



Identifying the Predictive Power of Biological Literacy and Attitudes Toward Biology in Academic Achievement in High School Students

Research Article

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ABSTRACT

The main aim of this study is to analyze the attitudes of 9th grade students who have taken biology course toward this lesson and their biological literacy levels, and to determine the predictive power of these variables in terms of students' academic achievement in biology. The study employed correlational method, which is a relational research design. The study group consisted of 406 students who were in 9th grade in an Eastern Anatolian province during the 2017-2018 academic year, and volunteered to participate in the study. The research data was gathered using "Biology Lesson Attitude Scale" that measure students' attitudes toward biology course and "Biological Literacy Scale" to assess biological literacy levels. Finding of the study was that; the students had high attitudes toward biology lesson and had high scores for biological literacy scale subfactors and were in structural biological literacy level for all the subfactors. The results of regression analysis in the findings section demonstrated that there was a positive correlation between biology lesson attitude scale score and academic achievement score, and attitude toward this lesson was relatively the most significant variable in the prediction of academic achievement. Furthermore, when other variables were controlled, there was a positive low correlation between academic achievement and "knowledge and use of knowledge" and "science and nature of science" subfactors of biological literacy scale, and a negative low correlation between "interest" subfactor and academic achievement.

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Keywords:

Biological literacy, biology, attitude, academic achievement

Introduction

Literacy means competence in a particular area and is defined as cognitive competency needed in daily life like establishing causal relationships between phenomena and problem solving. According to Disinger and Roth (1992), literacy is an integration of thinking, talking, interacting, and valuing skills on a certain subject. McBride et al. (2013) assert that literacy requires understanding, making informed decisions on a

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particular subject, and acting with responsibility on complex topics and issues facing the society. As literacy involves such skills, it is naturally a plural concept. As the expectations, values and needs of society change almost every day, skills required from individuals and accordingly, the scope of literacy also change and extend. Furthermore, since literacy is a skill that can be improved consistently, what matters is not being literate or not, but to what extent an individual can be literate. In such a changing and developing world, literacy is also an active skill. At the same time, it is inclined to contain everything in the world, i.e. all the knowledge, skills and phenomena that human mind is capable of thinking, and will continue to expand (Kurudayıoğlu and Tüzel, 2010).

Biological literacy

Biological literacy refers to scientific literacy in the subjects of biology (Suwono, Pratiwi, Susanto and Susilo, 2017). Thus, a biologically literate person should have scientific literacy first, for which they should become acquainted with the characteristics of scientific knowledge, the value of science and scientific research methods. A biologically literate individual needs to understand the basic concepts of biology, historical development of biological concepts, biological principles and human effects on biosphere, and know the impact of scientific research, biodiversity, biology-biotechnology on society as well as the significance of biology. They must be capable of creative thinking, formulating problems concerning nature, reason critically, evaluate knowledge, use biotechnology in an appropriate way, make ethical decisions on biological issues and use biology knowledge to solve problems. In brief, the essence of biological literacy is to understand the general principles of biology and implement them in personal and social life. A biologically literate person can comprehend methods and scientific processes implemented by scientists in their studies. They have such skills as observing and classifying scientific studies, designing experiments, interpreting data and making inferences. Thus, the aim of biology education is helping students to put scientific values into practice in natural and technological world as much as ensuring that biological concepts are understood (Uno and Bybee, 1994).

Biological literacy model developed by Uno and Bybee (1994, p.554) represents different levels of understanding and comprehension of biological concepts in students. In this model, there are four levels of biological literacy: nominal, functional, structural and multidimensional.

Table 1: Characteristics of students at the four levels of biological literacy by Uno and Bybee

Level	Characteristics
Nominal biological literacy	Can identify terms and questions as biological in nature
	Possess misconceptions
	Provide naive explanations of biological concepts
Functional biological literacy)	Use biological vocabulary
	Define terms correctly
	Memorize responses
Structural biological literacy	Understand conceptual schemes of biology
	Possess procedural knowledge and skills
	Can explain biological concepts in own words
Multidimensional biological literacy	Understand the place of biology among other disciplines
	Know the history and nature of biology
	Understand the interactions between biology and societ

1. *Nominal biological literacy*: Students can identify biological concepts. For instance, students can define the concept of photosynthesis in this level, but have little knowledge of its meaning and usage.
2. *Functional biological literacy*: Students can define concepts correctly, and have an understanding and experience of the subject at the least. As they cannot fully grasp the conceptual structure of biology, they do not feel the excitement in scientific studies.
3. *Structural biological literacy*: Students understand the conceptual schemes of biology and ideas contributing to the organization of the whole biological thinking. They know the nature and methods of scientific studies and can explain biology subjects in their own words. Students in this level desire to have more information about the biology subjects they are interested in. For example, even if they have learned photosynthesis as a series of chemical reactions, they know the significance of photosynthesis in their own lives. They are aware of the fact that oxygen they inhale, food they eat and clothes they wear are all products of photosynthesis.
4. *Multidimensional biological literacy*: This is the highest level of biological literacy and requires detailed knowledge of biology subjects and establishing relationships between other topics of biology. Students with multidimensional biological literacy can associate biology subjects with other subjects and disciplines. To possess multidimensional biological literacy, a student needs to make research and have a high level of interest in a specific subject, or face a problem concerning their research subject. All these will enhance the level of biological literacy in students.

