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Predictors of Students' Low and Basic Performance Levels in PISA Turkey Implementations

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ABSTRACT

The aim of study is to determine the year-by-year change of family and student characteristics of whose performance is at or below basic proficiency level in domain of reading comprehension on PISA Turkey 2012, 2015 and 2018 implementations. This study is designed as a correlational survey research and also covers a secondary data analysis. Data was obtained from the official website of OECD. For data analysis, descriptive statistics and logistic regression analysis were used. Based on the research findings, it was seen that low performing students have started to come from better educated families as well as families with higher ESCS index. Resources available to students increased by years. Logistic regression analysis revealed that various variables are classifiers for students' performance levels for each implementation years. Some findings are found to be contradictory with the literature such as predictive role of maternal education level and educational software. Suggestions are made based on the findings to improve students' performances from low to at least basic proficiency levels.

Keywords: Family characteristics, Logistic regression, Low performing students.

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ÖZ

Bu çalışmanın amacı PISA 2012, 2015 ve 2018 yılları Türkiye uygulamalarında okuduğunu anlama alanında düşük ve temel performans düzeylerinde performans gösteren öğrencilerin, kendi özelliklerinin ve aile özelliklerinin yıldan yıla değişiminin tespit edilmesidir. Bu çalışma ilişkisel tarama modelinde tasarlanmıştır ve aynı zamanda bir ikincil veri analizi çalışmasıdır. Veri OECD resmi internet sayfasından elde edilmiştir. Veri çözümleme süreci için betimsel istatistikler ve lojistik regresyon analizi kullanılmıştır. Araştırma bulgularına dayalı olarak, düşük performans gösteren öğrencilerin yıldan yıla daha iyi eğitimli ve daha yüksek sosyoekonomik ve kültürel düzeye sahip olan ailelerden gelmeye başladıkları görülmektedir. Uygulama yılları boyunca öğrenciler için mevcut imkanlar gelişim göstermiştir. Lojistik regresyon analizi sonuçları her bir uygulama yılı için sınıflayıcı olan değişkenlerin çeşitli olduğunu ortaya çıkartmıştır. Anne eğitim düzeyi ve eğitsel yazılım gibi değişkenlerin yordayıcı rolüne ilişkin bazı bulguların alanyazınla çelişkili olduğu görülmüştür. Bulgulara dayalı yorumlar öğrenci düşük performansının en azından temel performans düzeyine doğru geliştirilebilmesi hususu göz önünde tutularak yapılmıştır.

Anahtar kelimeler: Aile özellikleri, Lojistik regresyon, Düşük başarılı öğrenciler.

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INTRODUCTION

Student success is an issue that needs to be examined at the individual and national level. Societies want to raise successful individuals to increase the happiness and living standards of their citizens and to ensure socioeconomic and sociocultural progress. However, for many reasons, it is not possible to achieve this goal at the targeted level. Many countries are conducting projects to determine the causes of this problem and to take the necessary measures. Some of these projects involve large-scale standard tests administered to determine student achievement. The findings obtained from these guide education decisions at the national level. However, countries mostly determine the characteristics of students who get high scores on these tests (OECD, 2016a) and make their education decisions accordingly. This increases the learning differences with the students in the low achievement bracket, and many children lag behind in education. In 1990, the World Declaration on Education for All, which was unanimously accepted by the participating countries, was published. At the conference where this declaration was accepted, the idea that "No Child Left Behind" was discussed and common views were reached on the decisions to be taken (UNDP and UNICEF, 1990). However, the Education for All Global Monitoring Reports prepared by UNESCO states that the decisions taken have not been realized (UNESCO, 2013-4). Increasing the learning success of the students in the low achievement group is an important problem that the Turkish education system needs to solve.

The Program for International Students Assessment (PISA) is carried to determine and monitor the skills of students. In PISA implementations, student performances are determined in terms of their proficiency levels on a scale (OECD, 2019). These levels, which provide information about student performance, are grouped in six dimensions from simple to complex, and proficiencies related to each dimension are defined as an indicator of learning. The basic level is Level 1 while the highest is Level 6.

When performance indicators of reading comprehension are reviewed from OECD (2019), it can be seen that the cognitive performance expected from the student is simpler as the basic proficiency level decreases. The students at the second proficiency level for reading, science and mathematics literacy in OECD are defined as students who are successful at the basic level, and students who fall below this level (Level 1) are defined as students with low achievement (OECD, 2016a). Chakrabarty and Asha (2014) define low-performing students as who do not get the expected scores in the fields they study. Level 1 and below Level 1 are defined as follows in PISA (MEB, 2013).

