Journal of Social Sciences of Mus Alparslan University

anemon

Derginin ana sayfası: http://dergipark.gov.tr/anemon

Araştırma Makalesi ● Research Article

Examination of Variables Affecting Science Success of Eighth Grade Students Using Ordinal Logistic Regression Method

Sekizinci Sınıf Öğrencilerinin Fen Başarısı Üzerinde Etkili Olan Değişkenlerin Ordinal Lojistik Regresyon Yöntemiyle İncelenmesi

Özlem Bezek Güre[*], Hikmet Şevgin[**], Murat Kayri[***]

Abstract: The aim of this study is to investigate factors affecting science success of eighth-grade students using Ordinal Logistic Regression method. In this study, information collected from a total of 4224 students, 2202 (52.1%) male and 2022 (47.9%) female, participating in ABIDE2016 application, was used. Ethics Committee approval was obtained from Batman University (16.11.2021-E.37185).The scores obtained by the students entering ABIDE 2016 application from science course were transformed into categorical ones according to the determined threshold values. In analysis, categorized science success score was used as predicted variable, and 15 variables considered to affect science success were used as predictive variables. Then, the obtained data were examined with the help of OLR method. Accordingly, the factors affecting science success were determined as peer bullying, perceived self-efficiency, value given to the course, parental attention, family pressure, father's educational status, mother's educational status, monthly income, having a computer or tablet, having a room of one's own, student's educational goal and participation in science support courses. The results were found to be remarkably similar to those present in the literature. This indicates that OLR method is quite effective in predicting training data. These studies are considered to be handled objectively and without bias.

Keywords: ABIDE, Science Success, Ordinal Logistic Regression Analysis

Öz: Bu çalışmanın amacı, Ordinal Lojistik Regresyon yöntemi kullanılarak sekizinci sınıf öğrencilerinin fen başarısını etkileyen faktörleri araştırmaktır. Bu çalışmada, ABİDE 2016 uygulamasına katılan 2202'si (%52.1) erkek ve 2022'si (%47.9) kız olmak üzere, toplam 4224 öğrenciden toplanan bilgiler kullanılmıştır. Etik Kurul onayı Batman Üniversitesinden alınmıştır. (16.11.2021-E.37185). ABİDE 2016 uygulamasına giren öğrencilerin

[*] Asst. Prof. Dr., Batman University, Health Services Vocational School, Department of Medical Documentation and Secretariat Program
ORCID: 0000-0002-5272-4639, ozlem.bezekgure@batman.edu.tr
[**] Asst. Prof. Dr., Van Yüzüncü Yıl University Department of Education Sciences, Measurement and Evaluation,
ORCID: 0000-0002-9727-5865, hikmetsevgin@yyu.edu.tr
[***] Prof .Dr., Van Yüzüncü Yıl University Department of Computer and Teaching Technologies Education,
ORCID: 0000-0002-5933-6444 E-mail: muratkayri@yyu.edu.tr

Cite as/ Atıf: Güre, Ö. B., Şevgin, H. & Kayri, M. (2022). Examination of variables affecting science success of eighth grade students using ordinal logistic regression method. *Anemon Muş Alparslan Üniversitesi Sosyal Bilimler Dergisi*, *10*(2), 781-797. http://dx.doi.org/10.18506/anemon.1052062
Received/Geliş: 01 January/Ocak 2022
Accepted/Kabul: 18 June/Haziran 2022
Published/Yayın: 30 August/Ağustos 2022

e-ISSN: 2149-4622.

Fen Bilimleri dersinden almış oldukları puanlar belirlenmiş eşik değerlere göre kategorik hale dönüştürülmüştür. Analizde; kategorik hale getirilen fen başarı puanı yordanan değişken; fen başarısını etkilediği düşünülen 15 adet değişken ise yordayıcı değişken olarak kullanılmıştır. Daha sonra elde edilen veriler Ordinal Lojistik Regresyon yöntemi ile incelenmiştir. İnceleme sonucu fen başarısını etkileyen faktörler sırasıyla; akran zorbalığı, öz yeterlilik algısı, derse verilen değer, aile ilgisi, aile baskısı, baba eğitim durumu, anne eğitim durumu, aylık gelir, bilgisayar ya da tablet sahibi olma durumu, kendisine ait odaya sahip olma durumu, öğrencinin eğitimdeki hedefi ve fen destekleme kurslarına katılma durumu olarak belirlenmiştir. Elde edilen sonuçların literatür ile büyük oranda benzerlik gösterdiği görülmüştür. Bu da OLR yönteminin eğitim verileri üzerinde tahmin yeteneğinin yüksek olduğuna işaret etmektedir. Bu tür çalışmaları yansız-sapmasız ele alacağı düşünülmektedir.

Anahtar Kelimeler: ABIDE, Fen Bilimleri, Ordinal Lojistik Regresyon Analizi.

Introduction

Education is one of the most important indicators of the level of development of societies. In recent years, the need for creative, innovative, and productive individuals who have scientific thinking and problem-solving skills, and who are able to keep up with developments, and do research and solve question has been increasing (Anıl, 2009; Çalık, 2020). It is possible to meet this need with a qualified education. As a result of the rapid advancement of technology, it is necessary for students to learn basic scientific concepts and theories as well as the skills needed to address scientific problems (Anıl, 2009). Science and technology advancements are strongly intertwined with scientific innovations. As a result, science education is essential in educational systems (Sadıç& Çam, 2015). Science develops students' ability to evaluate and think critically about their daily lives. It also helps them to understand and deal with economic, social, and environmental challenges (Ramirez, Luo, Schofer, & Meyer, 2006). Therefore, considering that our century is the age of technology, it is crucial to educate individuals who can understand basic scientific concepts and theories and have the ability to configure and solve scientific problems. For this reason, countries participate in national and international practices in order to increase the success level of students, to see the impact of education policies on their students, and to increase the quality and level of education (Anıl, 2009). Countries can use these applications to assess their present condition, develop plans for the future, and compare themselves to other countries. As a result, they may identify the strengths and weaknesses of different educational systems (Çalık, 2020). Our country participates in international practices such as Programme for International Student Assessment (PISA), The Trends in International Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS) (Anıl, 2009; Azapağası, İlbağı&Akgün, 2012). Due to the insufficiency of these practices in determining the success of national education programs, the Ministry of Education has undertaken an application ABIDE (Şevgin, 2020). The national-based practice was first carried out in our country in 2016 (Çalık, 2020; MEB, 2017; Yılmaz, 2021). ABIDE research, which is carried out periodically every two years, was applied in 2016 and 2018, but could not be implemented in 2020 due to the Covid-19 pandemic.

ABIDE aims to assess the knowledge and skills gained by eighth graders in formal education and to develop a nationwide monitoring and assessment system (MEB, 2017). Furthermore, ABIDE application allows for the determination of students' academic levels as well as their comparisons across regions and provinces. The application attempts to assess students' opportunity to utilize what they have learnt in school in their daily lives. In addition, information believed to be helpful in student success is also collected about student, family, teacher, and school factors (MEB, 2017; Şevgin, 2020; Ülkü, 2019).

ABIDE application is similar to PISA in terms of measurement of skills and TIMMS in terms of acquisition (MEB, 2017). PISA program includes Reading Skills, Science, and Mathematics, whereas TIMMS application includes Mathematics and Science. In ABIDE application, achievement tests prepared in the field of Turkish, Mathematics, Science and Social Studies are applied to students.

