, 2015; Partin and Haney, 2012), learning goals (e.g., Poondej and Lerdpornkulrat, 2016; Sungur and Gungoren, 2009), and self-regulation (e.g. Sungur and Gungoren, 2009; Talan and Gulsecen, 2018). In these studies, learning environment was found to be related to self-efficacy beliefs, mastery goals, and self-regulation. Additionally, these concepts have not been studied in the last 10 years as much as earlier. However, changes in everything from lifestyle to technology influence generations' characteristics. For instance, as primary and middle school students, Generation Z (i.e. Next Generation, Digital Natives, iGen), can use technology better than the previous generations and adapt it to every aspect of their lives. Generation Z prefers to observe before doing, work alone, applied learning, and interpersonal learning (Seemiller and Grace, 2017). Generation Z needs more interaction, reinforcement of concepts with videos and cooperative learning in their class (Swanzen, 2018). Thus, the Z generation might differ from the previous generation in terms of perceptions, and beliefs, so these concepts need to be studied again.

To address the gap in the literature, the following research questions were sought:

Research Question 1: Is there a significant difference in students' perception of a constructivist learning environment, their motivational beliefs, and self-regulation of effort in a science lesson in terms of their gender?

Research Question 2: Is there a relationship between students' perception of a constructivist learning environment, their motivational beliefs, and self-regulation of effort in a science lesson?

MATERIAL AND METHODS

Participants

Convenience sampling, which involves individuals who are available conveniently, was utilized in this study. All of the middle schools in Mentese-Mugla in Turkey were enrolled in this study. Totally 489 students (259 females, 228 males, 2 not specified; mean age for both gender: 12.9 years) from the schools participated in the study. All of the schools are public schools affiliated with the Ministry of Education, and thus all the classrooms have similar characteristics in terms of class size, physical conditions, etc. Additionally, they all follow a standardized national curriculum. The university ethics committee approved the study, and the administrators of the participating schools and the parents of the participating students gave their informed consent.

Instruments

To explore the relationship between variables without any manipulation, correlational in other words associational research was employed in this study. Correlational research studies the possible relationships among two or more variables (Fraenkel, Wallen and Hyun, 2019).

Constructivist learning environment survey (CLES)

The Constructivist Learning Environment Survey (CLES) assesses student perceptions of the degree to which the classroom learning environment is constructivist-oriented. The original CLES was developed by Taylor and Fraser (1991). Johnson and McClure (2004) created a shortened and revised version, adapted into Turkish by Yilmaz-Tuzun, Cakiroglu and Boone (2006). The CLES consists of 5 scales - personal relevance, uncertainty, critical voice, shared control, and student negotiation - with a total of 20 items and a Likert-type response scale of one to five. Table 1 displays scale descriptions, sample items, and Cronbach's Alpha values.

Scale	Scale description	Sample item	Cronbach's Alpha shortened version*	Cronbach's Alpha Turkish version*	Cronbach's Alpha present study
Personal Relevance (PR)	Extent to which teachers relate science to students' out of school experiences	"In this science class, I learn about the world inside and outside of school."	.90	.79	.83
Uncertainty (U)	Extent to which opportunities are provided for students to experience scientific knowledge as arising from theory-dependent inquiry.	"In this science class I learn the views of science have changed over time."	.81	.74	.88
Critical Voice (CV)	Extent to which a social climate has been established in which students feel that it is beneficial to question the teacher's pedagogical plans and methods to express concerns about any impediments to their learning.	"In this science class, I safely question what or how I am being taught."	.88	.86	.85
Shared Control (SC)	Extent to which students are invited to share with the teacher control of the learning environment.	"In this science class, I help the teacher to plan what I am going to learn."	.76	.72	.89
Student Negotiation (SN)	Extent to which opportunities exist for students to explain and justify to other students their newly developing ideas.	"In this science class, I ask other students to explain their ideas."	.81	.78	.85

All scale descriptions are taken from Johnson and McClure (2004), and Taylor, Fraser and Fisher (1997)
**354 upper elementary, middle and high school students. Johnson and McClure (2004).*

Table 1: Constructivist Learning Environment Survey (CLES)

Students' adaptive learning engagement in science (SALES)

The Students' Adaptive Learning Engagement in Science (SALES) survey assesses student motivation and self-regulation of effort in science learning. The SALES was developed by Velayutham, Aldridge and Fraser (2011) and adapted into Turkish by Şenler (2014). The survey consists of 4 scales - learning goal orientation, task value, self-efficacy, and self-regulation of effort - with a total of 32 items and a Likert-type response scale of one to five. Table 2 presents scale descriptions, sample items, and Cronbach's Alpha values.

