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ORIGINAL ARTICLE

Context-based Biology Motivations of Secondary School Students

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ABSTRACT

This study aimed to examine the motivation of secondary school students toward context-based biology in terms of variables. Motivations were examined in terms of gender, grade level, school type, project experience, and biology laboratory experience. The research was planned according to the "Survey design." The sample consisted of 545 students studying at different grade levels (9th, 10th, 11th, and 12th grades) of secondary education institutions in Turkey. The study data were collected through the "Context-Based Biology Motivation Scale (CBBMS)". The measurement tool consists of 34 items in a five-point Likert type, and a total of three sub-factors: association and effect, participation and competence, and enjoyment and satisfaction. Cronbach's alpha reliability coefficient was determined (α = 0.943) for the entire measurement tool. For the sub-factors, it was α = 0.898 for association and effect, α = 0.914 for participation and competence, α = 0.846 and for enjoyment and satisfaction. For independent groups, the t-test, one-way analysis of variance (ANOVA), and Tukey test were used in the data analysis. According to the research results, secondary school students' motivations toward context-based biology differed significantly according to gender, school type, biology laboratory experience, and grade level. On the contrary, motivations did not differ significantly according to their project experiences. The data obtained from the research will contribute to the literature in determining the factors affecting the motivation of secondary school students toward context-based biology.

KEY WORDS: COVID-19; motivation toward context-based biology; secondary school students

INTRODUCTION

Many people wonder about the organisms that live around them. This sense of curiosity leads some people to do research. Although this research sometimes begins with a simple observation, it is sometimes conducted through systematic and regular research. This research may also led to the emergence of biology. Biology is the study of life scientifically. Moreover, biology is a study of the nature of life, that is, a persistent inquiry. Biology includes microscopic molecules and cells that comprise organisms and the world of living creatures on a global scale (Sadava et al., 2017; Urry et al., 2021). Although some people say that they dislike biology, most will admit that they naturally love living things (biophilia). If anyone owns a pet, is interested in fitness and healthy eating, visits a zoo or an aquarium for fun, goes hiking, visits national parks, collects shells on the seashore, watches TV documentaries about sharks or dinosaurs, feeds stray animals, and feeds birds in winters, it means that they do in fact have an affection for biology. Moreover, many are aware that the subject of biology has a significant impact on themselves because of its connections to the fields of medicine, biotechnology, agriculture, environment, law, and thousands of other fields. In addition, humans have an inherited curiosity about life that leads them to examine other living things and their environments.

An examination of history has revealed that there have been constant research and discoveries in the field of biology (Simon et al., 2020). For example, our ancestors applied the principles of evolutionary biology when domesticating plants and animals. They investigated the cause of diseases and tried to treat these diseases. People realized that infections could be transmitted from person to person long before microbes were discovered to be the causative agents of disease, and some written records were found regarding the isolation of sick people. A more modern reason to learn biology is to understand the effects of the rapidly increasing human population on the environment. Using natural resources by humans puts pressure on the Earth's ecosystems' capacity to continue producing the goods and services that societies need. Human activities have been changing the Earth's climate, leading to many species such as amphibians becoming extinct, reappearing of ancient diseases, and causing new diseases to spread. It has been noted that the spread of influenza viruses has becomes easier through modern forms of travel as well as tuberculosis recently re-emerging due to the evolution of antibiotic-resistant bacteria (Karakaya et al., 2021; Wong et al., 2020).

Biological information is vital to determine the causes of changes in the world and to produce smart policies about them (Sadava et al., 2017). Therefore, high motivation levels