For each of these four basic areas, students are ranked in five categories as below basic, basic, intermediate, upper-intermediate, and advanced according to their success levels, using standard cut-

off scores determined by the experts of fields. The cut-off scores for science from these categories are as in Table 1.

Table 1. Science Proficiency Levels and Scores

Proficiency Levels	**Range**
Below Basic	X < 326.72
Basic	326.72 < X < 437.80
Intermediate	437.80 < X < 518.20
Upper-Intermediate	518.20 < X < 571.50
Advanced	X > 571.50

(MEB, 2017)

When Table 1 is examined, it is seen that those who score less than 326.20 points in the science achievement test are at the below-basic proficiency level, and those who score between 326.72 and 437.80 are at the basic proficiency level, and those who score between 437.80 and 518.20 are at the intermediate proficiency level, and those who score between 518.20 and 571.50 are at the upper-intermediate proficiency level, and those who score between 517.50 and 517.50 are at the advanced proficiency level.

As shown in Table 1, the field specialists transformed the student success score obtained as a continuous score in each field, including Turkish, Mathematics, Science, and Social Sciences, into an ordinal categorical form in ABIDE application. Thus, students with similar success characteristics were grouped together and ranked in the same category, whilst students with diverse success characteristics were placed in different categories based on their performance levels. As in ABIDE application, in other large-scale national and international applications (such as PISA, TIMSS, PIRLS), academic achievement is ordinally categorized at certain cut-off points. Therefore, it is important to use the Ordinal Logistic Regression (OLR) method in order to obtain robust results for large-scale applications giving results for student success in ordinal and discrete categorical scores as well as continuous score types.

When the literature is examined, it is seen that there are many studies on students' science success (Akamca&Hamurcu, 2005; Alkan, Alkan&Bayri, 2017; Anıl, 2009; Bayat, Şekercioğlu& Bakır, 2014; Ceylan& Berberoğlu, 2010; Sadıç& Çam, 2015; Uzun& Öğretmen, 2010; Uzun, Gelbal& Öğretmen, 2010) On the other hand, it is also seen that there are many studies carried out using ABIDE data (Akıncı, 2020; Çalık, 2020; Elkonca, 2020; Şevgin, 2020; Ülkü, 2019). However, there is no study having used OLR method to assess the factors impacting students' science success using ABIDE data, as used in the current study.

The purpose of this study is to use OLR method to determine the factors impacting eighth-grade students' science success. Various demographic information and scales belonging to the students participating in ABIDE 2016 application were used as independent variables.

Method

This study is carried out in the general survey model because it includes survey arrangements (Karasar, 2012) to make a general judgment about the universe on the sample taken from the universe. It is a descriptive study since it aims to describe the nature of the variables as they are without changing them, and it is also carried out in the relational survey model because it tries to predict the possible relationships between the variables based on the data obtained from a large number of participants.

Study Group

Ethics Committee approval was obtained from Batman University (16.11.2021-E.37185). 34693 students were selected from 81 provinces to participate in ABIDE program between April and May 2016. In this study, data obtained from 5000 students randomly drawn from 34693 students were used. However, when using deletion for lost demographic information, value assignment was performed using EM (Expectation-Maximization) algorithm from missing data assignment techniques because the ratio of missing data at the scale level was less than 5%. As a result of the missing data deletion and assignment processes, the current number was determined as 4224, of which 2202 (52.1%) were boys and 2022 (47.9%) were girls. It can be said that this number is quite high in terms of its ability to represent the population.

In addition, since it was observed that the current missing data was less than 5% at the variable level, value assignment was performed for the missing data using EM (Expectation-Maximization) algorithm, one of the missing data assignment techniques

Measurement Tools

As part of the research, Science Achievement Test and student questionnaire belonging to ABIDE 2016 application were used as measurement tools and the data collected through these tools were used. The data file of ABIDE 2016 application was obtained with the permission of the Ministry of National Education. The raw data was then modified to the study's scope using statistical programs.

In this study, the variables of peer bullying, perceived self-efficacy, value given to the course, parental attention, and family pressure, which are thought to affect students' science success and included in the analysis as continuous variables, consisted of data collected at the scale level and included in the model over the total score of the scales. Categorical variables were gathered from demographic data, and their categories and percentages of representation are shown in Table 2.

Table 2. Descriptive Statistics of Categorical Variables

Predictors	**Categories**	**%**
Gender	Female	52.1
	Male	47.9
Mother's Educational Status	Unknown	2.6
	Postgraduate	1.1
	Bachelor degree	5.3
	Associate degree	1.2
	High-school graduate	15.1
	Secondary school graduate	19.6
	Primary school graduate	43.9
	Never went to school or dropped out of primary school	11.2
Father's Educational Status	Unknown	2.5
	Postgraduate	1.7
	Bachelor degree	8.2
	Associate degree	2.8
	High-school graduate	24.6
	Secondary school graduate	23.1
	Primary school graduate	33.7
	Never went to school or dropped out of primary school	3.4
Family's Monthly Income	Unknown	20.3
	6001 TL and above	2.5
	Between 4001-6000 TL	5.1
	Between 2501-4000 TL	15.5
	Between 1501-2500 TL	25.5
	Between 0-1500 TL	31.1
Do you have your own computer or tablet?	Yes	55.7

	No	44.3
Do you have your own desk?	Yes	73.4
	No	26.6
Do you have your own room?	Yes	63.8
	No	36.2
Do you have internet connection?	Yes	56.9
	No	43.1
What is your educational goal?	Doing a master's or doctorate (Getting a postgraduate degree)	26.6
	Finishing university	57.5
	Finishing college	4.8
	Finishing high-school	11.1
Have you participated in the Support and Training Courses opened in your school during this academic year for the Science Course?	I've participated both semesters	35.3
	I've only participated 2nd semester	11.8
	I've only participated 1st semester	7.4
	I haven't participated	45.5

In Table 2, it is seen that 52.1% of the students are female and 47.9% are male. When the educational status of the parents is examined, it is understood that most of the students' parents are primary school graduates. When looking at the family's monthly income, it's seen that 31.1% of the students have a monthly income of 0-1500 TL, followed by 25.5% with a monthly income of 1501-2500 TL. When looking at the number of students who own a computer or tablet, it is seen that 55.7% of students have one, while the rest do not. Table 2 shows that 73.4% of students have a desk, 63.8 percent have their own room, and 56.9% have their own bathroom. Finally, it is understood that the rate of those who have not participated in Science Support and Training courses is high.

Data Analysis

Before starting the data analysis with OLR method, it was determined whether the variables collected at the scale level had any problems with reliability, validity, or multicollinearity. Table 3 shows the evidence obtained at the scale level for the reliability and validity of the variables of bullying, perceived self-efficacy, value given to the course, parental attention, and family pressure.