A reliability coefficient of.70 and above are considered reliable (Nunnally, 1978). As it is seen in Table 1 and Table 2 Cronbach's Alpha values of the present study are above .70 which indicates, the reliability of the scales.

Scales	Scale description	Sample item	Cronbach's Alpha shortened version*	Cronbach's Alpha Turkish version*	Cronbach's Alpha present study
Learning goal orientation (LG)	The degree to which the student perceives him/herself to be participating in a science classroom for the purpose of learning, understanding and mastering science concepts, as well as improving science skills.	"In this science class, it is important for me to learn the science content that is taught."	.91	.83	.88
Task value (TV)	The degree to which the student perceives the science learning tasks in terms of interest, importance and utility.	"In this science class, what I learn can be used in my daily life."	.92	.83	.84
Self-efficacy (SE)	The degree of confidence and beliefs that a student has in his/her own ability to successfully perform science-learning tasks.	"In this science class, even if the science work is hard, I can learn it."	.92	.86	.78
Self-regulation of effort (SR)	The degree to which the student controls and regulates his/her effort in science learning tasks.	"In this science class, even when tasks are uninteresting, I keep working."	.91	.85	.90

All scale descriptions are taken from Velayutham, Aldridge and Afari (2013:122)

Table 2: Students' Adaptive Learning Engagement in Science Scale (SALES)

Data analysis

To answer the first research question independent *t*-test was utilized for each variable. To answer the second research question canonical correlation analysis was performed. Canonical correlation analysis is a technique used to identify the degree of relationship between two sets of variables with two or more variables each (Tabachnick and Fidell, 2007). In this study, there are 2 instruments and thus 2 data sets; the CLES data set contains 5 variables, and the SALES data set contains 4 variables, so the maximum number of canonical variable pairs that can be formed is four. Moreover, because the number of observations in the data sets must be 20 times that of the total number of variables for the results of canonical correlation analysis to be interpreted correctly (Stevens, 2002), this study required a sample size of 180, as there are 9 variables in the data sets. Normality of distribution was determined based on Skewness and Kurtosis values. According to George and Mallery (2010), Skewness and Kurtosis values should be between -2 and +2 for a normal distribution of data. This study's skewness values ranged between -.040 and -1.279, and Kurtosis values ranged between -.666 and +1.623, indicating a normal distribution. The independent sample t-tests and canonical correlation analysis were performed using the PASW 21 with the significance level set at 0.05. For the canonical correlation analysis, the CANCORR syntax software program was employed.

RESULTS

Descriptive statistics

Descriptive statistics concerning student perceptions of a constructivist learning environment, their motivational beliefs, and their self-regulation are presented in Table 3. Mean values above the mid-point of the 5-point Likert scale indicate that the study participants had modest positive perceptions of a constructivist learning environment, whereas their learning goal orientation and self-efficacy beliefs were reported to be relatively high.

Variables	*M*	*SD*
Personal Relevance (PR)	3.12	.69
Uncertainty (U)	2.85	.63
Critical Voice (CV)	2.61	.75
Shared Control (SC)	2.44	.81
Student Negotiation (SN)	2.88	.70
Learning Goal Orientation (LG)	4.19	.75
Task Value (TV)	3.94	.77
Self-Efficacy (SE)	4.08	.79
Self-Regulation of Effort (SR)	3.94	.80

Table 3: Descriptive statistics for 'constructivist learning environment' and 'adaptive learning engagement' scales

Table 4 shows the correlation values indicating the relationship between a constructivist learning environment and adaptive learning engagement.

As Table 4 shows, all variables demonstrated positive and significant relationships at a significance level of .01. Correlation coefficients among the first data set variables (PR, U, CV, SC, SN) ranged between .36 and .64. In contrast, correlation coefficients among the second data set (LG, TV, SE, SR) ranged between .62 and .76. Correlation coefficients between variables in the first and second data sets ranged between .21 and .48.