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of individuals toward context-based biology should positively affect the science, technology, education, and state policies to be produced. The context-based learning model is a concept put forward by a group known as "Salters Chemistry" (Salters), which conducts its research in the field of chemistry education at York University in England. This concept has entered curricula under different names in many countries of the world. For example, "Chemistry in Community (ChemCom)" and "Chemistry in Context (CiC)" in the USA; "Chemie im Kontext (ChiK)" in Germany; "Industrial Chemistry (IC)" in Israel; and "Chemistry in Practice (ChiP)" in the Netherlands (Bennett and Lubben, 2006; Kutu and Sözbilir, 2011; Pilot and Bulte, 2006). The concept of context-based learning was included in the biology curriculum in Turkey in 2018 (MoNE, 2018). Bennett (2003) defined context-based learning as "to show young people the relationship between everyday life and science learned at school" (p. 114). Including a problem or event in daily life, context-based learning provides learners a need for information and aims to use the learned concepts and relationships as a tool in solving these problems and events (Acar and Yaman, 2011). With this model, learners create contexts and gain experiences using examples from daily life (Gül, 2019). In this way, learning becomes easier, more meaningful, and permanent in authentic learning environments (Choi and Johnson, 2005; Topuz et al., 2013).

Context-based courses are thought to increase students' motivation levels and feed their knowledge deeply (Bennett and Holman, 2003; Konu and Gül, 2017; Özay Köse and Çam Tosun, 2011). Because, in context-based courses, motivation enables students to see the whole (Gül, 2019) by analyzing processes and to learn permanently. Motivation is defined by Glynn et al. (2009) as the physiological, cognitive, and affective power that enables individuals to focus, direct, and act within the framework of a purpose. It is easy for motivated students to learn problem solving strategies and to practice the learned knowledge (Bereby-Meyer and Kaplan, 2005). In this regard, context-based learning methods should be used effectively in all courses.

When the relevant literature is examined, it is seen that there are Turkish (İnel Ekici et al., 2014; Karakaya et al., 2018; Konu and Gül, 2017; Yurt, 2022) and international (Barlia, 2012; Glynn et al., 2009; Hardre et al., 2006; Khamis et al., 2008; Tseng et al., 2010) studies regarding the motivation of students. In addition, when the literature in Turkey is further examined, context-based learning has been applied in the fields of physics (Ayvacı et al., 2016; Hırça, 2012; Korsacılar and Çalışkan, 2015; Özkan and Sezgin Selçuk, 2015), chemistry (Günter, 2018; Karsli and Yiğit, 2017; Kutu and Sözbilir, 2011; Ültay et al., 2015; Ültay and Çalık, 2011; 2016) and biology (Acar and Yaman, 2011; Dağlı and Yazıcı, 2021; Gül, 2016, 2019; Konu and Gül, 2017; Yakışan and Görmüş, 2020).

Biology is both a scientific and a social science branch that directly includes human beings due to the subjects in it and its relations with different disciplines (Göçmençelebi and Özkan, 2011). Therefore, there is a need to examine the affective dimensions of students' interests, motivations, and attitudes toward context-based biology, which is intertwined with our daily life. The specific objectives of the Secondary Education Biology Course are aimed to raise individuals who "research, think critically, cooperate, have effective communication skills, solve problems, question, produce, and are willing to learn life-long science" (MoNE, 2018, p. 11). To achieve the purpose of the curriculum, the factors affecting the motivation of students toward context-based biology must be determined, and the factors related to the planning of the educational processes must be paid attention to. However, it is seen that studies that determine the factors affecting students' life-based biology motivations are not included in the national or international literature. Therefore, it is thought that this research will contribute to the literature with the aim of determining the factors affecting motivation toward context-based biology.

Purpose of the Research

This study aimed to examine the motivation of secondary school students toward context-based biology in terms of various variables. The answers to the following questions were sought in the direction of the research:

1. How does secondary school students' motivation for context-based biology differ according to gender?
2. How does secondary school students' motivation for context-based biology differ according to school type?
3. How does secondary school students' motivation for context-based biology differ according to project experience?
4. How does secondary school students' motivation for context-based biology differ according to laboratory experience?
5. How does secondary school students' motivation for context-based biology differ according to grade level?

METHODS

Research Model

In this study, a survey model was used. Survey model is a scanning arrangement made on the population or the sample selected from the population, aiming to reach a general judgment about the population consisting of many factors (Karasar, 2006).