Table 3. Reliability and factor analysis results of variables

	Alfa (α)	**McDonald's (ω)**	**Lowest factor loading value**	**Highest factor loading value**	**Number of factors**
Bullying	0.89	0.90	0.675	0.810	1
Perceived self-efficacy	0.85	0.86	0.433	0.881	1
Value given to the course	0.90	0.90	0.687	0.876	1
Parental attention	0.77	0.78	0.468	0.782	1
Family pressure	0.76	0.77	0.482	0.791	1

In Table 3, Chronbach Alpha (α) and McDonald's (ω) reliability indices are given for the reliability of each scale. Unlike Cronbach Alpha (α),McDonald's (ω)is known to produce more unbiased results due to the fact that factor loading values of the items in the scales are not equal (Yurdugül, 2006). The lowest and highest values were obtained as 0.77 and 0.90 using the McDonald's (ω) reliability coefficient, respectively. These values regarding the variables obtained at the scale level show that the reliability is at good levels (Kılıç, 2016; Kula Kartal&MorDirlik, 2017). The lowest and highest factor loading values of the items that make up each scale are presented for validity. The acceptable range for the factor loading value of the items is 0.40 and above. However, there is a common view that the minimum value should be 0.30 (Çokluk, Şekercioğlu& Büyüköztürk, 2012). In Table 3, it is seen that the lowest value is 0.433 and the highest value is 0.881 when looking at the factor loading values on which the items belonging to the scales are loaded. In other words, the factor loads of the items are above the acceptable limit. In addition, the number of factors was obtained as 1 for each variable, which indicates that the variables are one-dimensional. Again, VIF (Variance Inflation Factor) and tolerance values were examined to be able to determine the multicollinearity problem between the variables. It was observed that VIF values were between 1.033 and 1.453, and

tolerance values were between 0.688 and 0.968. The fact that the obtained VIF values are not greater than 10 and the tolerance values are not less than 0.2 (Arı&Yıldız,2016; Büyüköztürk, 2011; Keller, El-Sheikh, Granger& Buckhalt, 2012; Özdamar, 2013) indicates that there is no multicollinearity problem. In addition, since the assumptions such as normality, linearity and homogeneity are not the prerequisites in OLR method, these assumptions have not been tested separately. Finally, the number of students in the cells of the independent variable sub-categories was controlled and reduced to a single cell with the name of postgraduate in order to demonstrate a balanced distribution of the number of students in the master and doctorate cells at the level of parent's educational status.

Ordinal Logistic Regression Analysis

It is seen that OLR method is frequently used in studies that are centered on variables that are categorized in an ordinal way and that show graduality (Abacıoğlu& Ünal, 2017; Akın& Şentürk, 2012; Bozpolat, 2016; Şevgin, 2013). In this study, OLR method was used in order to carry out a category-level examination because the science success of the students exhibited ordinal categorical characteristics in itself. In this way, it is possible to examine the factors that are investigated for success and their possible effects on student success that show ordinal categorical characteristics at the level of categories.

OLR method is one of the members of the logistic regression family and is called by this name according to the type of dependent variable. In the logistic regression family, the binary logistic regression method is used for cases where the dependent variable is binary categorical, the ordinal logistic regression method for cases where there are more than two and ordinal scales, and the multinomial logistic regression method for cases where there are more than two categories and there is no ordered situation between the categories.

In logistic regression models, it is not necessary to provide assumptions such as normality, linearity and homogeneity of variances, which are prerequisite assumptions in linear regression models (Abacıoğlu& Ünal, 2017; Akın& Şentürk, 2012; Bozpolat, 2016; Çokluk, 2010; Çokluk, Şekercioğlu& Büyüköztürk, 2012; Tabachnick& Fidell, 1996). However, there are some assumptions that need to be met in order to apply OLR method. These are the "parallel lines" and "goodness of fit" assumptions. The most important assumption in OLR method is the assumption of parallelism (Akın& Şentürk, 2012; Bozpolat, 2016; Özdamar, 2013). Various methods such as Wald test, chi-square test and likelihood ratio test are used to check the validity of the parallel lines assumption (Akın& Şentürk, 2012; Özdamar, 2013; Şevgin, 2013).

OLR method uses "odds" ratios, called the cumulative ratio model, similar to other regression methods. Among the dependent variable categories, the one displaying the last group is selected as the reference category. Then, for each of the subsequent categories, J-1 cut-off point estimations with cumulative probability can be generated (Akboğa Kale, 2020; McCullagh, 1980; O'Connell, 2006). Since cumulative frequencies are used, the probability of the last category is always equal to 1. The equation of OLR method is as follows;

$$\ln(Y_j) = \ln\left(\frac{P(Y\leq/\ /X_1,X_2,\ldots..X_i}{1-P(Y\leq/\ /X_1,X_2,\ldots..X_i}\right) = \alpha_j - (\beta_1 X_1 + \cdots .. + \beta_i X_i) \qquad (1)$$

OLR method uses ordinal logit models based on cumulative probabilities because they are easy to implement and interpret. Ordinal logic models are of 3 different types: proportional odds model, generalized ordinal logit model, partial proportional odds model (Arı& Yıldız, 2016).

Proportional Odds Model

The Proportional Odds Model, which is a member of the cumulative logistic regression family and also called Cumulative Logit Model, is used in cases where the parallelism assumption is met in OLR method (Arı&Yıldız, 2016; Liu, 2009; McCullagh, 2005). The Proportional Odds (Cumulative) Model proposed by McCullagh (1980) is widely used in logit models of ordinal dependent variables (Fullerton, 2009; Halaby 1986; McCullagh, 1980; Wright, Baxter, and Birkelund 1995). This model is based on the distribution of cumulative probabilities (Arı, 2013).

The proportional odds model assumes that breakpoints between categories are unknown to avoid assigning random scores to categories. The equation for the proportional odds model is given below (Fullerton& Xu, 2012; Long& Cheng 2004; McCullagh 1980):

$$\Pr(Y \leq m\backslash x) = \pi_1(x) + \cdots + \pi_m(x), \quad m = 1, \ldots, M \qquad (2)$$

Here, π_m represents the probability of Y=m for m=1. The equation defined by the binary logit function is shown below:

$$\ln\left(\frac{\Pr(y\leq m/x)}{\Pr(y>m/x}\right) = \ln\left(\frac{\pi_1(x)+\cdots+\tau_m(x)}{\pi_{m+1}(x)+\cdots+\pi_M(x)}\right) \quad (1 \leq m < M) \qquad (3)$$

Here, each cumulative logit function uses all M dependent variables. The Proportional Ratio model simultaneously estimates M-1 cumulative logits and limits β's in the equation given below:

$$ln\left(\frac{\Pr(y\leq m/x)}{\Pr(y>m/x}\right) = \tau_m - x\beta \; (1 \leq m < M) \qquad (4)$$

Here; m represents the ordinal dependent categories, x represents the vector of the independent variables, τ represents the cut-off point, and β represents the coefficient vector of the logit function. The proportional odds model assumes that there is an underlying hidden variable of observable, intermittent, and categorical data (Arı, 2013; Tansel & Güngör, 2004). However, this assumption is not necessary to estimate the model and the model coefficients. The assumption of equality of β in breakpoint equations is known as the proportional odds or parallel regression assumption. (McCullagh & Nelder, 1989; McCullagh, 1998; Fullerton & Xu, 2012).