Level 1: They can answer clearly defined questions with all relevant information about the solution in a familiar context. They can perform routine operations by following the given instructions and have the ability to write some amount of information. Below Level 1: They can read a number in a very clearly stated simple notation, have the skills to perform some very simple operations with natural numbers.

When the reports prepared based on the PISA results are examined (OECD, 2016a), it can be observed that all the countries have low performing students, in other words, students that cannot perform at a basic level in any learning domain. Singapore is one of the countries that has rapidly increased its student success rate in PISA implementations with its recent reforms in education. Compared to Turkey, the percentage of students at Level 1 and below in Singapore in PISA 2015 is 7.6% in mathematics, 9.6% in science and 11.1% in reading (OECD, 2016a). In Turkey, these percentages are as high as 51.4% for mathematics, 44.5% for science and 40% for reading (OECD, 2016a). The percentages of students who show proficiency at Level 2 and below in Turkey's PISA 2012, 2015 and 2018 tests in all learning domains are given in Table 1.

Table 1. Distribution of Students in PISA 2012, 2015 and 2018 Turkey by Basic and Below-Basic Proficiency Levels

Years	Reading Literacy		Mathematics Literacy		Science Literacy	
	Below Basic Proficiency (%)	Basic Proficiency (%)	Below Basic Proficiency (%)	Basic Proficiency (%)	Below Basic Proficiency (%)	Basic Proficiency (%)
2012	21.7	30.8	42.0	17.8	26.3	35.4
2015	40.0	32.6	51.3	25.3	44.4	31.3
2018	26.1	30.2	36.7	27.3	25.1	32.8

According to Table 1, the percentage of students performing at basic proficiency and below proficiency levels is over 50% for all learning domains and participation years. The percentage of students performing below the basic proficiency level is at least 20% of the students participating in PISA. It is worth bearing in mind that these high values in the case of Turkey are also related to educational, economic and social problems. The question "Why is the percentage of students at the basic proficiency level and below so high in Turkey?" needs to be asked. Turkey's socio-economic development, cultural enrichment, and individual and social welfare are closely related to answering this question and finding a solution to it. According to Kutlu (2004), it is very difficult for individuals to develop the skills of giving meaning to social events, associating events, questioning and producing solutions without developing their reading comprehension skills first.

Reading comprehension is a basic life skill that individuals need throughout their lives and that they use effectively in almost every field. Eastman (2010) defines reading comprehension as an individual's making sense of a message to be interpreted by using his/her prior knowledge and experiences. To be able to learn various pieces of information, to use this information, for example, in shopping, travel, family decisions, friendship relations, understanding different cultures, and continuing this learning at higher levels in many similar situations requires having good reading and reading comprehension skills. Considering the positive effects of reading comprehension skills at the individual, social and academic level, it is inevitable that students and societies with low success in reading comprehension will suffer some terrible consequences for both their present and future lives.

In light of the research findings discussed above, the current study is considered important since it aims to reveal the characteristics of the families of low performing students in the national literature. Studies in the literature on PISA seem to focus on factors that affect or predict students' success (Boyd, 2004; Brookhart, 2001; Deng & Gopinathan, 2016; Grehan, Flanagan, & Malgady, 2011; McKenzie & Schweitzer, 2010; Powell & Arriola, 2010; White, 1982). Determining the factors behind success, specifying factors pointing to failure and planning studies based on precautions will enable some important steps to be taken to improve the performance of underachieving students. Findings may enable these students to show higher performance by taking the necessary measures. The focus of the study is to determine the family characteristics of students which can make a distinction between low and basic performers at reading domain.

Research Questions

The aim of this study is to describe the family characteristics of students who have reading success at the basic level and below the basic level in PISA Turkey 2012, 2015 and 2018, to observe the year-by-year changes and to determine the variables that classify the students at the basic proficiency level or below.

For this purpose, the questions to be answered in the research are as follows:

1. Regarding the students who performed at the basic proficiency level and below the basic proficiency level in PISA Turkey 2012, 2015 and 2018, how did their;

   a- maternal and paternal education status,

   b- sociocultural and economic status, and

   c- the resources at home change?

2. Which of the student and family variables predict(s) the basic (or below) proficiency level of the students participating in the PISA Turkey 2012, 2015 and 2018?
3. How did the variables that predict students to be at or below the basic proficiency level change over the years of implementation?