Let alone students, few scientists can have multidimensional biological literacy in every subject of biology. For instance, while a scientist can have multidimensional literacy about the life history of temperate birds, they can be in functional literacy level in terms of molecular physiology of plants. In a similar vein, a student can be in a different level of biological literacy in every subject as they can also be in any of these levels. For example, even though a student possesses a low level of biological literacy about the subjects of meiosis, the same student can have more biological literacy regarding the animal world. They also can have only nominal literacy about plant physiology while they are in multidimensional literacy level in terms of human physiology. Nevertheless, the general aim of biology education should be providing students with the highest level of biological literacy in every subject of biology even though it is not so simple to achieve.

Attitude toward Biology

Attitudes are emotional inclinations toward people, places, events or ideas (Simpson and Oliver, 1990) and represent a brief assessment of objects or events with attributions such as pleasant-unpleasant, good-bad and useful-harmful (Ajzecz, 2001). There is a connection between attitudes and success (Russel and Hollander, 1975). Biology is a branch of science that has both scientific and social aspects, and biology lesson is affected by attitudes. It is directed by attitudes in a negative or positive way (Pehlivan and Köseoğlu, 2010). Therefore, knowledge of biology can only be acquired with positive attitudes toward biology lesson. Cipkova et al. (2017) assert that teachers should encourage students to observe and explore the nature and natural phenomena, and to have a deeper understanding for developing positive attitudes toward biology.

For adapting to a global world, individuals need to understand the problems of today's world that threaten the life. Understanding numerous problems in areas such as social, environmental and health requires knowledge of biology. Considering that even current issues and news cover epidemics, use of antibiotics, environmental pollution, evolution, global warming, degradation of biodiversity, family planning and murders committed because of not giving birth to a boy, even an understanding of only the domestic and global agenda requires knowledge of biology. From this point of view, Tosun (2011) states that biology has served humanity more than any other discipline. For these reasons, it is of importance that every individual has biological literacy albeit at basic level. Particularly those engaged in sciences must be biologically literate in moderate level at the least and develop positive attitudes toward biology.

Aim of the study

The main aim of this study is to analyze the attitudes of 9th grade students who have taken biology course toward this lesson and their biological literacy levels, and to determine the predictive power of these variables in terms of students' academic achievement in biology.

When the high school education weekly course schedules drafted by the Board of Education of the Ministry of National Education were analyzed, it was seen that biology is offered as part of common courses in 9th grade in all high school education institutions. It is of importance to investigate attitudes toward biology lesson and whether biological literacy has any impact on academic achievement in this course for providing a perspective on students' competence and deficiency, if any, in biology course as a discipline intertwined with life, and increasing their academic achievement. While there are studies in literature examining high school students' attitudes toward biology that may affect their academic achievement in this course (e.g. Çıkıcı, Arıcak and Ilgaz, 2011; Ekici and Hevedanlı, 2010; Erkol and Uğulu, 2013; Gül and Yeşilyurt, 2010; Kışoğlu, 2018; Koçakoğlu and Türkmen, 2010; Konu and Gül, 2017; Özbaş, 2016), we did not find any study aimed at determining learners' biological literacy levels and the predictive power of these variables in academic achievement in this course. In this respect, we believe that the study will contribute to fill the gap observed in literature.

Method

Research design

The study employed correlational method, which is a relational research design. Correlational studies are used to assess the relationship between two or more variables without intervening in these variables in any way (Büyüköztürk, Kılıç-Çakmak, Akgün, Karadeniz and Demirel, 2017). This is a predictive correlational study, which is among correlational research methods.

Study group

The study group consisted of 406 students who were in 9th grade in the province of Kars, Turkey, during the 2017-2018 academic year, and volunteered to participate in the study. The reason why the study group was chosen from 9th grade is that biology course is one of the common courses in 9th grade level in all high school education levels in Turkish education system. For creating the study group, convenience sampling method was preferred, thus, researchers tried to achieve speed and practicality in the study by selecting student groups that were easy to access. Demographic information about the students in the study group is given in Table 2.