Generalized Ordinal Logit Model

The Generalized Ordinal Logit Model was developed by Fu (1998). In this model, the proportional ratio assumption for independent variables is relaxed (Fullerton, 2009; Fullerton& Xu, 2012; Maddala, 1983; McCullagh& Nelder, 1989; Williams, 2006). Parallelism assumption is not met in the model and cumulative logits are used during logit generation (Arı, 2013)

Generalized Ordinal Logit Model is as follow:

$$\ln\left(\frac{\Pr\{y\leq m/x\}}{\Pr\{y>m/x\}}\right) = \tau_m - \boldsymbol{x}\beta_m \; (1 \leq m < M) \qquad (5)$$

The equation can be expressed as shown above. Here, m represents the ordinal dependent variable, x represents the vector of the independent variables, τ represents the cut-off point, β represents the logit coefficients vector. The subscript m on the logit coefficient vector shows that different coefficients can be obtained for each independent variable in breakpoint equations (Fullerton& Xu, 2009). In this aspect, it is separated from the proportional odds model (Arı, 2013).

Partial Proportional Odds Model

The Partial Proportional Odds Model (1990), which shows the characteristics of proportional odds and generalized ordinal logit models, was proposed by Peterson and Harrell (Arı& Yıldız, 2016). The model is used when the assumption of parallelism is met for some variables but not for others (Arı, 2013; Peterson& Harrell, 1990). Arı (2013) states that this model is more efficient than the generalized ordinal logit model because it includes the assumption of parallel lines and generates common parameters for the variables that supply the assumption, and therefore has fewer parameters to study.

Partial proportional odds model is as follows:

$$\ln\left(\frac{Pr(y\leq m/x)}{Pr(y>m/x}\right) = \tau_m - x\beta - \omega\eta_m \; (1 \leq m < M) \qquad (6)$$

Here, m represents the ordinal dependent variable, x and ω represent the vector of the independent variables, τ represents the cut-off point, β represents the constant logit coefficients of the cut-off point equations, and η represents the logit coefficient vector of various cut-off point equations (Fullerton& Xu, 2009).

The Partial Proportional Odds model is divided into two categories as constrained and unconstrained partial proportional odds models (Peterson& Harrell, 1990).

a. Unconstrained Partial Proportional Odds Model

The Unconstrained Partial Proportional Odds Model was also developed by Peterson and Harell (1990). It is used in cases where the parallel lines assumption cannot be met for all variables. In this model, two coefficient sets are estimated, in which the assumption of parallelism is met in one of the clusters but not in the other (Dağlıoğlu& Oral Erbaş, 2017).

The cumulative probability function of the model of the dependent variable Y with k+1 category, which has N independent variables, is given below:

$$C_{ij} = \Pr(Y \geq j \backslash X_i) = \frac{1}{1+\exp(-\alpha_j - X_i' - T_i'\gamma_j)},\ j = 1, \ldots\ldots, k \qquad (7)$$

Here; p represents px1 dimensional vector containing the observation values over the set of independent variables, **β** represents px1 vector of the regression coefficients associated with p variables in X_i, $\mathbf{T_i}$, q≤p represents cases where the proportional odds assumption is not met or tested, p represents qx1 dimensional vector containing the observation values "i" over the subset of its arguments, γj representsqx1-dimensional vector of the regression coefficients associated with the q variables and thus, $T_i'\gamma_j$ represents the increment associated with the jth cumulative logit function with j=1, …., k and γ_J=0. The elements of γ_j are expressed as $\gamma_{jl}$with ļ=1,…,q (Peterson& Harrell, 1990).

b. Constrained Partial Proportional Odds Models

The Constrained Partial Proportional Odds model was first proposed by Fullerton (2009) and developed by Peterson and Harrell (1990). It requires fewer parameters than the Generalized Ordered Logit Model or the Unconstrained Partial Proportional Ratio Model in this model, parameter constants are estimated using Maximum Availability estimation (MAE) instead of assigning values based on preliminary knowledge and beliefs (Williams, 2006) or findings from an unrestricted partial result (Fullerton& Xu, 2012).

$$C_{ij} = \Pr(Y \geq j \backslash X_i) = \frac{1}{1+\exp(-\alpha_j - \boldsymbol{X_i'\beta} - \boldsymbol{T_i'\gamma}\ \ \boldsymbol{\Gamma}_j)},\ j = 1, \ldots\ldots, k \qquad (8)$$

The Constrained Proportional Rate Model is as shown above. Here; $\mathbf{\Gamma_j}$ represents the predetermined constant scalar and.γ, on the other hand represents a vector with a length of q elements that doesn't have the subscript j and is expressed as γ realized Ordered Logit Model or the Unconstrained Partial $\mathbf{\Gamma_j}$'in the calculation of jth cumulative logit function (Peterson &Harrell, 1990).

Findings

A model of OLR was established in order to determine the factors affecting students' science success in terms of various variables. In the established model, the parallelism assumption was first tested. The results of the analysis are given in Table 4.

Table 4. Parallelism Assumption Test

Model	-2 Loglikelihood	Chi-Square (χ^2)	df	Sig.
Null Hypothesis	10711.030			
General	10597.564[b]	113.465[c]	105	0.269

H_0: Parameter predictions pass through the same breakpoint.

H_1: Parameter predictions pass through different breakpoints.

As shown in Table 4, the parallelism assumption was tested with the chi-square (χ2) test with χ2=113.465 and p=0.269. Due to p>0.05, the parallelism assumption can be said to be met in this

situation. This shows that OLR method can be applied. Then the model goodness needs to be tested. The hypotheses for model goodness are as follows:

H_0: The model fits for its data.

H_1: The model does not fit for its data.

Table 5. Goodness of Fit Test by Test Statistics

	X^2	df	Sig.
Pearson	16489.904	16849	.975
Deviation	10711.030	16849	1.000

As shown in Table 5, since p is greater than 0.05 (p>0,05), it seems that the model is suitable as of its data.

In the current study, the accuracy of the fit of the model was examined with the Pseudo R^2. McFadden, Cox-Snell and Nagelkerke statistics are among the most used Pseudo R^2 statistics. (Bozpolat,2016; Şenel and Alatlı, 2014). R^2 value is not considered a good criterion because it is low in logistic regression analysis (Akın&Şentürk, 2012; Bozpolat, 2016).

Table 6. Goodness of Fit Values according to Pseudo R-square Values

CoxandSnell	Nagelkerke	McFadden
0.282	0.299	0.115

The goodness of fit of the model R^2 (Coefficient of Determination) is a measure that shows what percentage of the dependent variable is explained by the independent variables. As shown in Table 6, the values are as follows: Cox and Snell R^2=0.282, Nagelkerke R^2=0.299, and McFadden R^2=0.115. It is seen that 30% of the dependent variable of science success in the model is explained by the independent variables.

Finally, Table 7 is used to interpret the parameters. In this table, those with a significant value less than 0.05 are statistically significant. When interpreting table values, the marks in front of the estimate values are taken into consideration. A negative sign is interpreted as a negative contribution, and a positive sign is interpreted as a positive contribution.