METHOD

Research Design

This study was designed as a correlational survey. Survey studies aim to reveal the relationship between two or more quantitative variables (Fraenkel & Wallen, 2006). This study analyzes some variables related to students and their families and its predictive power for the level of reading proficiency. This research is also a secondary data analysis study on PISA Turkey 2012, 2015 and 2018 data. The purpose of secondary data analysis studies is to analyze the already collected and analyzed data with better techniques or to use the relevant data to answer different questions (Glass, 1976). This study aims to answer different questions based on the data collected

for PISA Turkey 2012, 2015 and 2018.Method section may include research design, the study group or participants of the study, data collection tools, data analysis.

Study Group

Group of this study composed of PISA samples. The study group of the research consists of students at the first and second proficiency levels in the Turkey test samples of PISA 2012, 2015 and 2018. The number of students in the population and working group of PISA Turkey 2015, 2015 and 2018 are given in Table 2.

Table 2. Distribution of Students in PISA Turkey 2012, 2015 and 2018

Population and Study Group	Gender	Implementation Years					
		2012		2015		2018	
		f	%	f	%	f	%
Population	Female	2370	48.9	2938	49.8	3396	49.3
	Male	2478	51.1	2957	50.2	3494	50.7
	Total	4848	100	5895	100	6890	100
Below Basic Proficiency Level (Level 1)	Female	291	28	1035	43	696	38
	Male	748	72	1391	57	1128	62
	Total	1039	100	2426	100	1824	100
Basic Proficiency Level (Level 2)	Female	699	46	1002	51	1036	50
	Male	795	53	962	49	1039	50
	Total	1494	100	1964	100	2075	100

Table 2 gives information about the gender distribution of students who participated in the PISA implementation in different years. When the table is examined, the percentage of female students are quite close for all years. On the other hand, the percentage of male students in the group of low performers was higher in all years.

Data Collection

Data for each implementation year was downloaded from OECD official web site. Student questionnaires were examined. Information about the variables were provided from student questionnaires.

Data Analysis

As suggested by OECD (2009), first, student sampling weights were normalized. Later, all analysis were performed on all plausible values separately, for all implementation years and the averages of the results were reported. Descriptive statistics were used to summarize the first research question. The findings are presented in numbers, percentages and through graphs. Logistic regression was used to answer the second and third research questions. All assumptions of the analysis were checked and met (Cokluk, Şekercioğlu, & Büyüköztürk, 2012).

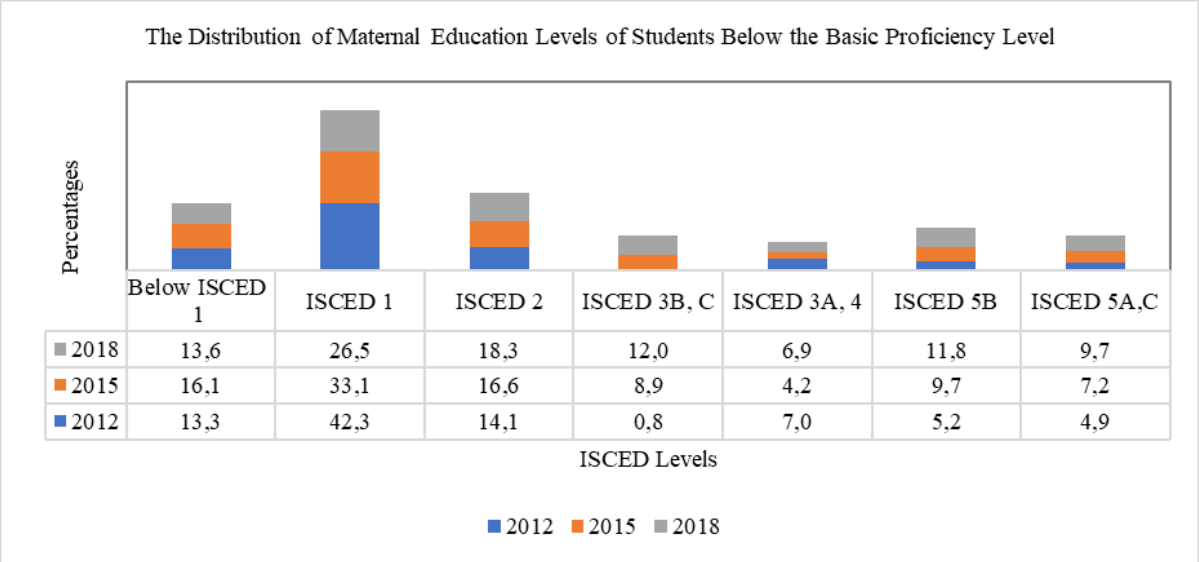
The predictive variables in the regression model are as follows: student's gender, pre-school education status, having a desk where the student can study, a room, a quiet place of his/her own, computer, educational software, internet connection, literature, poetry, art, test book, technical book, number of books, socioeconomic and cultural indexes of the family, mother and father education level and grade repetition. It was considered important to choose the same predictor variables for all implementation years to be able to make a comparison. In PISA 2018, attending pre-school education had a lot of missing data in the Turkish version. Therefore, it was excluded from the analysis for PISA 2018. The predicted variable is students' being at or below the basic proficiency at reading comprehension.