Table 2: Demographic information about the study group

Demographic characteristics	Gender		Type of school		
	Female	Male	General High School	Anatolian High School	Vocational and Technical Anatolian High School
N	216	190	135	151	120

Data collection tools

The research data was gathered using data a collection tool comprising three parts. In part one, there were 3 items providing information about the students' gender, school types and average achievement in biology course. Second part involved "Biology Lesson Attitude Scale" that was developed by Tosun (2011) to measure high school students' attitudes toward biology course while "Biological Literacy Scale" developed by

Soğuksu (2013) to assess biological literacy levels was administered in third part. Designed as a 5-point Likert-type scale with single factor model, the Biology Lesson Attitude Scale has 36 items and an alpha value of .96. The students' responses to the item scales concerning their attitudes toward biology are given points from 5 to 1 for positive statements varying between "strongly agree" to "strongly disagree" and from 1 to 5 for negative statements varying between "strongly disagree" to "strongly agree".

Biological Literacy Scale is a 5-point Likert-type scale and comprises 24 items on 3 factors. The total Cronbach's alpha reliability coefficient of the scale was .63. Scoring range of the scale was based on biological literacy levels in Uno and Bybee's study. Accordingly, average scores for the subdimensions in the scale were assessed as follows: conceptual between 5.00-4.20, structural between 4.19-3.40, functional between 3.39-2.60, and nominal between 2.59-1.80 and 1.79-1.00.

Alpha reliability coefficients calculated for the scales are given in Table 3.

Table 3: Reliability Coefficients for Data Collection Tools

Scales	Cronbach's alpha reliability coefficients
Biology Lesson Attitude Scale	.97
Biological Literacy Scale	.89
<i>Knowledge and use of knowledge</i>	.78
<i>Science and nature of science</i>	.89
<i>Interest</i>	.80

Data analysis

SPSS 15 program was used to analyze research data. First, the students' academic achievement scores in biology and attitudes toward biology lesson and biological literacy levels were calculated using descriptive statistics techniques. Afterwards, skewness and kurtosis values were analyzed to determine whether dependent and independent variables showed normal distribution. It was found that the skewness values of the variables varied between -.825 and -.005 while kurtosis values varied between -1.189 and -.227. Based on these values, it was concluded that the data set did not violate the normality assumption (Can, 2014; Seçer, 2013). While Mahalanobis distance was used to examine whether the variables showed multivariate normal distribution and to find extreme values (Pallant, 2015), the study found no extreme value, or result in violation of multivariate normal distribution. To identify multicollinearity, correlation coefficients between the variables as well as VIF and tolerance values were analyzed, and it was found that multicollinearity did not exist. Finally, correlation analysis was conducted to identify whether the independent variables were intercorrelated, and after revealing the existence of correlation, multiple regression analysis was performed for assessing to what extent the students' biology grade averages were predicted by independent variables.

Findings

Table 4 presents the results of descriptive statistical analyses on 9th grade students' academic achievement scores in biology, attitudes toward this lesson and biological literacy scale subdimensions.

Table 4: Descriptive statistics results on the variables

Variables	N	Min	Max	\bar{X}	SS
<i>Academic Achievement scores</i>	406	50	98	73.57	13.83
<i>Biology Lesson Attitude Scale score</i>	406	110	179	151.12	15.75
<i>Biological Literacy Scale scores</i>					
Knowledge and use of knowledge	406	20	50	38.02	8.27

Science and nature of science	406	7	35	26.86	6.63
Interest	406	7	35	26.47	6.66

An analysis of Table 4 revealed that the high school students' academic achievement averages in biology were satisfactory ($\bar{X} = 73.57$). It was found that the participants had high biology lesson attitude scores ($\bar{X} = 151.12$; $151.12/36=4.19$) and high biological literacy scale subfactor scores ($\bar{X}_{\text{fac1}}=38.02$, $38.02/10=3.80$; $\bar{X}_{\text{fac2}}=26.86$, $26.86/7=3.83$; $\bar{X}_{\text{fac3}}=26.47$, $26.47/7=3.78$). It was also identified that the participants were in structural literacy level for all the subfactors of the scale, because of the nature of biological literacy scale.

Table 5 provides the results of correlation analysis indicating the relationship between the participants' academic achievement scores and the scores obtained from biology lesson attitude scale and from the subfactors of biological literacy scale.

Table 5: Results of correlation analysis on the variables

Variables	1	2	3	4	5	
Academic achievement score	1	1				
Attitude Scale score	2	.762	1			
Knowledge and use of knowledge	3	.660	.668	1		
Science and nature of science	4	.658	.625	.736	1	
Interest	5	.548	.587	.694	.812	1

The analysis of correlation values presented in Table 5 showed that academic achievement score, the dependent variable in the study, had a high positive correlation ($r=.762$; $p<.05$) with biology lesson attitude scale score while it had a positive but moderate correlation with biological literacy scale subfactor scores ($r_{\text{fac1}}=.660$, $p<.05$; $r_{\text{fac2}}=.658$, $p<.05$; $r_{\text{fac3}}=.548$, $p<.05$).