Table 7. Expression of Significance of Model Parameters

	Estimate	Std. Error	p	Odds Ratio
[SCIENCE CATEGORY = 1.00]	-2.621	0.346	**0.000**	
[SCIENCE CATEGORY = 2.00]	1.002	0.329	**0.002**	
[SCIENCE CATEGORY = 3.00]	2.587	0.332	**0.000**	
[SCIENCE CATEGORY = 4.00]	3.823	0.333	**0.000**	
Peer bullying	-0.015	0.006	**0.007**	**0.985**
Perceived self-efficacy	0.023	0.004	**0.000**	**1.023**
Value given to the course	-0.019	0.007	**0.005**	**0.981**
Parental attention	0.023	0.011	**0.040**	**1.023**
Family pressure	-0.038	0.012	**0.002**	**0.963**
[Gender=Male]	-0.027	0.06	0.651	0.973
[Gender=Female]	0[a]	.	.	
[Father's Educational Status =1]	0.531	0.266	**0.045**	**1.701**
[Father's Educational Status =2]	1.003	0.327	**0.002**	**2.726**
[Father's Educational Status =3]	0.797	0.218	**0.000**	**2.219**
[Father's Educational Status =4]	0.973	0.256	**0.000**	**2.646**
[Father's Educational Status =5]	0.328	0.186	0.078	1.388
[Father's Educational Status =6]	0.091	0.183	0.621	1.095
[Father's Educational Status =7]	-0067	0.177	0.707	0.935
[Father's Educational Status =8]	0[a]	.	.	

[Mother's Educational Status=1]	-0.112	0.223	0.614	0.894
[Mother's Educational Status =2]	1.085	0.341	**0.001**	**2.959**
[Mother's Educational Status =3]	1.427	0.193	**0.000**	**4.166**
[Mother's Educational Status =4]	1.513	0.309	**0.000**	**4.540**
[Mother's Educational Status =5]	0.756	0.133	**0.000**	**2.130**
[Mother's Educational Status =6]	0.481	0.122	**0.000**	**1.618**
[Mother's Educational Status =7]	0.636	0.106	**0.000**	**1.889**
[Mother's Educational Status=8]	0[a]	.	**.**	
[Monthly Income=1]	-0.142	0.083	0.088	0.868
[Monthly Income=2]	0.128	0.211	0.543	1.137
[Monthly Income=3]	0.248	0.154	0.107	1.281
[Monthly Income=4]	0.323	0.098	**0.001**	**1.381**
[Monthly Income =5]	0.282	0.079	**0.000**	**1.326**
[Monthly Income =6]	0[a]	.	**.**	.
[Having a Computer or Tablet=1]	-0.170	0.065	**0.009**	**0.844**
[Having a Computer or Tablet=2]	0[a]	.	.	
[Having a Workdesk=1]	0.111	0.073	0.128	1.117
[Having a Workdesk=2]	0[a]	.	.	
[Having a Room of One's Own=1]	0.133	0.067	**0.049**	**1.142**
[Having a Room of One's Own=2]	0[a]	.	.	
[Internet Connection=1]	0.119	0.067	0.074	1.126
[Internet Connection=2]	0[a]	.	**.**	
[Educational Goal=1]	2.396	0.123	**0.000**	**10.979**
[Educational Goal=2]	1.548	0.109	**0.000**	**4.702**
[Educational Goal=3]	0.655	0.164	**0.000**	**1.925**
[Educational Goal=4]	0[a]	.	**.**	
[Participation in Science Support Course =1]	0.450	0.097	**0.000**	**1.569**
[Participation in Science Support Course =2]	-0.135	0.116	0.245	0.874
[Participation in Science Support Course =3]	-0.287	0.067	**0.000**	**0.750**
[Participation in Science Support Course =4]	0[a]	.	.	

a:Set to zero because this parameter is redundant.

When Table 7 is examined, it is seen that 12 of the 15 independent variables used in the study are statistically significant according to certain categories, while the others are not significant. As a result, 12 variables found to be significant will be interpreted. Again, it is seen that the last categories of the variables are the reference categories. Therefore, the comments for each variable will be interpreted according to the last category, which is the reference category.

Table 7shows that variables of peer bullying, perceived self-efficacy, value given to the course, parental attention, and family pressure had statistically significant effects on scientific success ($p<0.05$). The variables of peer bullying, value given to the course, and family pressure have been found to have a negative impact on success, whereas the variables of perceived self-efficacy and parental attention had a positive impact.

When examining the situation between the father's educational status and students' science success, it appears that there is a statistically significant difference between certain categories of father's educational status and science success. The categories in question were found to be "Unknown, Postgraduate, Bachelor's Degree, and Associate Degree". The category of "never went to school or dropped out of primary school" is included in the analysis as a reference category. According to the reference category, those whose father's educational status were unknown were 1.7 times more successful, those with a postgraduate degree were 2.72 times more successful, those with a bachelor's degree were 2.21 times more successful and those with an associate degree were 2.64 times more successful.

When examining the relationship between the mother's educational status and students' science success, it is seen that there is a statistically significant difference between certain categories of mother's educational status and science success. The categories in question were found to be "Postgraduate, Bachelor's degree, and Associate Degree, High School Graduate, Secondary School Graduate and Primary School Graduate". The category of "never went to school or dropped out of primary school" is included in the analysis as a reference category. According to the reference

category, it is seen that those whose mothers have a postgraduate education are 2.05 times more successful, those with a bachelor's degree 4.16 times, those with an associate degree 4.54 times, those whose mothers are high school graduates 2.13 times, those whose mothers are secondary school graduates 1.61 times, and those whose mothers are primary school graduates 1.88 times more successful.

When examining the relationship between the monthly income variable and the students' science success, it is seen that the two variables have a statistically significant difference. Those with a monthly income of "0-1500 TL" are used as the reference group in the analysis. According to the reference category, those with a monthly income of 2501-4000 TL are 1.38 times more successful, while those with a monthly income of 1500-2500 TL are 1.33 times more successful.

When examining the relationship between the variable of "having a computer or tablet" and students' science success, it is seen that there is a statistically significant difference between the two variables. "Those who do not own computers or tablets" is included in the analysis as a reference category. It is understood that those who own computers or tablets are about 0.84 times more likely to fail than those who do not.

When examining the relationship between the variable of "having a room of one's own" and the science success of students, it is seen that there is a statistically significant difference between the two variables. "Those who have no room of their own" is included in the analysis as a reference category. It is understood that those who own rooms are 1.14 times more successful than those who do not.

When examining the relationship between the variable of "educational goal" and the students' science success, it is seen that there is a statistically significant difference between the specific categories of the educational goal variable and science success. These categories were found to be "doing a master's or doctorate", "finishing university", "finishing college" and "finishing high-school". The category of "finishing high school" in the variable of educational goal is included in the analysis as a reference category. According to the reference category, it is seen that those who aim to do a master's or doctorate degree were 10.98 times more successful, those who aim to finish university 4.7 times, and those who aim to finish college were 1.92 times more successful.

Finally, when examining the relationship between the variable of "participation in science support courses" and students' science success, it is seen that there is a statistically significant difference between certain categories of participation in science support courses and students' science success. The categories in question were found to be "I've participated both semesters" and "I've only participated 1stsemester". Those who did not participate in the course are included in the analysis as a reference category. According to the reference category, those who participated in Science Support courses for both terms are 1.57 times more likely to succeed, whereas those who participated for only the first semester are 0.75 times more likely to fail.

Discussion and Conclusion

The aim of this study is to use OLR method to discover the elements that influence students' science success. According to the results of OLR method, the factors affecting science success were determined as peer bullying, perceived self-efficacy, value given to the course, parental attention, family pressure, father's educational status, mother's educational status, monthly income, having a computer or tablet, having a room of one's own, student's educational goal and participation in science support courses.