Research Ethics

This data used and analysed in this study was downloaded from the official web site of OECD. Therefore, it requires no ethical committee permission. However, no research ethics were violated.

FINDINGS

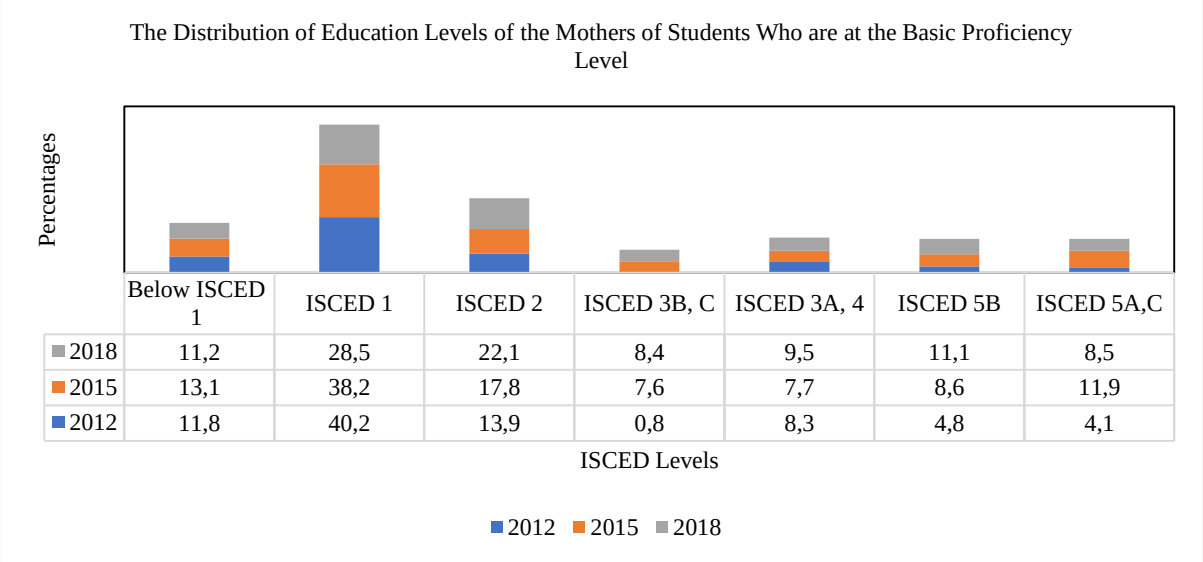
The first question answered as part of the research concerns the extent of change in the family characteristics (education level of the parents, economic and sociocultural indexes and resources at home) of the students who are at or below the basic proficiency level in PISA Turkey 2012, 2015 and 2018. OECD collects the data about the parental education levels according to an international classification called The International Standard Classification of Education (ISCED). Education levels corresponding to ISCED levels can be found from OECD, 2015 if interested. Figure 1 shows the distribution of education levels of the mothers of students who are below the basic proficiency level.



	Below ISCED 1	ISCED 1	ISCED 2	ISCED 3B, C	ISCED 3A, 4	ISCED 5B	ISCED 5A,C
2018	13,6	26,5	18,3	12,0	6,9	11,8	9,7
2015	16,1	33,1	16,6	8,9	4,2	9,7	7,2
2012	13,3	42,3	14,1	0,8	7,0	5,2	4,9

Figure 1. *Maternal Education Levels of Low Performer Students*

The first striking finding revealed by Figure 1 is that mothers graduating from primary school (Below ISCED 1) constitute approximately 15% of the group for all years. The mothers of 15 students out of every 100 students below the basic proficiency level are not even primary school graduates. For this level, the highest percentage of mothers hold either primary school (ISCED 1) or secondary school (ISCED 2) degrees. Mothers who are primary and secondary school graduates for all implementation years constitute half of the group. Figure 2 shows the distribution of education levels of mothers of students at the basic proficiency level.