Table 6 presents the results of multiple linear regression analysis on the prediction of academic achievement in biology lesson by attitudes toward this lesson and biological literacy levels in 9th grade students who participated in the study.

Table 6: Results of linear multiple regression analysis

Variables	B	Standard Error	β	t	p	Binary r	Partial r	Semi partial r
Constant	-18.127	4.112		-4.408	.000*			
Attitude scale score	0.471	0.036	0.536	12.952	.000*	.762	.543	.383
Knowledge and use of knowledge	0.281	0.081	0.168	3.472	.001*	.660	.171	.103
Science and nature of science	0.639	0.118	0.306	5.430	.000*	.658	.262	.161
Interest	-0.275	0.109	-0.132	-2.522	.012*	.548	-.125	-.075

R=.805 R²=.649
 F(4, 401)=185,154 p=.000

*p<.05

When binary and partial correlations between predictive variables and the dependent variable in the Table was examined, it was seen that there was a high positive correlation between academic achievement score and biology lesson attitude score ($r=.762$), and the correlation between the two variables was $r=.543$ when

other variables were controlled. There was a moderate positive correlation between "knowledge and use of knowledge", the first subfactor of biological literacy scale, and academic achievement score. However, it was seen that this moderate correlation was $r=.171$ when other three variables were controlled. On the other hand, the binary, positive moderate correlation between the subfactor "science and nature of science" and academic achievement score ($r=.658$) was positive but low ($r=.262$) when other three variables were controlled. It was also found that the positive moderate correlation between "interest", the third subfactor of biological literacy scale, and academic achievement score in biology ($r=.548$) was negative and low when other variables were controlled ($r=-.125$).

According to Table 6, biology lesson attitude score and biological literacy scale subfactor scores had a high significant correlation with the students' academic achievement scores for this course. ($R=.805$; $R^2=.649$; $p<.05$). The four variables explained 65% of the total variance in academic achievement. According to the standardized regression coefficient (β), relative significance of predictive variables in academic achievement score in biology course was as follows: attitude score, science and nature of science, knowledge and use of knowledge, and interest. The analysis of the results of T-test on the significance of regression coefficients indicated that the four variables were significant predictors of academic achievement score. Based on these findings, the mathematical representation of multiple linear regression analysis can be as follows:

Academic Achievement = 0.471 Attitude + 0.281 Knowledge and Use of Knowledge + 0.639 Science and Nature of Science - 0.275 Interest

Conclusion, Discussion and Recommendations

This study explored 9th grade students' attitudes toward biology course and biological literacy levels which affect their academic achievement in this course, evaluated the research findings, discussed the results in light of relevant literature and made several recommendations.

The first finding of the study was that the students had high attitudes toward biology lesson. When other studies on the subject were analyzed, it was found that high school students usually display moderate and high attitude toward biology course (Atik, Kayabaşı, Yağcı, Ünlü-Erkoç, 2015; Çevik and Ekici, 2008; Ekli, Karadon and Sahin, 2009; Erkol and Uğulu, 2013; Gül and Yeşilyurt, 2010; Hussaini, Foong and Kamar, 2015; Özbaş, 2016; Prokop, Tuncer and Chuda, 2007). The results obtained from this subdimension of the study are consistent with literature. In addition, it was also found that the students had high scores for biological literacy scale subfactors and were in structural biological literacy level for all the subfactors. Uno and Bybee (1994) who examined biological literacy in various levels assert that individuals in the structural level of biological literacy can understand major concepts in biology and associate these concepts with other disciplines. They can conduct scientific research for biological problems, collect and analyze data, and reach conclusions. Thus, it is a positive finding that the participants had biological literacy in this level. However, necessary effort should also be made to ensure that learners have biological literacy in conceptual level as well.