Data Collection Tool

In this study, the "Context-based Biology Motivation Scale (CBBMS) " developed by Gül (2019) was used. The scale is a five-point Likert type consisting of 34 questions with three factors: Association and Effect, Participation and Competence, and Enjoyment and Satisfaction. The questions in the scale were scored based on the statements 1: Strongly Disagree, 2: Disagree, 3: Undecided, 4: Agree, and 5: Strongly Agree. The lowest score that can be received from the scale is 34, and the highest score is 170. The Cronbach's Alpha internal consistency coefficient was calculated for the reliability of the scale. Accordingly, the Cronbach's Alpha internal consistency

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coefficient results for the scale and its sub-factors are presented in Table 1.

According to the findings in Table 1, that the total of the 34-item CBBMS score is more than.80 and all three sub-factors are more than 0.60 which indicates the reliability and suitability of this instrument for this study (Güngören et al., 2014).

Data Analysis

The data obtained from the research were analyzed using the IBM SPSS version 26 package program. To determine whether the data obtained in the study showed a normal distribution, skewness, and kurtosis values were examined. The skewness values for the scale and its sub-factors were calculated as (CBBMS = 0.381; Association and Effect = −0.016; Participation and Competence = 0.714; and Enjoyment and Satisfaction = 0.181). The kurtosis values for the scale and its sub-factors were calculated as (CBBMS = −0.144; Association and Impact = −0.707; Participation and Competence = 0.214; and Enjoyment and Satisfaction = −0.551). Skewness and kurtosis values between ±1.5 indicate that the distribution is normal (Tabachnick and Fidell, 2013). Accordingly, it can be said that the obtained data are normally distributed. In the evaluation of the data obtained, t-test for independent groups, one-way analysis of variance (ANOVA) and Tukey test were used. Furthermore, the data were evaluated at *$\rho < 0.05$ significance level in the study, and percentage, frequency, mean and standard deviation were calculated from the basic statistical values.

Research Sample

The sample of the study was determined using the convenience sampling method. The convenience sampling method is based on the items that are completely available, quick and easy to reach (Balcı, 2021). Accordingly, the sample of the research consists of 545 students studying at different secondary education institutions in a province in the Central Anatolian region of Turkey. The necessary ethical permissions were obtained for the research and the purpose of the research was provided to the participants. Then, consent and declarations of volunteering were taken from those who wanted to participate in the research. The distribution of demographic information for the participants in the sample of the study is given in Table 2.

When Table 2 is examined, the study group consisted of 411 female (75.4%) and 134 male (24.6%) students. It was determined that 392 of the students (71.9%) attended state school and 153 (28.1%) private school. It was determined that 208 of the students (38.2%) had a project experience, while 337 (61.8%) had none. Again, it was determined that 165 of the students had biology laboratory experience (30.3%), while 380 students (69.7%) did not. Of the students in the study group, 188 (34.5%) were in the ninth grade, 153 (28.1%) in the 10th grade, 123 in the 11th grade (22.6%), and 81 in the 12th grade (14.9%).

Table 1: Cronbach's alpha reliability coefficient values of the scale and its sub-factors

Scale dimensions	Cronbach's alpha	
	Gül (2019)	Karakaya, Arık andYılmaz
Association and effect	0.898	0.849
Participation and competence	0.914	0.815
Enjoyment and satisfaction	0.846	0.821
CBBMS	0.943	0.924

CBBMS: Context-based biology motivation scale

FINDINGS

In this section, the findings regarding the sub-problems of the research have been presented. In the research, the answer to the question "How does secondary school students' motivation for context-based biology differ according to gender?" was sought. The obtained results are given in Table 3.

When the findings in Table 3 are examined, considering secondary school students' scores ($t_{(543)} = 4.344$; $\rho < 0.05$) from the context-based biology motivation scale, it was determined that there was a statistically significant difference in favor of female students in the factors of association and effect ($t_{(543)} = 5.537$; $\rho < 0.05$), participation and competence ($t_{(543)} = 2.215$; $\rho < 0.05$), and enjoyment and satisfaction ($t_{(543)} = 3.885$; $\rho < 0.05$).

The answer to the question of "How does secondary school students' motivation for context-based biology differ according to school type?" has been obtained from the results given in Table 4.