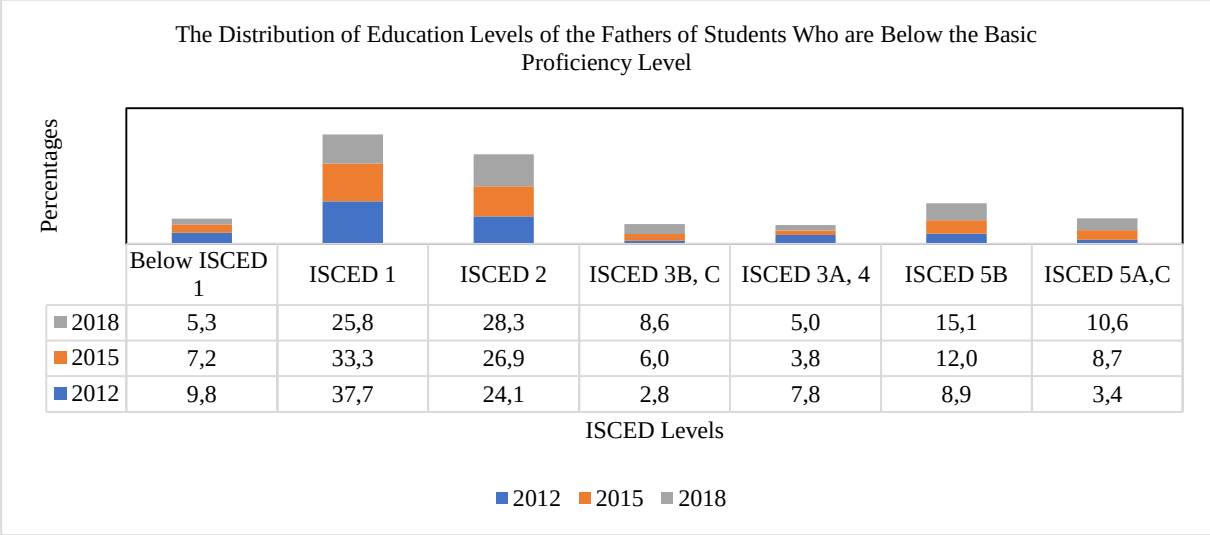


	Below ISCED 1	ISCED 1	ISCED 2	ISCED 3B, C	ISCED 3A, 4	ISCED 5B	ISCED 5A,C
2018	11,2	28,5	22,1	8,4	9,5	11,1	8,5
2015	13,1	38,2	17,8	7,6	7,7	8,6	11,9
2012	11,8	40,2	13,9	0,8	8,3	4,8	4,1

Figure 2. *Maternal Education Levels of Basic Performer Students*

According to Figure 2, 11 out of every 100 students at the basic proficiency level in all years of implementation have either had no primary education or have not completed primary school (ISCED Below 1). The percentage of mothers with primary and secondary school degree is 54.1% for 2012, 56% for 2015, and 50.6% for 2018. When the education level of mothers with less than secondary education is considered as a whole, it can be seen to be above 60% for all three years of implementation.