Variables	1	2	3	4	5	6	7	8	9
PR (1)	1								
U (2)	.61**	1							
CV (3)	.46**	.49**	1						
SC (4)	.36**	.50**	.57**	1					
SN (5)	.61**	.64**	.56**	.55**	1				
LG (6)	.46**	.34**	.32**	.21**	.40**	1			
TV (7)	.48**	.37**	.33**	.25**	.37**	.67**	1		
SE (8)	.48**	.37**	.34**	.21**	.43**	.75**	.67**	1	
SR (9)	.37**	.34**	.33**	.26**	.40**	.69**	.62**	.76**	1

***Correlation is significant at the 0.01 level (2-tailed).*

Table 4: Relationship among the variables

Inferential statistics

Gender-related differences in students' perceptions of a constructivist learning environment, their motivational beliefs, and self-regulation of effort in a science lesson

Independent sample *t*-tests were conducted to identify whether there is a significant difference between females and males in their scores of students' perception of a constructivist learning environment, their motivational beliefs, and self-regulation of effort in a science lesson. The results were displayed in Table 5. As presented in Table 5, independent t-tests results revealed that there is a significant difference between females and males in self-regulation of effort [$t(485) = 2.61$, $p < .05$]. These results implied that female students' scores ($M = 32.22$, $SD = 6.07$) of self-regulation of effort were significantly higher than those of boys ($M = 30.70$, $SD = 6.72$). On the other hand, females and males did not differ significantly in constructivist learning environment perception scores [$t(485) = -.49$, $p > .05$], and motivational beliefs scores [$t(485) = 1.87$, $p > .05$].

	Females		Males			
	M	*SD*	*M*	*SD*	*t*	*p*
Constructivist Learning Environment Perception	69.18	13.26	69.81	15.24	-.49	.63
Motivational Beliefs	99.02	14.33	96.23	18.44	1.87	.06
Self-Regulation of Effort	32.22	6.07	30.70	6.72	2.61	.01

Table 5: Independent t-test results

Relationship between student perceptions of a constructivist learning environment and their motivational beliefs and self-regulation of effort in a science class

Canonical correlation analysis was utilized to explore the relationship between student perceptions of a constructivist learning environment and their motivational beliefs and self-regulation of effort in a science class. The analysis began with an analysis of multivariate significance tests, which indicated the canonical model constructed based on the study data to possess statistical significance [Wilks' $\lambda = .64$, $F(20, 1592.93) = 11.53$, $p < .001$]. Canonical correlation coefficients calculated for the four canonical roots, along with Wilks' λ, Chi-square values, degrees of freedom and significance levels, are given in Table 6.

As Table 6 shows, the first canonical root had a canonical correlation value of .57, with a 32% shared variance for the constructivist learning environment data set and the adaptive learning engagement data set. The second canonical root had a canonical correlation value of .20, with a 4% shared variance for the two data sets. The third canonical root had a canonical correlation value of .16, with a 2% shared variance for the two data sets. In contrast, the fourth canonical root had a canonical correlation value of .03, with a 0% shared variance for the two data sets. While both first and second roots were found to be statistically significant since the canonical correlation value of the second root ($r_c = .20$) was less than .30, in line with Tabachnick and Fidell (2007), only the first root was evaluated (see Table 7).

Roots	r_c	r_c^2	Wilks' λ	$\chi 2$	*SD*	*p*
1	.57	.32	.64	11.53	20.00	< .01
2	.20	.04	.94	2.55	12.00	< .01
3	.15	.02	.98	1.88	6.00	.08
4	.03	.00	1	.28	2.00	.76

Table 6: Canonical correlation analysis

	Root 1	
	Canonical Correlations	Canonical Coefficients
Constructivist Learning Environment Variables		
PR	.95	.68
U	.72	.08
CV	.79	.21
SC	.44	-.11
SN	.65	.27
Percent of Variance	.53	
Redundancy	.30	
Adaptive Learning Engagement Variables		
LG	.88	.29
TV	.88	.40
SE	.92	.48
SR	.76	-.05
Percent of Variance	.74	
Redundancy	.42	
Canonical Correlation	.57	

Table 7: Correlations, standardized canonical coefficients, canonical correlations, percent of the variance, and redundancies between constructivist variables of perceptions of a constructivist learning environment and variables of adaptive learning engagement

As Table 7 shows, all the variables in both the constructivist learning environment set and the adaptive learning engagement set were positively correlated with the first canonical variate, with a cut-off correlation of .30 (Tabachnick and Fidell, 2007). In particular, the first pair of canonical variates indicated higher PR, U, CV, SC, and SN levels correlated with higher levels of LG, TV, SE, and SR.
In addition, the first canonical variate was found to account for 53% of the variance in the constructivist learning environment data set and 74% of the variance in the adaptive learning engagement data set. Furthermore, redundancy values revealed that the adaptive learning engagement variables explained 30% of the variance in the constructivist learning environment data set, while the constructivist learning environment variables explained 42% of the variance in the adaptive learning engagement data set. Canonical correlation coefficients between the first canonical root's structural coefficients and the data sets for this root are given in Figure 1.