When we look at foreign literature on biological literacy from past to present, we can find studies by Riddle (1954), Buchanan (1958), Klinge (1960), Wise (1966), Rowntree (1974), Tamir and Jungwirth (1975), Lang (1976), Kolb (1977), Wislinsky (1977), Tones (1977), Rowan (1981), Losco (1982), Flint (1982), Mertens and Hendrix (1982), Risser (1986), Jones (1989), Demastes and Wandersee (1992), Lemons (1994), Uno and Bybee (1994), Bybee (1995) and McInerney (1996). When we searched for the concept of "biological literacy" on Google Ngram, it was seen that the subject has been discussed in the field of international science since the 1950s. Domestically, the concept of biological literacy was introduced to literature after the 2000s, Kaya and Gürbüz (2002), Özbaş and Soran (2012) and Horasan, Aydın and Kete (2013) mentioned about "biology literacy" while only Kurt et al. (2009) and Soğuksu (2013) discussed it in detail. When we searched for the concept as "biyoloji okuryazarlığı" or "biyolojik okuryazarlık" in Turkish language on Google Ngram, unfortunately, no result was

obtained. It means that a subject that has existed for nearly 65 years throughout the world has been addressed in Turkey only in recent years. The fact that biological literacy which particularly interests everyone as the science of life has been mentioned only recently even in Turkish academic circles demonstrates the current status of our country. In this respect, it is a vital need to discuss biological literacy in addition to scientific literacy in all other branches of science more frequently and intensively for the purpose of increasing Turkey's competitiveness in the globalised world. Accordingly, this study was conducted to fill this gap observed in literature. It is also a necessity to increase the number of studies examining the biological literacy levels of learners in the future.

At the end of this study, a high positive correlation was identified between the students' academic achievement scores in biology and their attitudes toward this lesson. Based on this finding, we can claim that high positive attitude toward biology will enhance academic performance in this course. Furthermore, the results of regression analysis in the findings section demonstrated that there was a positive correlation between biology lesson attitude scale score and academic achievement score, and attitude toward this lesson was relatively the most significant variable in the prediction of academic achievement. The results of other studies in literature also found a positive correlation between attitude toward biology lesson and academic achievement, which is consistent with our finding (Afari, 2015; Ali and Awan, 2013; Çıkıcı, Arıca and İlgez, 2011; Nasr and Soltani, 2011; Weinburgh, 1995). As is stated in Ekici and Hedevalı (2010), there is a directly proportional correlation between students' attitude toward the lesson and academic achievement. Thus, when attitudes that are analyzed as part of cognitive field are positive, it might allow students to have a deeper understanding of academic knowledge forming the content of a scientific branch - like biology - that is evolving rapidly and providing knowledge about the living world and life, and also increase their success in this area.

The results of the study also identified a positive moderate correlation between the students' biology literacy levels and academic achievement in biology. The result of the regression analysis showed that when other variables were controlled, there was a positive low correlation between academic achievement and "knowledge and use of knowledge" and "science and nature of science" subfactors of biological literacy scale, and a negative low correlation between "interest" subfactor and academic achievement. One of the primary reasons for such change in correlations may be the extent of biological literacy. Uno and Bybee (1994) maintain that biological literacy is not an endpoint that can be reached in biology courses, but a continuity that improves individuals' understanding throughout their lives. Thus, it is not possible to claim that the participants' biological literacy level was only related to the biology course taken in 9th grade and they achieved structural biological literacy at the end of this lesson. Biology lesson is only one of the factors affecting students' biology literacy levels. Indeed, the results of the regression analysis performed in the study also provide consistent information in this regard. The examination of Beta value indicating the contribution of biological literacy scale subfactors to the prediction of academic achievement ($\text{Fac1}\beta = 0.168$; $\text{Fac2}\beta = 0.306$; $\text{Fac3}\beta = 0.132$) revealed that none of these values were higher than the Beta value calculated for the attitude scale score ($\beta_{\text{attitude}} = 0.536$). These findings show that the subfactors of biological literacy scale makes relatively less contribution to the prediction of academic achievement, the dependent variable, compared to biology lesson attitude scale. However, at the end of the study, it was found that each of the three subfactors of the scale was significant predictors of academic achievement. Based on these findings, it can be concluded that all the subfactors of biological literacy scale had an impact on the students' academic performance, thus the students' biological literacy levels were correlated with biology education and were also among the factors affecting academic performance in this area. Indeed, Roberts (2001) states that one of the aims of biology education is improving learners' biological literacy levels so that they can comment on biology subjects and make decisions in various levels. Besides, a study by Demastes and Wandersee (1992) indicates that biological literacy affects students' academic success.

Uno and Bybee (1994) assert that science and bioethics subjects should be used in class to encourage biological literacy in students. Suwono et al. (2017) state that socio-biological case-based learning can enhance biology student teachers' biological literacy. In their study, Demastes and Wandersee (1992) compiled news articles requiring biological literacy from every issue of a major daily newspaper for the month of November 1989 and found that there was news such as environment, wildlife, domestic animals, biological research in the US media even at that time. When considered in this sense, it is seen that many news articles involving biology knowledge are frequently covered in Turkish media as well. It underlines the necessity that not only biology or science students, teacher candidates or teachers but also the public need to be biologically literate.