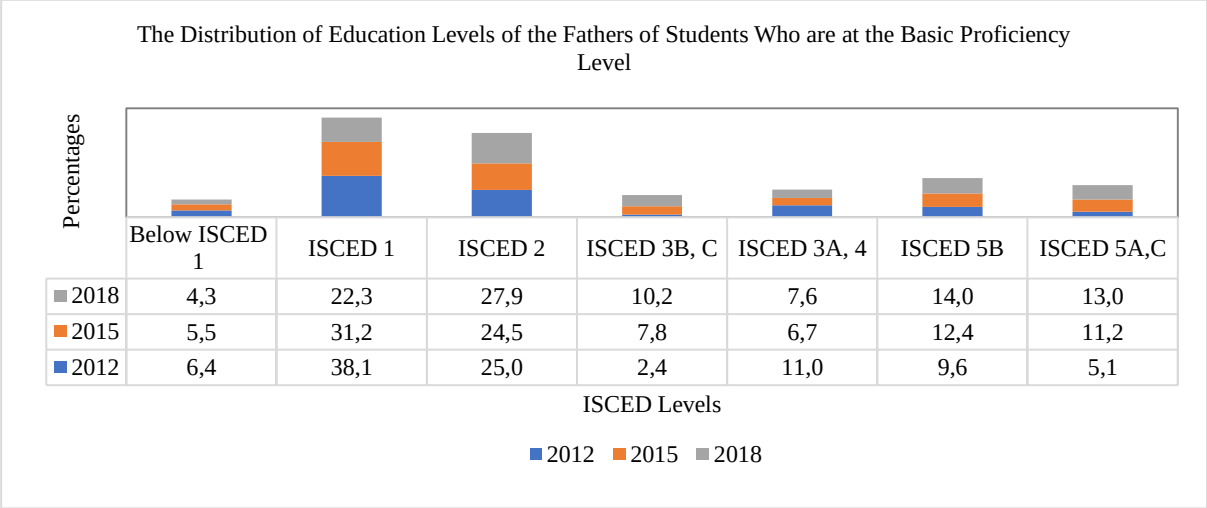
When Figure 1 and Figure 2 are examined together, the distribution of mothers of students who are at or below basic proficiency level by education levels can be observed to be similar, although with varying percentages. In addition, maternal education level increases for both groups from 2012 to 2018, without any significant change in students' proficiency levels. Figure 3 shows the education level distribution of fathers of students who are below the basic proficiency level.



	Below ISCED 1	ISCED 1	ISCED 2	ISCED 3B, C	ISCED 3A, 4	ISCED 5B	ISCED 5A,C
2018	5,3	25,8	28,3	8,6	5,0	15,1	10,6
2015	7,2	33,3	26,9	6,0	3,8	12,0	8,7
2012	9,8	37,7	24,1	2,8	7,8	8,9	3,4

Figure 3. *Paternal Education Levels of Low Performer Students*

Figure 3 shows that the education levels of fathers with less than secondary education ((ISCED 2) is observed to be around 60% for each of the three years of implementation. Its trend showed a decrease; yet, the percentages are high. Figure 4 shows the education level distribution of fathers of students at the basic proficiency level.

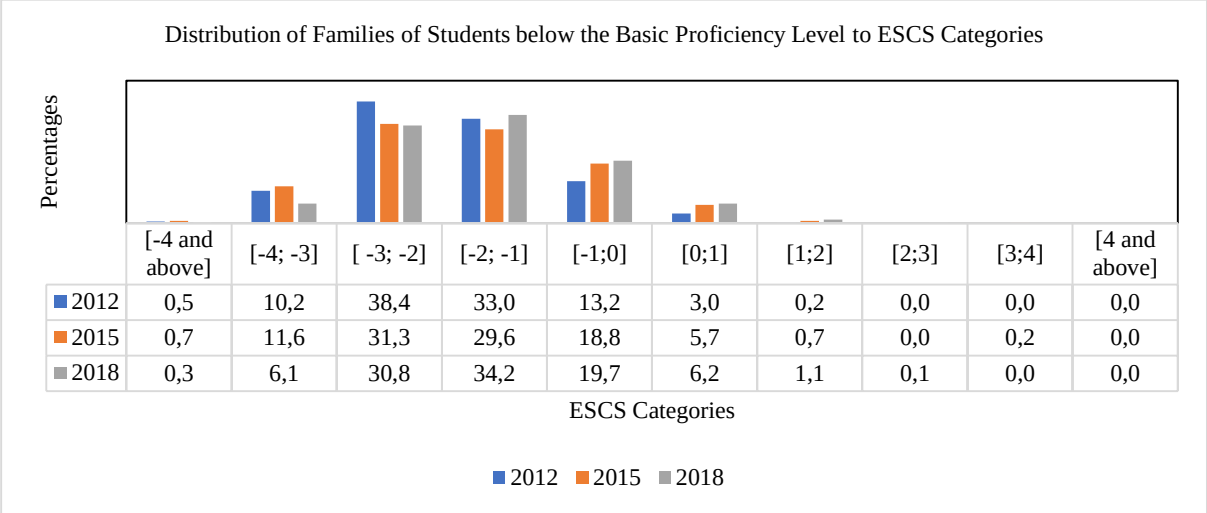


	Below ISCED 1	ISCED 1	ISCED 2	ISCED 3B, C	ISCED 3A, 4	ISCED 5B	ISCED 5A,C
2018	4,3	22,3	27,9	10,2	7,6	14,0	13,0
2015	5,5	31,2	24,5	7,8	6,7	12,4	11,2
2012	6,4	38,1	25,0	2,4	11,0	9,6	5,1

Figure 4. *Paternal Education Levels of Basic Performer Students*

As can be seen in Figure 4, about 5% of every 100 students at the basic proficiency level have fathers without a primary school degree (Below ISCED 1). The primary (ISCED 1) or secondary school (ISCED 2) graduates constitute 63.1% of the group in the 2012, 55.7% in 2015, and 50.2% in 2018. Regarding all three years of implementation, approximately 60% of the fathers have less than secondary education. When Figures 3 and 4 are considered together, the distribution of father's education level presents similar distributions. The education level of fathers increases from 2012 to 2018 for both groups.