When the findings given in Table 4 are examined, it is seen that considering secondary school students' scores ($t_{(543)} = 2.376$; $\rho < 0.05$) from the context-based biology motivation scale, it was determined a statistically significant difference in favor of students studying in state school in the factors of

Table 2: Distribution of demographic information of students in the sample

Demographic ınformation	n	%
Gender		
Female	411	75.4
Male	134	24.6
School type		
State	392	71.9
Private	153	28.1
Project experience		
Yes	208	38.2
No	337	61.8
Biology laboratuary experience		
Yes	165	30.3
No	380	69.7
Grade level		
9th grade	188	34.5
10th grade	153	28.1
11th grade	123	22.6
12th grade	81	14.9

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Table 3: Results of one-way independent t-test analysis for gender

Factors	Gender	n	$\bar{x}$	SD	t	ρ
Association and effect	Female	411	52.64	543	5.537	0.000*
	Male	134	50.12			
Participation and competence	Female	411	47.91	543	2.215	0.030*
	Male	134	46.89			
Enjoyment and satisfaction	Female	411	42.36	543	3.885	0.000*
	Male	134	40.75			
CBBMS	Female	411	142.91	543	4.344	0.000*
	Male	134	137.77			

*ρ<0.05, CBBMS: Context-based biology motivation scale

Table 4: One-way independent t-test analysis results according to school type

Factors	School	n	$\bar{x}$	SD	t	ρ
Association and effect	State	392	52.36	543	2.659	0.008*
	Private	153	51.17			
Participation and competence	State	392	47.72	543	0.548	0.584
	Private	153	47.48			
Enjoyment and satisfaction	State	392	42.32	543	3.259	0.001*
	Private	153	41.03			
CBBMS	State	392	142.42	543	2.376	0.018*
	Private	153	139.69			

*ρ<0.05, CBBMS: Context-based biology motivation scale

association and effect ($t_{(543)}$ = 2.659; ρ < 0.05) and enjoyment and satisfaction ($t_{(543)}$ = 3.259; ρ < 0.05). However, it was determined that there was no statistically significant difference in the factor of participation and competence ($t_{(543)}$ = 0.548; ρ > 0.05) compared to the school types.

The response to the "How does secondary school students' motivation for context-based biology differs according to project experience?" question was sought. The results achieved are shown in Table 5.

When the findings in Table 5 are examined, it is seen that considering secondary school students' scores ($t_{(543)}$ = 1.479; ρ > 0.05) from the context-based biology motivation scale, it was determined that there was no statistically significant difference in the factors of association and effect ($t_{(543)}$ = 0.391; ρ > 0.05) and enjoyment and satisfaction ($t_{(543)}$=.738; ρ > 0.05) compared to project experience. However, it was determined that there was statistically significant difference in the factor of participation and competence ($t_{(543)}$ = 2.765; ρ < 0.05) in favor of students with project experience.

In the research, the answer to the question of "How does secondary school students' motivation for context-based biology differ according to laboratory experience?" has been sought. The findings obtained as a result of the one-way independent t-test analysis are given in Table 6.

When the findings in Table 6 are examined, the scores that considering secondary school students received from

Table 5: One-way independent t-test analysis results based on project experience

Factors	Project experience	n	$\bar{x}$	SD	t	ρ
Association and effect	Yes	208	52.12	543	0.391	0.696
	No	337	51.96			
Participation and competence	Yes	208	48.36	543	2.765	0.006*
	No	337	47.22			
Enjoyment and satisfaction	Yes	208	42.13	543	0.738	0.461
	No	337	41.86			
CBBMS	Yes	208	142.62	543	1.479	0.140
	No	337	141.05			

*ρ<0.05, CBBMS: Context-based biology motivation scale

Table 6: The results of the one-way independent t-test analysis performed according to the biology laboratory experiences

Factors	Laboratory experience	n	$\bar{x}$	SD	t	ρ
Association and Effect	Yes	165	52.87	543	2.795	0.005*
	No	380	51.66			
Participation and Competence	Yes	165	48.75	543	3.628	0.000*
	No	380	47.18			
Enjoyment and Satisfaction	Yes	165	42.52	543	2.060	0.040*
	No	380	41.72			
CBBMS	Yes	165	144.16	543	3.217	0.001*
	No	380	140.56			

*ρ<0.05, CBBMS: Context-based biology motivation scale

the context-based biology motivation scale ($t_{(543)}$ = 3.217; ρ < 0.05), it was determined that there was a statistically significant difference in favor of students with biology laboratory experience in the factors of association and the effect ($t_{(543)}$ = 2.795; ρ < 0.05), participation and competence ($t_{(543)}$ = 3.628; ρ < 0.05), and enjoyment and satisfaction ($t_{(543)}$ = 2.060; ρ < 0.05).