The bullying variable was revealed to be a negative predictor of science success according to OLR method. Similarly, in Şevgin's (2020) study, it was discovered that there is a negative relationship between science success and bullying. According to the literature, students who are bullied have lower academic success than those who are not (Kartal& Bilgin, 2009; Whitted& Dupper, 2005; Winnaar, Arends& Beku, 2018).

Another variable that is considered to be significant according to OLR method is perceived self-efficacy. Self-efficacy describes people's belief in their own ability to achieve the level of success they

want (Bandura, 1993). When the literature is examined, it is seen that there are studies that investigate the science success with self-efficacy (Çalık, 2020; Şevgin, 2020). In parallel with the findings of this study, it has been reported that self-efficacy is a significant part of science success. In the literature, there are many studies showing that there is a significant relationship between self-efficacy and academic success (Aktürk& Aylaz, 2013; Chang& Bangsri, 2020; Çalışkan, 2008; Doğan& Barış, 2010; Doğan, Beyaztaş& Koçak, 2012; Juan, Hannan &Namome, 2018; Maier& Curtin 2005).

Another variable that influences science success is the value given to the course. The value given to the science course was found to have a significant negative impact on success in the current study. Unlike this study, other research has found that giving greater value to a course improves science success (Ceylan &Berberoğlu, 2010; Çalışkan 2008; Şevgin, 2020). As a result of these researches, it can be concluded that the belief that increasing the value given to the course will enhance success is more prevalent.

The family has a significant impact on a student's academic success (Aslanargun, 2007). The variables of parental attention and family pressure have been found to be statistically significant in the study's findings. The parental attention variable is seen to have a positive impact on a student's science success, whereas the family pressure variable has a negative impact. Similarly, according to research done by Çelenk (2003) and Jeynes (2005), parental attention has a positive impact on student's academic success. Parallel to the results of the study, Diaz (1989) reported that students with low achievement were deprived of parental attention.

Monthly income variable was found to be statistically significant in predicting science success. In parallel with the results of this study, there are studies that show that students' academic success is affected by the family's monthly income (Abacı, 2015; Aslanargun, Bozkurt& Sarıoğlu, 2016; Okutan, 2017). On the other hand, Aslanargun, Bozkurt and Sarıoğlu (2016) and Şevgin(2020) reported that success increases as the monthly income of the family increases.

The findings of the study revealed that the parents' educational status was a strong predictor of their children's science success. The findings of this study arealso supported by a study of Çalık (2020). According to Şaşmazel (2006), an increase in the father's educational level enhances the child's science success. Similarly, in the study conducted by Aslanargun, Bozkurt, and Sarıoğlu similar results were reported (2016). When the literature is examined, it is possible to see many studies examining academic success and educational status of parents (Anıl, 2009; Bezek Güre, Kayri& Erdoğan, 2019; Bezek Güre, Kayri& Erdoğan, 2020; Erdoğan& Acar Güvendir, 2018; Pala, 2008; Urfalı Dadandı, Dadandı& Koca, 2018).

According to the findings of OLR method, there is a statistically significant relationship between having a computer or tablet and science success. It has been proven that those who own a computer or tablet are less successful in science than those who do not. There are studies that demonstrate a significant relationship between having a computer at home and success (Aksu, Güzeller& Eser, 2017; Erdinç Akan, 2016; Güvendir, 2017). On the other hand, in the study conducted by Şevgin (2013), no significant difference was found between having a computer and success.

According to the results of the analysis, having a room of one's own was also found to be statistically significant. Having a room of one's own can be considered to improve science success. Some studies show that if the students have their own room, it will have a positive effect on their science course subject (Acar& Güvendir, 2014; Akhan& Bindak, 2017; Gelbal, 2008; Kırmızı& İşigüzel, 2014; Türkan, Üner& Alcı, 2015). On the other hand, in the study conducted by Şevgin (2013), no statistically significant difference was found between the students having a room of their own and success.

In the current study, a statistically significant relationship was found between the students' educational goals and their science success. In line with the findings of this study, Bezek Güre, Kayri, and Erdoğan (2020) discovered that the goal that a student aspires to achieve in his educational life is crucial. In this research, it is apparent that as the students'goals grows, so does their science success. The fact that students who aim to graduate from a postgraduate education level have higher science success indicates that student's goals have an influence in their success.

Finally, it has been obtained that participating in science support courses "in two semesters" contributes significantly to science success in a statistically positive way. Similarly, Nartgün and Dilekci (2016) stated in their study that support courses greatly increase student motivation and course performance. In their research of secondary school teachers, Aküzüm and Saraçoğlu (2018) concluded that support courses help students academically. The science success of the students who participated in the science support courses only in the first semester and did not continue in the second semester was negatively affected by this process. It is a fact that weekend support branch courses, in general, enhance student success by reinforcing the topic and assisting in the resolution of many questions. From this perspective, students, who complete the course showing a willingness to continue the course, are more successful than students who drop out in the semester.

OLR method was examined in the context of this study to evaluate data obtained in the field of education with an ordinal categorical dependent variable, and it was discovered that the results produced were mostly similar to those found in the literature. This indicates that OLR has a high ability to predict the Educational data.

It is recommended that OLR method be used in studies in the field of education where the dependent variable is ordinal categorical. As a result, this method is expected to be a powerful and appropriate analytical method that will provide an unbiased and objective examination of the data structure.

References

Abacı, Ç. Ç. (2015). *The evaluation of central system common exams in terms of different variables* (Master's thesis). Retrieved from https://tez.yok.gov.tr. (Thesis number. 421437)

Abacıoğlu,S. & Ünal, İ.H. (2017). Determining the efficiency of companies by using data envelopment and ordinal logistic regression analysis: a study of weaving, apperal and leather industry*Eurasian Journal of Researches in Social and Economics,* 4 (12), 1-19.

Güvendir, M. A. (2014). Student and school characteristics' relation to Turkish achievement in student achievement determination exam. *Education and Science*, 39(172). Large-Scale Assessment Special Issue

Akamca, G. Ö. & Hamurcu, H. (2005). The effects of instruction based on multiple intelligence theory on students' science achievement, attitudes and retention of knowledge. *Hacettepe University Faculty of Educational Sciences Journal*, 28(28), 178-187.

Akboğa Kale, Ö., (2020). Determınation of poor compliance wıth osh rules of construction workers using ordinal regression model. *Mugla Journal of Science and Technology,* 6(1), 78-88.

Akhan, Ş. & Bindak, R. (2017). The effect of some individual variables on secondary school students' math achievement: a regression model.*Ihlara Journal of Educational Research,* 2(2), 5-17.

Akın, H.B. & Şentürk, E. (2012). Analysing levels of happiness of individuals with ordinal logistic analysis. *Öneri Journal,* 10.(37),183-193.

Akıncı, B. (2020). *The examination of science curriculum and assessment studies according to the monitoring and evaluation of academic skills (ABİDE)* (Master's thesis). Retrieved from https://tez.yok.gov.tr.(Thesis number. 617651)

Aksu, G., Güzeller, C. O. & Eser, M. T. (2017). Analysis of Maths Literacy Performances of Students with Hierarchical Linear Modeling (HLM): The Case of PISA 2012 Turkey.*Education and Science,* 42(191), 247-266.

Aktürk, Ü. & Aylaz, R. (2013). Students' levels of self-sufficiency in a primary school.*DEUHYO ED,* 6(4),177-183.