In line with the results of the study, the following recommendations are made:

1. After examining high school students' attitudes toward biology, various practices such as extra class hours, practical applications and experimental studies can be added to biology curriculum to make the negative attitudes of students positive. The extra class hour will allow learners to become more involved in the science of biology in the teaching-learning process. If the content of the course is supported by learning-centered educational approaches, the students will be able to participate more actively in the learning process, gain experience in learning and adapt their learning to their daily life. This process may lead to a positive development in the attitudes of learners towards biology.
2. Future studies should frequently address the subject of biological literacy to enrich the relevant domestic literature. It is recommended to increase the number of studies exploring biological literacy all of school levels students in the future to fill the gap in domestic literature on biological literacy and to enhance the validity of the results of this study.
3. Biological literacy level of learners at various levels of education should be investigated, and for those who could not reach conceptual biological literacy level, international studies in this context should be examined and additional educational activities should be held.
4. This study was limited by identifying high school students' attitudes toward biology lesson and biological literacy which are predictors of academic achievement in this lesson. In the future, studies aimed at enhancing attitudes toward biology and biological literacy can be conducted and their impact on academic achievement can be explored.
5. The study found that attitudes toward biology and biological literacy explain 65% of the variance in academic achievement while the remaining 35% is explained by diverse factors. By including factors such as grade, gender, age, high school grade point, academic self-efficacy, academic motivation, etc., the predictive power of these variables in academic achievement in biology can be examined.

GENİŞLETİLMİŞ ÖZET

Lise Öğrencilerinin Biyoloji Dersindeki Akademik Başarılarında Biyoloji Okuryazarlıklarının ve Bu Derse Yönelik Tutumlarının Yordayıcılık Gücünün Belirlenmesi

Problem Durumu ve Çalışmanın Amacı

Bu çalışmanın ana amacı, biyoloji dersini almış olan lise 9. sınıf öğrencilerinin bu derse yönelik tutum ile biyoloji okuryazarlığı düzeylerini inceleyerek, bu değişkenlerin öğrencilerin biyoloji dersine yönelik akademik başarılarını yordayıcılık gücünü belirlemektir. Biyoloji dersine yönelik tutumların ve biyoloji okuryazarlığının bu derse yönelik akademik başarı üzerinde etkisi olup olmadığının araştırılması, öğrencilerin hayatla iç içe bir bilim dalı olan biyoloji dersine ilişkin yeterlikleri ve varsa eksiklikleri hakkında öngörü sağlayarak akademik başarıyı arttırmak amacıyla önem taşımaktadır. Alanyazında, lise öğrencilerinin biyoloji dersi başarılarını etkileyebileceği tahmin edilen derse yönelik tutumlarını inceleyen çalışmalara rastlanmakla birlikte (Ekici ve Hevedanlı, 2010; Gül ve Yeşilyurt, 2010; Koçakoğlu ve Türkmen, 2010; Çıkıcı, Arıca ve Ilgaz, 2011; Erkol ve Uğulu, 2013; Özbaş, 2016) öğrenenlerin biyoloji okuryazarlığı düzeyleri ve bu değişkenlerin derse yönelik akademik başarıyı yordama gücünü belirlemeyi amaçlayan herhangi bir çalışmaya rastlanmamıştır. Bu yönü ile araştırmanın alanyazında gözlemlenen boşluğu doldurmaya katkı sağlayacağı öngörülmektedir.

Metod

Araştırmanın çalışma grubunu 2017-2018 eğitim-öğretim yılında Doğu Anadolu Bölgesi'ndeki bir ilde 9. sınıf düzeyinde öğrenim gören ve araştırmaya gönüllü olarak katılmak isteyen 406 öğrenci oluşturmaktadır. Araştırmanın çalışma grubunun oluşturulmasında kolay ulaşılabilir durum örnekleme yöntemi tercih edilmiş, böylelikle araştırmacılar erişilmesi kolay olan öğrenci gruplarını seçerek araştırmaya hız ve pratiklik kazandırmaya çalışmışlardır.

Araştırmada veriler üç bölümden oluşan veri toplama aracı kullanılarak toplanmıştır. Birinci bölümde, katılımcı öğrencilerin cinsiyetleri, öğrenim gördükleri okul türleri ile biyoloji dersi genel başarı ortalamalarına ait bilgilerin yer aldığı 3 madde yer almaktadır. İkinci bölümde öğrencilerin biyoloji dersine yönelik tutum düzeylerini belirlemek amacıyla Tosun (2011) tarafından geliştirilen "Biyoloji Dersi Tutum Ölçeği", üçüncü bölümde ise biyoloji okuryazarlık düzeylerinin tespiti amacıyla Soğuksu (2013) tarafından geliştirilen "Biyolojik Okuryazarlık Ölçeği" yer almaktadır.