In the research, the answer to the question of "How does secondary school students' motivation for context-based biology differ according to grade level?" has been sought. Frequency, mean and standard deviation values of the obtained data are given in Table 7.

And the one-way analysis of variance (ANOVA) results is given in Table 8.

When the findings in Table 8 are examined, the students' scores of the context-based biology motivation scale [$F_{(3,541)}$ = 3.450; ρ < 0.05] and the factor of association and effect [$F_{(3,541)}$ = 6.083; ρ < 0.05] were determined that there was a statistically significant difference by the grade level. However, in the factors of participation and competence [$F_{(3,541)}$ = 1.341; ρ > 0.05] and enjoyment and satisfaction [$F_{(3,541)}$ = 1.846; ρ > 0.05] it was determined that there was no statistically significant difference according to grade level.

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Table 7: Frequency, mean, and standard deviation values regarding grade level

Factors	Grade level	n	$\bar{x}$	ss
Association And effect	9 grade	188	51.56	4.44
	10 grade	153	51.16	4.52
	11 grade	123	53.10	4.66
	12 grade	81	53.11	5.23
Participation and competence	9 grade	188	47.47	4.58
	10 grade	153	47.25	4.58
	11 grade	123	47.95	4.78
	12 grade	81	48.41	5.05
Enjoyment and satisfaction	9 grade	188	41.80	3.97
	10 grade	153	41.47	3.99
	11 grade	123	42.46	4.46
	12 grade	81	42.51	4.63
CBBMS	9 grade	188	140.84	11.34
	10 grade	153	139.88	11.53
	11 grade	123	143.52	12.48
	12 grade	81	144.04	13.59

CBBMS: Context-based biology motivation scale

Table 8: ANOVA results for grade level

Factors	Sum of squares	SD	Mean squares	F	ρ	Tukey
Association and effect						
Intergroups	392.75	3	130.918	6.083	0.000*	11>9.10
Intragroup	11642.77	541	21.521			12>9.10
Total	12035.53	544				
Participation and competence						
Intergroups	88.84	3	29.613	1.341	0.260	-
Intragroup	1197.36	541	22.084			
Total	12036.20	544				
Enjoyment and satisfaction						
Intergroups	97.69	3	32.565	1.846	0.138	-
Intragroup	9542.64	541	17.639			
Total	9640.33	544				
CBBMS						
Intergroups	1494.32	3	498.108	3.450	0.016*	11>10
Intragroup	78116.82	541	144.393			12>10
Total	79611.14	544				

*ρ<0.05, CBBMS: Context-based biology motivation scale

DISCUSSION AND CONCLUSIONS

The study aimed to examine secondary school students' motivations toward context-based biology according to various variables. Within the scope of the research, it was determined that the scores that secondary school students received from the context-based biology motivation scale and its sub-factors (association and effect, participation and competence, and enjoyment and satisfaction) were significantly different in favor of female students. According to these results, it can be said that gender is a factor in the context-based biology motivations of secondary school students. When the relevant literature is examined, it has been determined that there are studies showing that students' learning motivations change based on the gender variable (Hardre et al., 2006; İnel Ekici et al., 2014; Karakaya et al., 2018; Khamis et al., 2008; Özbaş, 2019; Uzun and Keleş, 2010). Studies have indicated that female students are more motivated because they have more positive thoughts about learning science and adapt to their goals faster (Hardre et al., 2006; Karakaya et al., 2018). According to İnel Ekici et al. (2014), female students' perspectives on events and their higher communication skills affected this result. In the study conducted by Özbaş (2019), it was concluded that female and male students were motivated differently (value, belief, and goal) and accordingly, their biology learning motivations changed. These results support the findings of this research.

