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High School Students' Intrinsic and Extrinsic Regulation in Learning Biology

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ABSTRACT The aim of this study was to investigate high school students' intrinsic and extrinsic regulations when learning biology. Participants included 565 high school students in the ninth, tenth, eleventh and twelfth grades from different schools in different cities. The data was collected through the motivational regulation scale. In the reliability and validity analysis, the 17-item and four-dimension scale included two dimensions and nine items. The internal consistency reliability of the scale was 0.76. The analysis indicated that students learn better because they enjoy biology, do their homework willingly and find the subject entertaining. On the other hand, it was noted that the most important goal for the students centered on attaining high scores. Female students' intrinsic and extrinsic regulations were higher than those of the male students. It was also found that the ninth grade biology students' extrinsic regulations were higher compared to other students.

INTRODUCTION

Biology provides important knowledge and helps understand nature and causes positive changes in life (Carvajal-Rodríguez 2015). Therefore, for a better adaptation to today's world, the aim of the biology curriculum should be to lead students to become biology literate (Bybee 1995; MEB 2013). It is of utmost importance that students should be educated in the field to fully master the subject. To achieve this, factors such as the learning environment (Hanrahan 1998), interest (Ainly et al. 2002) and the teacher-student relationship (McArthur and Bostedo-Conway 2012) need to be carefully studied. Another factor affecting sufficient and everlasting learning is motivation (Thomas and Müller 2011). Motivation is a forward movement undertaken to achieve something. In other words, motivation for achievement was a great important in the education (Dichter 2015). Motivation refers to behavioral reasons that relate to willingness and volition (Rheinberg et al. 2001; Faber 2009; Lai 2011). The levels of motivation and orientati on differ from person to person. The level of motivation and its variety is highly related to individuals' goals and attitudes. In the literature there are a number of motivation theories to describe motivation levels and inclinations. One of these theories is the self-determination theory (SDT) (Deci and Ryan 2000).

For Deci and Ryan (2000), people need to be self-determiners. The internalization and integration of values and behavioral regulations in STD are discussed. In STD, motivation is divided into two types when making a decision. The first type is intrinsic motivation. In this respect, it is essential that an individual is willing and pleasure to achieve something, and this is intrinsic motivation. The second type is extrinsic motivation, which presents itself within outside factors that contribute towards achievement. Extrinsic motivation includes different regulation forms, one of which is identified regulation. This shows an individual's inclination towards an outcome. Introject regulation represents a positive opinion through a socially approved behavior. External regulation, on the other hand, represents avoiding a negative outcome or actions to win an award. Both external and introject regulations aim at regulating behaviors through an external controller. However, an external control in identified regulation seems lesser. At this point, individual importance takes priority in regulating behavior (Ryan and Deci 2000). Thus, intrinsic and identified regulations turn out to be highly required aspects related to individual maturity, psychological health, wellbeing and a strong will to learn, as well as the ability to cope with achieving a required level in difficult homework and the ability to learn thoroughly (Thomas and Müller 2007). Intrinsic motivation is of the ut-

most importance in creativity and quality learning. These forms of motivational regulation are related to basic human needs such as autonomy, competence and relatedness (Ryan and Deci 2000; Kanat-Maymon et al. 2015).

Literature records show that self-regulation has been a topic in several studies (Akkus-Ispir et al. 2011) where scale studies were applied to different cultures (Gagne et al. 2014). Bearing in mind the effect of nature and public environment on humans, it is assumed that individual and culture of the self-concept impacts also affect self-regulation. Cultural values and social targets have an impact on socialization and help the individual develop self-regulation through internalization (Thrommsdorff 2009). Therefore, the cultural and self-regulation researches are important. A review on self-determination indicates that self-regulation efforts are rather limited in the area of biology (Batz et al. 2010; Mayer- Ahren et al. 2010; Ongowo and Hungi 2014) whereas self-regulation is of great help to students in applying various strategies and helps them become well aware of their performance and academic improvements (Zumbrunn et al. 2011; León et al. 2015; Hrbackova and Suchankova 2016). It is very important to study self-regulation for students' effective learning, as this improves their abilities and academic success.

Aim

The aim of this study is to investigate the students' motivational regulations when learning biology. It is hoped that this will help understand students' learning in motivational dimensions and shed light on the curriculum and on effective teaching-learning strategies.