Aküzüm, C. & Saraçoğlu, M. (2018). Investigation of Secondary School Teachers' Attitudes towards Supporting and Training Courses, *Turkish Journal of Educational Studies*, 5(2), 97-121.

Alkan, İ., Alkan, İ., & Bayri, N. (2017). A meta analysis study on the relationship between motivation for science learning and science achievement, *Dicle University Journal of Ziya Gökalp Faculty of Education,* (32), 865-874.

Anıl, D. (2009). Factors Effecting Science Achievement of Science Students in Programme for International Students' Achievement (PISA) in Turkey.*Education and Science,* 152(34), 87-100.

Arı, E. (2013). *Parallel lines assumption in ordinal logistic regression and analysis approaches* (Doctoral dissertation). Retrieved from https://tez.yok.gov.tr.(Thesis number. 348602)

Arı, E. & Yıldız, Z. (2016). An examination of factors that affect the individuals' life satisfaction with ordinal logit regression analysis, *The Journal of International Social Research,* 9(42),1362-1374.

Aslanargun, E. (2007). The review of literature on school-parent cooperation and students' school success.*Manas University Journal of Social Sciences,* 18, 119-135.

Aslanargun, E., Bozkurt, S. & Sarıoğlu, S. (2016). The Impacts of Socioeconomic Variables on the Academic Success of the Students.*Uşak University Journal of Social Sciences,*9(3), 214-234.

Azaapağası İlbağı E. & Akgün L., 2012. Examination of Attitudes of the Students Aged 15 In Terms of Pisa 2003 Student Questionnaire.*Western Anatolia Journal of Educational Science,* 3(6), 67-90.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational psychologist,* 28(2), 117-148.

Bayat, N., Şekercioğlu, G. & Bakır, S. (2014). The Relationship Between Reading Comprehension and Success in Science.*Education and Science,* 39(176).

Bezek Güre, Ö. Kayri, M. &Erdoğan, F.(2020). Analysis of Factors Effecting PISA 2015 Mathematics Literacy via Educational Data Mining.*Education and Science,* 45(202), 393-415.

Bezek Güre, Ö.,Kayri, M. & Erdoğan, F. (2019). Predicting factors affecting PISA 2015 Mathematics literacy via Radial Basis Function Artificial Neural Network. *Journal of Engineering and Technology,* 3(1), 1-11.

Bozpolat, E. (2016). Investigation of the Self-Regulated Learning Strategies of StudentsfromtheFaculty of Education Using Ordinal Logistic Regression Analysis.*Educational Sciences: Theory and Practice,* 16(1), 301-318.

Büyüköztürk Ş., (2011), *Sosyal Bilimler İçin Veri Analizi El Kitabı.*Ankara:Pegem Akademi Yayınları.

Ceylan, E.,& Berberoğlu, G. (2010). Factors Related With Students' Science Achievement: A Modeling Study.*Education and Science,* 32(144), 36-48.

Chang,Y.C. & Bangsri,A. (2020). ThaiStudents' Perceived Teacher Support on Their Reading Ability: Mediating Effects of Self-Efficacy and Sense of School Belonging. *International Journal of Educational Methodology,* 6(2), 435-446.

Çalık, G. (2020). *Investigation of 8th grade students' science achievement in Turkey: Results from monitoring and evaluating academic skills study (ABIDE) 2016* (Master's thesis). Retrieved from https://tez.yok.gov.tr. (Thesis number. 608197)

Çalışkan, M. (2008). *The impact of school and student related factors on scientific literacy skills in the programme for international student assessment PISA 2006* (Doctoral dissertation). Retrieved from https://tez.yok.gov.tr. (Thesis number. 176784)

Celenk, S. (2003). The prerequisite for school success: Home-school cooperation. Elementary *Education Online,* 2(2), 28-34.

Çokluk Ö., Şekercioğlu G. & Büyüköztürk Ş. (2012). *Sosyal bilimler için Çok değişkenli istatistik SPSS ve LISREL uygulamaları*. Ankara: Pegem Yayınları.

Çokluk, Ö. (2010). Logistic Regression: Concept and Application. *Educational Sciences: Theory&Practise,* 10(3), 1357-1407.

Dağlıoğlu, H. & Oral Erbaş, S. (2017). A Study on Correct Classification Performance ofUnconstraint Partial Proportional Odds Model.*Gazi Journal of Engineering Sciences* 3(3), 14-26.

Diaz, S. L. (1989). The home environment and Puertorican children's achievement: a researcher's diary. *In The National Association for Education Conference* (pp. 28-34).

Doğan, N. & Barış, F. (2010). Tutum, Değer ve Özyeterlik Değişkenlerinin TIMSS-1999 ve TIMSS-2007 Sınavlarında Öğrencilerin Matematik Başarılarını Yordama Düzeyleri. *Journal of Measurement and Evaluation in Education and Psychology*, 1(1), 44-50.

Doğan, N., Beyaztaş, İ. B. & Koçak, Z. (2012). The Effect of Self Efficacy Level of Students on Their Achievement in Terms of Their Grade Levels and Gender in A Social Studies Class: The Case of Erzurum.*Education and Science,* 37(165), 224-236.

Elkonca, F. (2020). *An analysis of the DIF sources of ABIDE self-efficacy scale by means of a latent class approach* (Doctoral dissertation). Retrieved from https://tez.yok.gov.tr.(Thesis number. 630660)

Erdinç Akan, O. (2016). *The investigation of the relationship between the characteristics of students and teachers and TIMSS 2011 8th grade students' achievement in respect to the cognitive domains: A two level hierarchical linear model analysis (Master's thesis).* Retrieved from https://tez.yok.gov.tr. (Thesis number. 450270)

Erdoğan, E. & Acar Güvendir, M. (2018). The Relationship between Students Socioeconomic Attributes and Their Reading Skills in Programme for International Student Assessment. *Eskişehir Osmangazi University Journal of Social Sciences*, 20, 493-523.

Fullerton, A.S. (2009). "A Conceptual Framework for Ordered Logistic Regression Models". *Sociological Methods and Research*, 38(2), 306-347.

Fullerton, A.S. & Xu, J.(2012). "The Proportional Odds with Partial Proportionality Constraints Model for Ordinal ResponseVariables". *Social Science Research*, 41(1), 182-198.

Gelbal, S. (2008). The Effect of Socio-Economic Status of Eighth Grade Students on Their Achievement in Turkish. *Education and Science,* 33(150), 1-13.

Güvendir, M. (2017). Determination of the Relationship between the Students' "Mathematical Literacy" and "Home and School Educational Resources" in Program for International Student Assessment - (PISA 2012). *Mersin University Journal of the Faculty of Education* 13(1), 94-109.

Halaby, Charles N. (1986). "Worker Attachment and Workplace Authority".*American Sociological Review* 51, 634-649.

Jeynes, W. H. (2005). A meta-analysis of the relation of parental involvement to urban elementary school student academic achievement. *Urban education*, 40(3), 237- 269.

Juan, A.,Hannan, S. & Namome, C. (2018). I believe I can do science: Self-efficacy and science achievement of Grade 9 students in South Africa. *South African Journal of Science*, 114(7-8), 48-54.

Karasar, N.(2006). *Bilimsel araştırma yöntemi*. Ankara: Nobel Yayın Dağıtım.