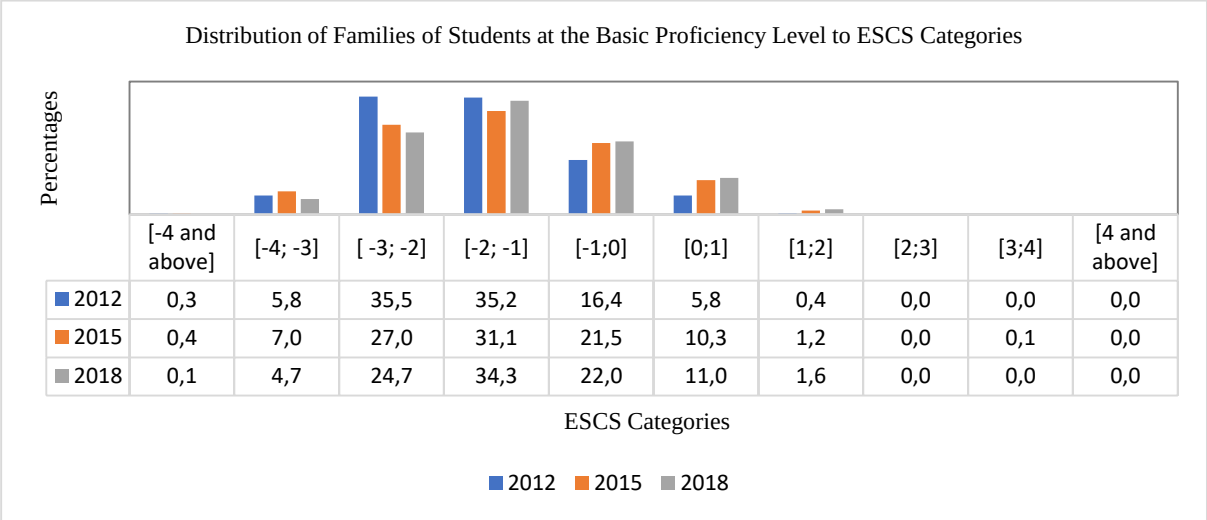
The Economic and Socio-Cultural Status (ESCS) distribution of the student families who participated in the PISA 2012, 2015 and 2018 at or below the basic proficiency level is given in Figure 5. ESCS is defined as an index in PISA and is a continuous variable. For the purposes of the current research, it was converted into an artificial discrete variable. Figure 5 shows the distribution of the economic and socio-cultural status of the families of students below the basic proficiency level by year.



	[-4 and above]	[-4; -3]	[-3; -2]	[-2; -1]	[-1;0]	[0;1]	[1;2]	[2;3]	[3;4]	[4 and above]
2012	0,5	10,2	38,4	33,0	13,2	3,0	0,2	0,0	0,0	0,0
2015	0,7	11,6	31,3	29,6	18,8	5,7	0,7	0,0	0,2	0,0
2018	0,3	6,1	30,8	34,2	19,7	6,2	1,1	0,1	0,0	0,0