METHODOLOGY

Sample

The participants in this study were high school students studying nature and biology. Sampling in this study was from the 2013 academic year because of the limitations in reaching the whole nature. A convenience sampling technique was carried out in coordination with biology teachers, 565 volunteer participants ranging from 14 to 19 in the ninth, tenth, eleventh and twelfth grades from Nigde, Antalya, Mugla, Kayseri, Aksaray and Istanbul (mean=16.7, std. derivation=99) at the Anatolian High School, the Anatolian Teacher Training School, the Vocational High School and general high schools.Table 1 shows the individual information provided by the participants.

Table 1: Demographic properties of high-school students

Variables	*f*	*%*
Gender		
Girls	317	56.1
Boys	246	43.5
City		
Nigde	152	26.9
Antalya	95	16.8
Mugla	89	15.8
Kayseri	76	13.5
Aksaray	61	10.8
Istanbul	92	16.3
General	61	10.8
Grade		
9	173	30.6
10	148	26.2
11	185	32.7
12	59	10.4
School Type		
Anatolian	270	47.8
Anatolian Teacher Training	152	26.9
Anatolian Vocational	82	14.5

The participants of the study were 371 girls and 246 boys. 173 were in the ninth grade, 148 were in the tenth grade, 185 were in the eleventh grade and 59 were in the twelfth grade. Of the participants, 270 students were from the Anatolian High School, 152 students were from the Teacher Training School, 82 students were from the Anatolian Vocational School and 82 students were from general high schools.

Questionnaire

The questionnaire used in this study included the motivational regulation scale, which aims to identify personal information related to the students' demographic features and to assess students' learning desire. The scale is based on the self-determination theory and was developed by Müller et al. (2007). The scale includes 17 items and four dimensions (intrinsic regulations: five items, identified regulations: four items, introject regulations: four items, and external regulations: four items). The students indicated the extent to which they agreed with each response on a five-point scale. The scale was translated from German into Turkish upon the consulta-

tion of those invol-ved. A single-back translation method was used in the adaptation. The Turkish version of the scale was closely examined by four experts on the subject and by two experts in language studies. In light of the experts' feedback, some expressions were reconsidered. Then, a German language expert with no idea about the original scale in Turkish translated it into German. Both scales were compared by Florian H. Müller and some items were reviewed upon his suggestions. The finalized scale was then converted into a questionnaire and in light of the data, an analysis was carried out for the validity and reliability of the scale.

The Reliability and Validity of the Motivational Regulation Scale

Exploratory Factor Analysis (EFA)

In order to determine the factorial structure and the validity of the 17-item scale, an exploratory analysis was carried out (Buyukozturk 2007). The variation table prepared by the Varimax rotation procedure is shown in Table 2. The Kaiser-Meyer-Olkin (KMO) statistic was observed as 0.843. The KMO statistic over 0.50 is the proof of the number of sampling. Bartlett's spherical test is calculated whether to test suitability of the data for factor analysis. Consequently, the suitability of the data for factor analysis.

When the factorial loading was studied, it was clear that the value of all items was above 0.40. In the first factor, six items (1, 5, 9, 13, 15, 17) were clustered, in the second factor, four items (3, 7, 11, 16) were clustered, and in the third factor, seven items (2, 4, 6, 8, 10, 12, 14) were clustered.

When the total variation table was studied, it was noted that three factors were higher than the eigenvalue in the 17-item scale, of which fifty-four percentwas measured. Eigenvalue and the related scree plot results can be put under three factors.

Cronbach's Alpha (CA) was used for the reliability of the scale. The CA scale was 0.758. The internal consistency reliability ranged from 0 to +1. The reliability coefficient values, which were around one, shows consistency among the items and this is what was expected. The item-total correlation is shown in Table 3.

Item-total correlation results were above the 0.25 value. The alpha coefficient of the six items consisting of the first factor was 0.846, the alpha coefficient for the four items consisting of the second factor was 0.754 and the alpha coefficient of the seven items consisting of the third factor was 0.703.