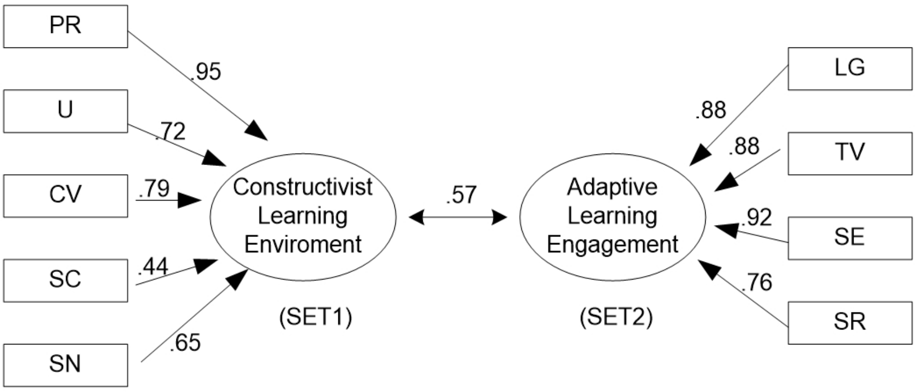

Figure 1: Canonical correlation between the constructivist learning environment and adaptive learning engagement

As Figure 1 shows, personal relevance (PR) had the highest level of canonical load (.95), and shared control (SC) had the lowest level of canonical load (.44) in the first data set, whereas self-efficacy (SE) had the highest level of canonical load (.92) and self-regulation of effort (SR) had the lowest level of canonical load (.76) in the second data set. Figure 2 shows the shared variance by two data sets, as determined based on canonical correlation analysis findings.

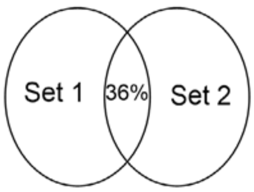

Figure 2: The shared variance by two data sets

As it is seen in Figure 2, the two data sets had a shared variance of 36% (1 - λ) which reflects the amount of the relationship between a constructivist learning environment and adaptive learning engagement.

DISCUSSION

This study determined gender-related differences in students' perceptions of a constructivist learning environment, their motivational beliefs, and self-regulation of effort in a science lesson. The results demonstrated the students' perceptions of a constructivist learning environment and motivation to learn science did not differ by gender. This finding is aligned with the previous studies revealing similar learning environment perceptions (e.g. LaRocque, 2008; Kingir, Gok and Bozkir, 2020) and motivational beliefs (e.g. Cetin-Dindar, 2016; Kingir, Gok and Bozkir, 2020) across gender. On the other hand, students' self-regulation of effort was found different across gender in favor of females. This finding is like the study by Nacaroğlu, Bektaş and Tüysüz (2021).

Correlation analysis explored the relationship between student perceptions of a constructivist learning environment and their motivational beliefs and self-regulation of effort in a science class. The result showed medium-level positive and significant relations between the CLES, comprised of Personal Relevance, Uncertainty, Critical Voice, Shared Control, and Student Negotiation, and the SALES, comprised of Learning Goal Orientation, Task Value, Self-Efficacy, and Self-Regulation of Effort. In line with the prior studies (Cetin-Dindar, 2016; Ozkal, Tekkaya and Cakiroglu, 2009), personal relevance was the variable with the largest contribution in the data set for a constructivist learning environment, suggesting that science teachers should construct an environment in which students realize that the science they are learning at school is relevant to their daily life. Also, in line with previous research (Cetin-Dindar, 2016), self-efficacy was found to be the variable with the largest contribution in the data set for adaptive learning engagement, suggesting that science teachers should organize activities that allow students to gain experience in science subjects, given that experiences of mastery are the most effective means of increasing self-efficacy beliefs (Bandura, 1997).

According to the canonical analysis conducted in this study, middle school students' perceptions of a constructivist learning environment are significantly related to their motivational beliefs and self-regulation of effort. In other words, students who perceive their science-learning environment as relevant to their daily lives, who view scientific knowledge as tentative, who question the teacher's practice, share control of the learning environment with the teacher, and interact with each other in this environment tend to focus on learning and understanding, give importance to the task at hand, have higher self-efficacy beliefs, and can better regulate their efforts in science-learning.