In the study, the scores of secondary school students from the context-based biology motivation scale and the sub-factors that formed the scale (association and effect, enjoyment and satisfaction) were determined to be significantly different in favor of the students studying at the state schools. However, there was no significant difference in the scores of secondary school students in the factor of participation and competence. In addition, when the relevant literature was examined, no study was found examining the effect of school type on students' context-based biology motivations. It can be stated that state school students' internalization of context-based learning affected the emergence of these results. Furthermore, students' internalization of events may be effective in increasing the scores that state school students received in the affective dimension related to context-based biology motivation. When state and private schools are compared, it is seen that the classes in state schools are more crowded than the private schools, students often come from lower socioeconomic levels, and parents impart less pressure on teachers and administrators (Gürler, 2020). In addition, the different conditions of these schools and teachers' workload cause differences in curriculum practices (Öztürk Akar, 2015). The fact that there is more success and knowledge-based learning and less place on affective features may have caused less attention to affective features and decreased motivation, especially in private schools.

In the research, there was no significant difference in the scores of secondary school students from the context-based biology motivation scale and its sub-factors (association and effect, enjoyment, and satisfaction) according to the project experience. However, there was a significant difference in favor of the students with project experience in the factor of participation and competence. The reason for this may be students' self-confidence depending on their project experience and increasing their motivation due to their self-efficacy, because self-efficacy has been identified as the most important factor that increases the motivation of the person and motivates individuals to fulfill the given tasks (Bayrakçeken et al., 2021). Research indicates that the motivation of the students is in the subjects in which they actively participate and gain experience (Doğaç and Gök, 2020; Konu and Gül, 2017; Özbaş, 2019). In addition, when the literature is examined, it is seen that self-efficacy (Ateş and Saylan, 2015; Yurt, 2022) and academic

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performance (Koca and Dadandı, 2019; Malkoç and Mutlu, 2018) increase with the increase in academic motivation. These results support the findings of the study.

Within the scope of the research, the scores of secondary school students from the context-based biology motivation scale and its sub-factors (association and effect, participation and competence, and enjoyment and satisfaction) significantly differed in favor of the students with the biology laboratory experience. This may be due to biology laboratory courses providing active participation of students and therefore an increase in course achievement. In addition, students with active laboratory experience use cognitive strategies more effectively and learn by practicing. Therefore, it can be said that laboratory experience affects secondary school students' context-based biology motivations. Studies have indicated that laboratory activities affect students' motivations (Duran, 2015; Longo, 2011; Şen et al., 2016). Because the experiences gained by individuals cause them to manage their learning processes correctly, make associations on different subjects (home, work, school, and life), and increase their motivation levels (MoNE, 2018).

In the study, the scores of secondary school students from the context-based biology motivation scale and the sub-factors (association and effect) that form the scale significantly differed in favor of the students studying in the 11th and 12th grades. However, there was no significant difference in the scores of secondary school students in the factors of enjoyment and satisfaction, participation, and competence. It is thought that the students' comprehension of the topic as a whole and their ability to associate the learned information with daily life in connection with the increase in the grade level affected this result. According to Rajić et al. (2015), individual's skill development changes positively as the grade level increases. When the relevant literature is examined, there are some studies indicating that students' motivations increase (Tseng et al., 2010) and decrease (Karakaya et al., 2018; Uzun and Keleş, 2010; Yıldırım and Karataş, 2018) toward learning science depending on the grade level.

Students' knowledge and understanding of the biological world are based on scientific attempts at the subjects of asking questions, formulating, and testing hypotheses. An important aspect of learning biology is to develop creative and critical reasoning skills by participating in the science process (Morgan and Carter, 2017). For these reasons, to increase students' motivation toward biology, it is recommended that the subjects be associated with daily life and provide them with experiences that will help them solve the problems they encounter. Curricula and courses should be supported by laboratories that engage students in the scientific process and encourage scientific thinking. Students should be ensured to experience the excitement of discovery and the satisfaction of solving problems and connecting concepts.

ETHICS COMMITTEE DECISION

The suitability of this research was discussed at the meeting of the Social and Human Sciences Ethics Committee of Tokat Gaziosmanpaşa University, dated April 9, 2021, and ethical permission was obtained with the decision number 08.07.

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