Confirmatory Analysis

In the EFA, it was found that the 17-item scale had three factors. When a confirmatory analy-

Table 2: Factor loading from the EFA

...I work on my biology subjects	*Factor 1*	*Factor 2*	*Factor 3*
Intrinsic Regulations			
Mot1..because it's fun	0.816		
Mot5 ..because I want to learn new things	0.706		
Mot9 ..because I enjoy solving tasks in this subject	0.845		
Mot13...because I enjoy thinking and reflecting about things in this subject	0.779		
Mot17…because I like to think about this subject	0.832		
Identified Regulations			
Mot3...so in the future, I can continue my education		0.767	
Mot7...because it will give me better career choices		0.842	
Mot11...because the knowledge in the subject will allow me to get a better job		0.787	
Mot15...because the things that I learn here will be useful in the future	0.552		
Introjected Regulations			
Mot2...because I want the teacher to think I'm a good student			0.635
Mot6 ..because that's what I'm supposed to do			0.421
Mot10...because I want other students to think I am quite good			0.712
Mot14...because I would feel ashamed of myself if I don't try			0.654
External Regulations			
Mot4...because otherwise I would get into trouble at home			0.512
Mot8...because otherwise I would get into trouble with my teacher			0.687
Mot12...because otherwise I would get bad grades			0.510
Mot16...because that's what I'm supposed to do		0.505	
KMO=0.843			
Bartlett's test of spherity: χ^2=3322,169 Sd= 414 p=0.000			

Table 3: The values of CA and item-total correlation

	Items	*Item-total correlation*	*Alpha*	*Items*
Factor 1	Mot1...because it's fun	0.713	0.846	6
	Mot5...because I want to learn new things	0.635		
	Mot9...because I enjoy thinking and reflecting about things in this subject	0.758		
	Mot13...because I enjoy solving tasks in this subject	0.690		
	Mot15...because the things that I learn here will be useful in the future	0.533		
	Mot17...because I like to think about this subject	0.740		
Factor 2	Mot3...so in the future, I can continue my education	0.569	0.754	4
	Mot7...because it will give me better career choices	0.668		
	Mot11...because the knowledge in the subject will allow me to get a better job	0.645		
	Mot16...because that's what I'm supposed to do	0.343		
Factor 3	Mot2...because I want the teacher to think I'm a good student	0.428	0.703	7
	Mot4...because otherwise I would get into trouble at home	0.339		
	Mot6...because otherwise I would have a guilty conscience	0.265		
	Mot8...because otherwise I would get into trouble with my teacher	0.521		
	Mot10...because I want other students to think I am quite good	0.508		
	Mot12...because otherwise I would get bad grades	0.377		
	Mot14…because I would feel ashamed of myself if I don't try	0.458		

sis was applied to the three factor scales, among the 17 items the seventh and 16th items in the second factor as well as the fourth and eighth items in the third factor were excluded due to the inconsistency related to "t" and the same procedure (CFA) was tried a second time. Here, the third item in the second factor was not found to be expressive. Excluding this item from the second factor, leaving behind only one item, led to a third CFA analysis of the remaining items. The result, Lambda, multi correlation (R^2) and the expressive "t" values are shown in Table 4.

The CFA results show the expressiveness of "t" values of all the items ($p<0.05$). Goodness of fit indices was used in order to see the harmony of the data in the double-dimension model. The similarity rate was determined as $\chi^2(26)=36.41$, $P<0.01$, RMSEA=0.085; SRMR=0.08, CF1=0.97, GF1=0.87, NF1=0.87, RF1=0.82. The CFA results show that the double-factor structure of the scale provided valid results.

The path graph related to the scale items is shown in Figure 1.

From the results of the validity and reliability analysis of the study, it was agreed that the double-dimension motivation scale was valid and reliable.

Analysis

The SPSS 22 program was used to analyze this study. All data was analyzed using frequency, percentage, mean, standard deviation, t-test, the analysis of variance (ANOVA) and correlation techniques. For normality, skewness and kurtosis values were checked. The results of the deviation are shown in Table 5.

After Table 5 was examined, the researcheragreed to use parametric tests. In the one-way ANOVA it was checked to see whether the assumption was violated or not. According to the

Table 4: The factor loading from CFA

		Lamda	*R^2*	*t*	*Goodness of fit indices*	*Value*
Factor 1	Mot1	0.75	0.57	5.96	χ^2/sd	36.41/26=1.40
	Mot9	0.30	0.09	2.14	GFI	0.87
	Mot13	0.34	0.12	2.43	CFI	0.97
	Mot15	0.70	0.49	5.46	NFI	0.87
Factor 2	Mot2	0.47	0.22	3.43	NNFI	0.96
	Mot6	0.75	0.57	6.18	RFI	0.82
	Mot10	0.64	0.40	4.95	S-RMR	0.08
	Mot12	0.33	0.11	2.37	RMSEA	0.085
	Mot14	0.78	0.61	6.47		