In fact, challenging learning environments that encourage student autonomy and control over learning have been shown to promote the development of adaptive motivational beliefs (Deci et al., 1991). Ram and Navdeep (2019) suggest that the students' motivational beliefs are higher in a constructive learning environment than in traditional learning environments. Hence, the learning environment can be designed to meet the students' needs and interests, and constructivist teaching methods, in which students can express their thoughts and relate what they have learned to their daily lives, can be used rather than traditional teaching methods. For instance, teachers may employ problem-based, project-based or context-based teaching to support students' social and emotional growth. Additionally, teachers may guide students on how to think, give examples and stories from the practice to promote students' attention in class, assure independent works (Berková, Borůvková and Lízalová, 2019).

Previous studies (e.g., Kingir et al., 2013) have also suggested a constructivist learning environment's variables to be positively related to task value. Indeed, given that a classroom learning environment that supports autonomy and choice of a task is known to enhance student interest in academic tasks (Maehr and Midgley, 1991), teachers should be encouraged to give students more autonomy in the classroom environment and their learning in general. To do that, teachers may provide students a voice and a choice in their own learning, encourage students to reflect on their learning, and think critically. Moreover, letting students work together also may improve students' autonomy.

Several earlier studies (e.g., Iverach and Fisher, 2008; Kingir et al., 2013) have shown that variables of a constructivist learning environment are also positively associated with learning goals. Students who perceive science as relevant to daily life view science expertise as developmental, question teachers' instructions, share control of their learning, and negotiate with each other to adopt mastery goals. Since constructivism involves learning-oriented instructional methods and focuses on student negotiation, it may also be suggested that a constructivist learning environment enables learners to adopt learning goals.

In the same vein with Dorman (2001), and Dorman and Adams (2004), the present study's finding that variables of a constructivist learning environment are positively linked to self-efficacy beliefs that have suggested students' self-efficacy beliefs improve when they perceive their learning environment as constructivist. Therefore, teachers may maintain students with some choice of tasks, ensure they interact with one another and utilize constructivist teaching methods such as problem-based learning in order to increase student self-efficacy.

Finally, the present study found perceptions of a constructivist learning environment to be associated with self-regulation of effort. Previous studies have also stated that students who view scientific knowledge as tentative, share control of the learning environment with the teacher (e.g., Kingir et al., 2013), and work cooperatively with each other (e.g., Xu and Ko, 2019) may be expected to have higher levels of self-regulation. Accordingly, science teachers should arrange such a learning environment to encourage student self-regulation of effort. For instance, as Xu and Ko (2019) suggested, changing the layout seats supports independent learning and cooperative learning. Moreover, providing students with challenging tasks along with a supportive environment promotes self-regulation (Yan, 2018).

CONCLUSION

The results concerning the relation of gender, female and male students' perceived their learning environment as constructivists, and had motivational beliefs equally, However, the female students had higher self-regulation of effort scores than the males. In this respect, researchers might conduct studies to explore the reasons for the differences. Determining the factors will help to find a way to increase the self-regulation of effort of males.

Furthermore, any changes in the students' perceptions of a constructivist learning environment will change their motivational beliefs and self-regulation of effort. Therefore, to promote students to have higher scores of self-efficacy and self-regulation, adopt mastery goals, and give value to a task, teachers should provide a constructivist learning environment to them. More specifically, ensuring the dialogue-based relationship between teacher-student and student-student, presenting teacher's support, and encouraging collaborative learning could enhance students' motivation and self-regulation of effort in science.

The findings of this study might benefit science teachers, science teacher educators, and educational policymakers. This study could help teachers realize how important to create a constructivist environment in their classroom. Teacher educators may emphasize the constructivist learning environment while training teachers. Policymakers may organize professional development programs to present teachers with the methods and strategies required to create a constructivist learning environment.

In interpreting this study's results, some limitations should be noted, namely the reliance on students' perceptions and self-reporting of data. To better understand the findings, future studies should be conducted that involve interviews with students and teachers, including observation of the actual classroom learning environment. Additionally, these results are limited to Turkey. Thus, it should be taken into consideration that factors such as culture, structural opportunities, etc. may affect these results. Accordingly, replication studies can be conducted in other countries to help contribute to the results' generalizability. Moreover, because every generation has own characteristics and different needs, replication studies can be employed also for the generations other than generation Z.

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