Verilerin analizi

Araştırma verilerinin analizi için SPSS 15 programı kullanılmıştır. Öncelikle öğrencilerin biyoloji dersi genel akademik başarı notları, derse karşı olan tutumları ve biyoloji okuryazarlık düzeyleri betimsel istatistik teknikleri ile hesaplanmıştır. Ardından araştırmanın bağımlı ve bağımsız değişkenlerin normal dağılım sergileyip sergilemediklerinin tespiti için çarpıklık ve basıklık değerleri incelenmiştir. Değişkenlerin çok değişkenli normal dağılım gösterip göstermediğine ve uç değerlere ilişkin inceleme Mahalanobis uzaklığı testiyle incelenmiştir (Pallant, 2015). Son olarak bağımsız değişkenlerin kendi aralarında ilişkili olup olmadıklarını belirlemek amacıyla korelasyon analizi yapılmış, ilişkinin varlığının tespitinin ardından öğrencilerin biyoloji dersi not ortalamalarının bağımsız değişkenler tarafından ne ölçüde yordandığını belirlemek amacıyla çoklu doğrusal regresyon analizi uygulanmıştır.

Bulgular ve Tartışma

Araştırmaya katılan öğrencilerin biyoloji dersi akademik başarıları not ortalamaları bakımından iyi düzeyde oldukları (\bar{X} =73.57) belirlenmiştir. Katılımcı öğrencilerin biyoloji dersi tutum puanları (\bar{X} =151.12;

151.12/36=4.19) ile biyolojik okuryazarlık ölçeği alt faktör puanlarının ise yüksek düzeyde olduğu (\bar{X} fak1=38.02, 38.02/10=3.80; \bar{X} fak2=26.86, 26.86/7=3.83; \bar{X} fak3=26.47, 26.47/7=3.78) tespit edilmiştir. Biyolojik okuryazarlık ölçeğinin yapısı gereği, katılımcı öğrencilerin ölçeğin tüm alt faktörlerindeki okuryazarlık seviyelerinin yapısal biyolojik okuryazarlık düzeyinde olduğu belirlenmiştir. Araştırmanın bağımlı değişkeni olan akademik başarı puanının biyoloji dersi tutum ölçeği puanı ile arasında pozitif yönde yüksek düzeyde ($r=.762$; $p<.05$), biyolojik okuryazarlık ölçeği alt faktör puanları ile de arasında pozitif yönde ancak orta düzeyde ($r_{fak1}=.660$, $p<.05$; $r_{fak2}=.658$, $p<.05$; $r_{fak3}=.548$, $p<.05$) ilişki olduğu tespit edilmiştir. Akademik başarı puanı ile biyoloji dersi tutum puanı arasında pozitif ve yüksek düzeyde bir ilişkinin olduğu ($r=.762$), diğer değişkenler kontrol edildiğinde ise iki değişken arasındaki korelasyonun $r=.543$ olduğu görülmektedir. Biyolojik okuryazarlık ölçeği birinci alt faktörü olan “*bilgi ve bilgiyi kullanabilme*” ile akademik başarı puanı arasında pozitif ve orta düzeyde bir ilişki vardır. Ancak diğer üç değişken kontrol edildiğinde bu orta düzeyde görünen korelasyonun $r=.171$ olarak hesaplandığı görülmektedir. “*Bilim ve bilimin doğası*” alt faktörü ile akademik başarı puanı arasında hesaplanan pozitif ve orta düzeydeki ikili korelasyonun ise ($r=.658$) diğer üç değişken kontrol edildiğinde pozitif ancak düşük düzeyde ($r=.262$) olduğu görülmektedir. Biyolojik okuryazarlık ölçeğinin son alt faktörü olan “*ilgi*” ile biyoloji dersi akademik başarı puanı arasında pozitif ve orta düzeyde hesaplanan ($r=.548$) korelasyonun diğer değişkenler kontrol altına alındığında negatif ve düşük düzeyde ($r=-.125$) olduğu belirlenmiştir.

Biyoloji dersi tutum puanı ile biyolojik okuryazarlık ölçeği alt faktör puanları birlikte, öğrencilerin bu derse yönelik akademik başarı puanları ile yüksek düzeyde ve anlamlı ilişkili vermektedir. ($R=.805$; $R^2=.649$; $p<.05$) Dört değişken birlikte akademik başarıdaki toplam varyansın yaklaşık %65’ini açıklamaktadırlar. Standardize edilmiş regresyon katsayısına (β) göre, yordayıcı değişkenlerin biyoloji dersi akademik başarı puanı üzerindeki göreceli önem sırası; tutum puanı, bilim ve bilimin doğası, bilgi ve bilgiyi kullanabilme ve ilgidir. Regresyon katsayılarının anlamlılığına ilişkin t-testi sonuçları incelendiğinde ise, dört değişkenin de akademik başarı puanı üzerinde anlamlı bir yordayıcı olduğu görülmektedir. Elde edilen bu sonuçlardan hareketle çoklu doğrusal regresyon modelinin sonuçları matematiksel olarak aşağıdaki gibi gösterilebilir.