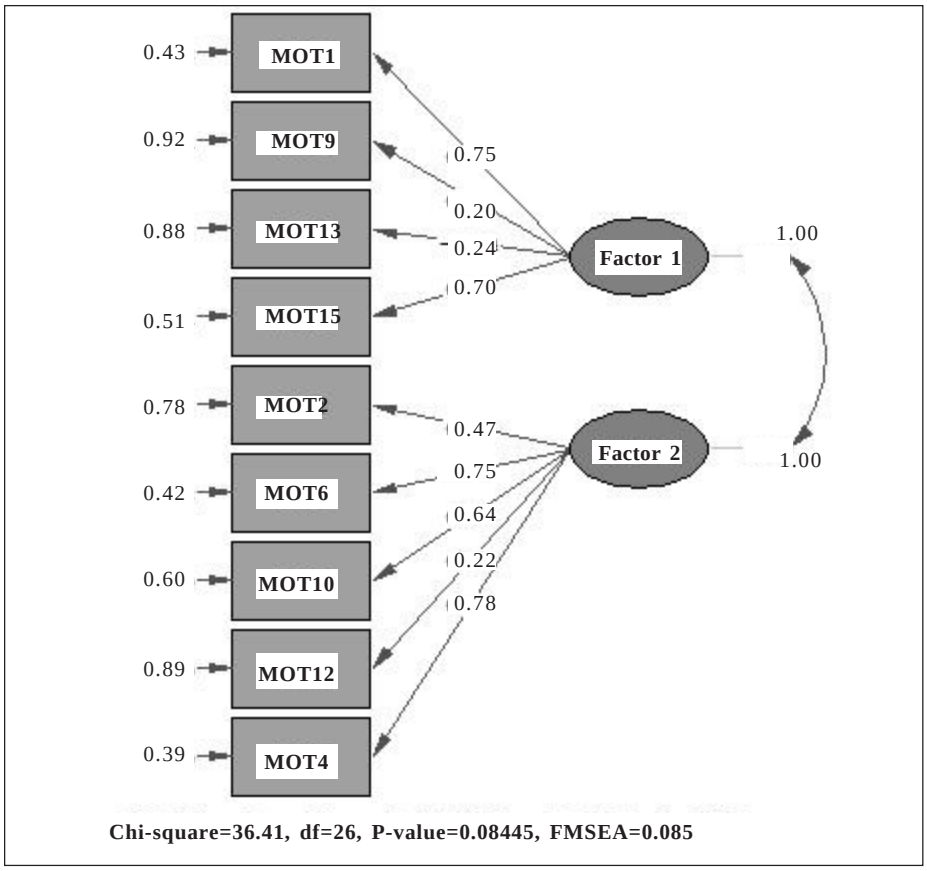

Fig. 1. CFA model for motivational regulation

Table 5: The distribution of data

	Skewness	*Kurtosis*
General	0.251	0.076
Intrinsic motivation	0.476	0.381
Extrinsic motivation	0.027	0.133

result of the Welch F test, the researcher's data did not match the homogeneity of variances. Therefore, the researcher used Dunnett's C post-hoc test.

RESULTS

The Descriptive Analysis

Table 6 shows the means of items related to students' self-regulated learning. According to Table 6, the means of items are 2.19+1.14-3.90+1.14. The highest mean belongs to "...because otherwise I would get bad marks". The lowest mean belongs to "...because I want other students to think I am quite good". This shows that the means of intrinsic motivation are closer to each other. While the students responded as "agree" to intrinsic motivation, they responded as "partially agree" to extrinsic motivation.

Correlation between Intrinsic and Extrinsic Motivation

Table 7 reflects the above correlation between intrinsic and extrinsic motivation. In Table 7, the mean of intrinsic motivation is 3.60 while the mean of extrinsic motivation is 2.99. According to the results of the correlation analysis, there was a statistically high significant correlation between intrinsic and extrinsic motivation.

Table 6: The means of items

	N	*Mean*	*Std. deviation*
Intrinsic			
Mot1...because it's fun	564	3.65	1.16
Mot9...because I enjoy thinking and reflecting about things in this subject	558	3.60	1.25
Mot13...because I enjoy solving tasks in this subject	559	3.40	1.18
Mot15...because the things that I learn here will be useful in the future	558	3.73	1.21
Extrinsic			
Mot2…because I want the teacher to think I'm a good student	563	2.88	1.29
Mot6…because otherwise I would have a guilty conscience	563	3.36	1.20
Mot10...because I want other students to think I am quite good	563	2.19	1.14
Mot12…because otherwise I would get bad grades	556	3.90	1.14
Mot14…because I would feel ashamed of myself if I don't try	559	2.66	1.35

Table 7: The results of correlation between intrinsic and extrinsic motivation

	N	*Mean*	*Std. dev.*	*Intrinsic (r)*	*Extrinsic (r)*
Intrinsic	546	3.60	0.97	-	
Extrinsic	546	2.99	0.79	0.96**	-

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

The Effect of Gender on Motivational Regulations in Biology Courses

The t-test technique was applied to determine the effect of gender on the self-regulated learning of high school students. The results of the analysis are shown in Table 8.