Kartal, H.,&Bilgin, A. (2009). Bullying and School Climate from the Aspects of the Students and Teachers. *Eurasian Journal of Educational Research*, (36), 209-226

Keller, P. S., El-Sheikh, M., Granger, D. A. & Buckhalt, J. A. (2012). Interactions between salivary cortisol and alpha amylase as predictors of children's cognitive functioning and academic performance. *Physiology&Behavior*, 105, 987-995.

Kılıç, S. (2016). Cronbach's Alpha Reliability Coefficient. *Journal of Mood Disorders*, 6(1), 47-48.

Kırmızı, B. & İşıgüzel, B. (2014). Determining the Factors Affecting Students' Achievement in German Language Learning, *Fırat University Journal of Social Science,* 24(1), 13-24

Kula-Kartal, S.,& Mor-Dirlik, E. (2017). Historical development of the concept of validity and the most preferred technique of reliability: Cronbach alpha coefficient, *Abant İzzet Baysal University Education Faculty Journal*, 16(4), 1865-1879.

Liu, X. (2009). Ordinal regression analysis: Fitting the proportional odds model using Stata, SAS and SPSS. *Journal of Modern Applied Statistical Methods*, 8(2), 30.

Long, J. S., & Cheng, S. (2004). *Regression models for categorical outcomes*. Handbook of data analysis, 704.

Maddala, G. S. (1983), *Limited-Dependent and QualitativeVariables in Economics*, New York: Cambridge University Press.

Maier, S. R. & Curtin, P.A. (2005). Self-EfficacyTheory: A Prescriptive Model for Teaching Research Methods. *Journalism and Mass Communication Educator*, 59(4), 352-364.

McCullagh, P. (2005). *Proportional-odds model*. Encyclopedia of Biostatistics, 6.

McCullagh, P. & Nelder, J. A. (1983). *Generalized linear models*. New York: Chapman and Hall London.

McCullagh, P. (1980). Regression models for ordinal data. *Journal of the Royal Statistical Society: Series B (Methodological)*, 42(2), 109-127.

McCullagh, P., (1998). *The proportional odds model*. In: Armitage, Peter, Colton, Theodore (Eds.), the Encyclopedia of Biostatistics. John Wiley and Sons,

MEB (2017). *Examination and evaluation of academic skills 8th grade report*, Ankara.

Nartgün, Ş. S. & Dilekçi, Ü. (2016). Student and Teacher Views on Educational Support and Training Courses *Kuram ve Uygulamada Eğitim Yönetimi,* 22(4), 537-564.

O'Connell, A.A. (2006). *Logistic Regression Models for Ordinal Response Variables*. California: Sage Publications.

Okutan, S. (2017). *Investigation of secondary school students' success in science in terms of various variables* (Doctoral dissertation). Retrieved from https://tez.yok.gov.tr.(Thesis number. 478384)

Özdamar, K. (2013). *Paket programlar ile istatiksel veri analizi*: MINITAB 16-IBM SPSS 21. Eskişehir: Nisan Kitabevi

Pala, N. M. (2008). *The effect of student and class characteristics on mathematical literacy and problem solving in accordance with PISA 2003 results* (Master's thesis). Retrieved from https://tez.yok.gov.tr. (Thesis number. 237681)

Peterson, B. & Harrell, F. E. (1990). Partial proportional odds models for ordinal response variables. *Applied Statistics*, 39, 205-217.

Ramirez, F. O.,Luo, X., Schofer, E. & Meyer, J. W. (2006). Student achievement and national economic growth. *American Journal of Education*, 113(1), 1-29.

Sadıç, A. &Çam, A. (2015). 8th grade students' epistemological beliefs for PISA performances and science and technology literacy, *Bilgisayar ve Eğitim Araştırmaları Dergisi*, 3(5), 18-49.

Şaşmazel, G.A. (2006). *Factors that affecting success of scientific literacy on students in Turkey that participate programme for international student assessment (PISA*) (Master's thesis). Retrieved from https://tez.yok.gov.tr.(Thesis number. 173187)

Şenel, S.,& Alatli, B. (2014). A Review of Articles Used Logistic Regression Analysis. *Journal of Measurement and Evaluation in Education and Psychology-EPOD,* 5(1), 35-52.

Şevgin, H. (2013). *Reearch of secondary school studendents motivation to the Physical Science with the method of ordinal logistic regression* (Master's thesis). Retrieved from https://tez.yok.gov.tr. (Thesis number. 357572)

Şevgin, H. (2020). *Predicting the ABIDE 2016 science achievement: The comparison of MARS and BRT data mining methods* (Doctoral dissertation). Retrieved from https://tez.yok.gov.tr. (Thesis number. 621221).

Tabachnick, B. G.,& Fidell, L. S. (1996). Using Multivariate *Statistics* (3rd ed.). New York: Harper Collins.

Tansel, A. & Güngör, N. D. (2004). Türkiye'den yurt dışına beyin göçü: Ampirik bir uygulama. *ERC (Economic Research Center) Working Papers in Economics*, 4(02), 1-10.

Türkan, A., Üner, S., &Alcı, B. (2015). An Analysis of 2012 PISA Mathematics Test Scores in Terms of Some Variables.*Ege Journal of Education,* 16(2), 358-372.

Urfalı Dadandı, P. Dadandı, İ. & Koca, F. (2018). The relationships between socioeconomic factors and reading literacy according to PISA 2015 Turkey results.*International Journal of Turkish Literature, Culture Education,* 7(2), 1239-1252.

Uzun, B. & Öğretmen, T. (2010). Assessing the Measurement Invariance of Factors that are Related to Students' Science Achievement across Gender in TIMSS-R Turkey Sample, *Education and Science,* 35(155).

Uzun, N. B.,Gelbal, S. & Öğretmen, T. (2010). Modeling the relationship between TIMSS-Rscience achievement and affective characteristics and comparing the model according to gender.*Kastamonu University, Kastamonu Education Journal,* 18(2), 531-544.

Ülkü, S. (2019). *Investigation of measurement invariance of Turkish and science's subtests on ABIDE 2016 in relation to characteristics of teachers* (Master's thesis). Retrieved from https://tez.yok.gov.tr.(Thesis number. 584503)

Whitted K. S. & Dupper, D. R. 2005. Best practices for preventing or reducing bullying in schools. *Children and Schools,* 27(3), 167–175.

Williams, R. (2006). Generalized ordered logit/partial proportional odds models for ordinal dependent variables. *Stata Journal*, 6(1), 58-82.

Winnaar, L.,Arends, F. &Beku, U. (2018). Reducing bullying in schools by focusing on school climate and school socio-economic status. *South African Journal of Education*, 38(1).

Wright, E. O., Baxter, J. & Birkelund, G. E. (1995). The gender gap in workplace authority: A cross-national study. *American sociological review*, 407-435.

Yılmaz, M. (2021). Investigation of differential item functioning of the test items in the abide study by using propensity scores. (Master's thesis). Retrieved from https://tez.yok.gov.tr.(Thesis number. 665024)

Yurdugül, H. (2006). The comparison of reliability coefficients in parallel, tau-equivalent, and congeneric measurements. *Ankara University Journal of Faculty of Educational Sciences*, 39(1), 15-37.

Disclosure Statements

1. Contribution rate statement of researchers: All authors contributed equally.

2. No potential conflict of interest was reported by the authors.