$$\text{Akademik Başarı} = 0.471 \text{Tutum} + 0.281 \text{Bilgi ve bilgiyi kullanabilme} + 0.639 \text{Bilim ve bilimin doğası} - 0.275 \text{İlgi}$$

Sonuç ve Öneriler

Bu araştırmadan elde edilen ilk bulgu katılımcı öğrencilerin biyoloji dersine yönelik tutumlarının yüksek düzeyde olmasıdır. Bu doğrultuda yürütülen çalışmalar incelendiğinde orta öğretim kademesindeki öğrencilerin biyoloji dersine yönelik genel olarak orta ve yüksek düzeyde bir tutuma sahip oldukları belirlenmiştir (Prokop, Tuncer ve Chuda, 2007; Çevik ve Ekici, 2008; Gül ve Yeşilyurt, 2010; Erkol ve Uğulu, 2013; Atik, Kayabaşı, Yağcı, Ünlü-Erkoç, 2015; Hussaini, Foong and Kamar, 2015; Özbaş, 2016; Ekli, Karadon ve Sahin, 2009). Araştırmanın bu alt boyutundan elde edilen sonuçlar literatür ile örtüşmektedir. Ayrıca araştırmada öğrencilerin biyolojik okuryazarlık ölçeği alt faktör puanlarının da yüksek düzeyde olduğu ve tüm alt faktörlerde yapısal biyolojik okuryazarlık seviyesinde oldukları belirlenmiştir. Biyolojik okuryazarlığı çeşitli seviyelerde inceleyen Uno ve Bybee (1994)’ e göre yapısal biyolojik okuryazarlık düzeyinde olan bireyler, biyoloji bilimindeki önemli kavramları anlayabilir ve bu kavramları diğer bilim dalları ile ilişkilendirebilirler. Biyolojik sorunlara yönelik bilimsel araştırmalar yürütüp veri toplayabilir, bunları analiz edip bir sonuca varabilirler. Dolayısıyla katılımcı öğrencilerin bu düzeyde biyolojik okuryazarlık seviyesinde olmaları olumlu bir sonuçtur.

Regresyon analizi sonuçları da biyoloji dersine yönelik tutum ölçeği puanı ile akademik başarı puanı arasında pozitif yönde bir ilişki olduğunu, bu derse yönelik tutumun akademik başarıyı yordayan göreceli olarak en güçlü değişken olduğu tespit edilmiştir. Alanyazında yer alan araştırma sonuçlarında da bu sonuçla uyumlu olarak biyoloji dersine yönelik tutum ile akademik başarı arasında pozitif yönde bir ilişki olduğu

belirlenmiştir (Weinburgh, 1995; Çıkıcı, Arıçak ve Ilgaz, 2011; Nasr ve Soltani, 2011; Ali ve Awan, 2013; Afari, 2015).

Araştırmanın sonucunda katılımcı öğrencilerin biyolojik okuryazarlık düzeyleri ile biyoloji dersi akademik başarıları arasında da pozitif yönde orta düzeyde ilişki olduğu tespit edilmiştir. Yapılan regresyon analizi sonucunda diğer değişkenler kontrol altına alındığında, akademik başarı ile biyolojik okuryazarlık ölçeği alt faktörlerinden “Bilgi ve bilgiyi kullanabilme”, “Bilim ve bilimin doğası” arasında pozitif yönde düşük düzeyde, “ilgi” ile akademik başarı arasında ise negatif yönde düşük düzeyde bir ilişki olduğu belirlenmiştir. Korelasyonlarda gözlenen bu değişimin önemli nedenlerinden biri biyolojik okuryazarlığın kapsamından kaynaklı olabilir. Uno ve Bybee (1994) biyolojik okuryazarlığın bütünüyle biyoloji derslerinde erişilebilecek bir bitim noktası olmadığını, bir kişinin tüm yaşamı boyunca anlayışını geliştiren bir süreklilik olduğunu ifade etmişlerdir. Uno ve Bybee (1994), öğrencilerin biyoloji okuryazarlığını teşvik etmek için bilim ve biyoetik konularının sınıflarda kullanılması gerektiğini belirtmiştir. Suwono vd. (2017), sosyo-biyolojik vaka temelli öğrenmenin biyoloji öğretmen adaylarının biyolojik okuryazarlıklarını geliştirebileceğini belirtmişlerdir.

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