When Table 8 is examined, gender seems to affect motivational regulations. Girls' intrinsic and extrinsic motives in learning biology are higher and more meaningful compared to that of boys.

The Effect of Grades on Motivational Regulated Learning in Biology Courses

One-way ANOVA techniques were applied to determine the effect of grades on the self-regulated learning of high-school students. The results of the analysis are shown in Table 9.

According to Table 9, grades significantly affect extrinsic motivation. This means that ninth-year students' extrinsic motives in learning biology are higher and more meaningful compared to others

DISCUSSION

This study indicates that students' intrinsic motivation in learning was higher than their extrinsic motivation. In other words, students enjoy their studies and enjoy completing homework. However, the highest source of motivation in biology was test scores. This implies that students relate their achievements to their test scores. It is assumed that the education system plays a big role in students' studies and their test scores. This, undoubtedly, affects biology curricula negatively and fails to lead students to reach the highest possible levels in the subject. If students' desire for success affects their academic performance positively, their self-concept is also affected positively success (Green et al. 2006). Motivation is an important key to success in education (Hrbackova and Suchankova 2016). Other studies have observed that self-regulation's effect is critical for achievement (for example, León et al. 2015).

In this study it was noted that there was a significant correlation between intrinsic and extrinsic motivation. The findings were in line with other studies (for example, Lee and Kim 2014; Lemos and Veríssimo 2014; Benedetti 2015; Gravel et al. 2016). The results are important for the continuum of autonomy (Deci and Ryan 2000).

Another finding in this study was that girls' intrinsic and extrinsic motivation to study biolo-

Table 8: The effect of gender on motivational regulations

		N	*Mean*	*Std. dev.*	*t*	*df*	*p*
Intrinsic	Girls	308	3.07	0.80	2.56	542.00	0.01
	Boys	236	2.90	0.76			
Extrinsic	Girls	298	3.41	0.62	4.50	526.00	0.00
	Boys	230	3.16	0.64			

Table 9: The effect of grades on motivational regulation

		N	*Mean*	*Std. dev.*	*F*	*df*	*p*	*Dunnett*
	9^{th}	164	3.47	0.96				
Intrinsic	10^{th}	138	3.67	0.99	2.14	3	0.09	
	11^{th}	170	3.59	0.97				
	12^{th}	58	3.81	0.91				
	9^{th}	164	3.28	0.77				10^{th}, 11^{th}, 12^{th}
Extrinsic	10^{th}	138	3.02	0.76	20.79	3	0.00	12^{th}
	11^{th}	170	2.88	0.70				12^{th}
	12^{th}	58	2.43	0.79				

gy was higher than that of boys. Other studies, too, have observed gender differences in motivation (Parlev 2007; Chen et al. 2013). These studies emphasize the importance and the need to use learning and teaching strategies for both sexes.

Finally, it was clearly seen that ninth-grade students' extrinsic motivation was higher. The reason for this is that the ninth-grade students wished to score higher grades in biology for a higher school average.

CONCLUSION

The result of this study indicated that students' intrinsic motivation in learning was higher than their extrinsic motivation. There was also a significant correlation between intrinsic and extrinsic motivation. Furthermore, found in this study was that girls' intrinsic and extrinsic motivation to study biology was higher than that of boys.It was clearly seen that ninth-grade students' extrinsic motivation was higher.

RECOMMENDATIONS

Regardless of the students' high scores for motivation, various educational activities can be practiced during the learning and teaching process. It is stated that activities in the curriculum are sufficient to motivate the students. A further study can be carried out to specify the relationship between the activities and motivation.

The basic reasons for adapting a double-dimension self-regulating scale in the Turkish language were related to the conditions of implementation research and participants' perception-of and attitudes toward questionnaire. Therefore, it is strongly recommended that in a future study, the motivational regulation study be reconsidered.

LIMITATIONS TO THE STUDY

The samples in this study were randomly selected students studying biology. Therefore, the findings could not be generalized.This is a preliminary study to provide a source for future studies.

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