Figure 5. *ESCS Categories Distribution of Families of Low Performer Students*

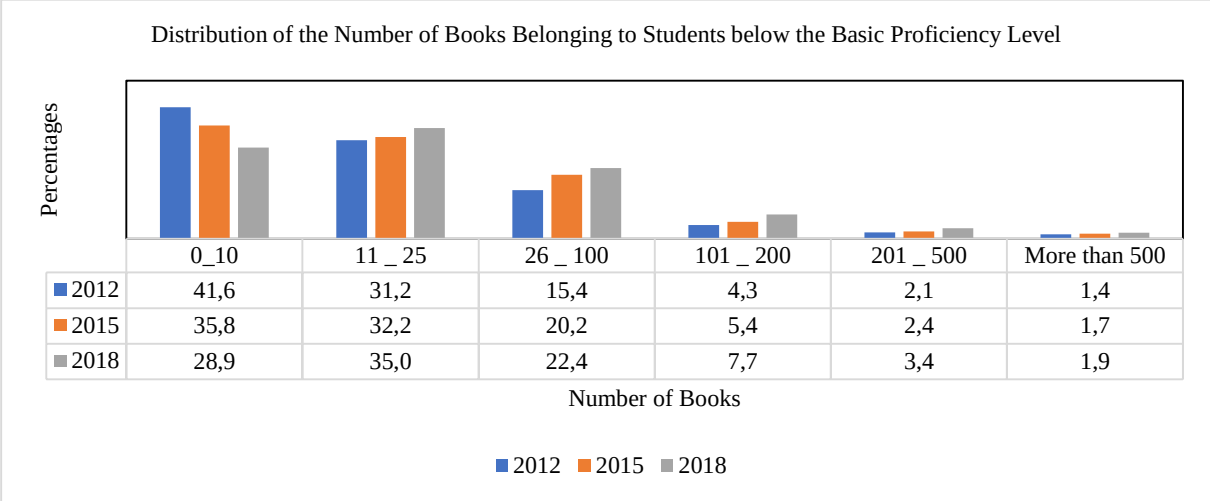
When Figure 5 is examined, it is seen that the students who are below the basic proficiency level for all the implementation years cumulate around the ESCS groups of [-3; -2], [-2; -1], and [-1; -0]. What is remarkable here is the group range in which the students below the basic proficiency level are distributed. In other words, as the years progress, students from high socioeconomic and sociocultural status are added to the low achievement group. Figure 6 shows the distribution of the economic and socio-cultural status of the families of students at the basic proficiency level by year.



	[-4 and above]	[-4; -3]	[-3; -2]	[-2; -1]	[-1;0]	[0;1]	[1;2]	[2;3]	[3;4]	[4 and above]
2012	0,3	5,8	35,5	35,2	16,4	5,8	0,4	0,0	0,0	0,0
2015	0,4	7,0	27,0	31,1	21,5	10,3	1,2	0,0	0,1	0,0
2018	0,1	4,7	24,7	34,3	22,0	11,0	1,6	0,0	0,0	0,0

Figure 6. *ESCS Categories Distribution of Families of Basic Performer Students*

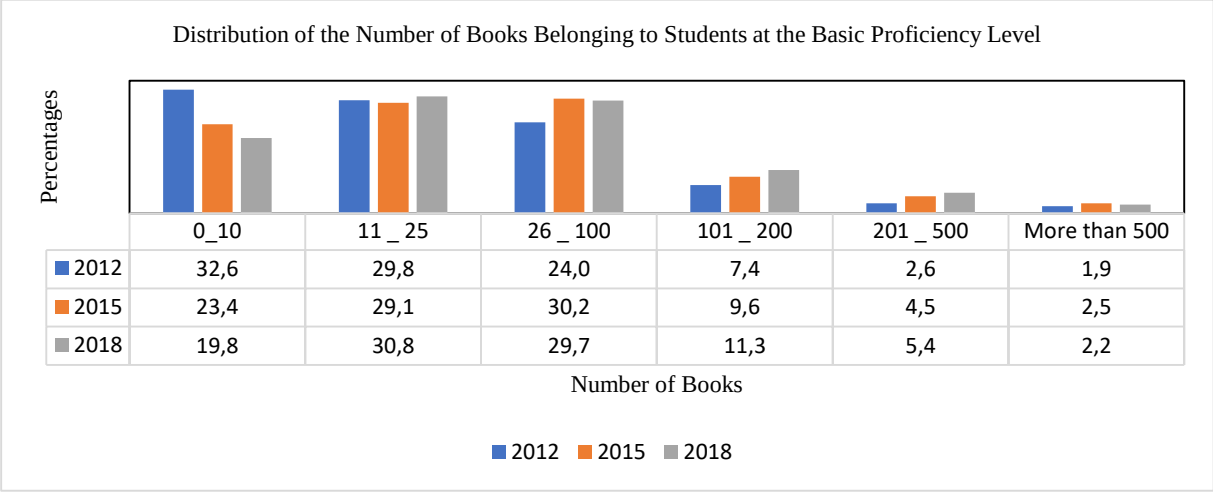
As shown in Figure 6, the families of students at the basic proficiency level pile up in the ESCS groups [-3; -2], [-2; -1], and [-1; -0]. A close look into the distribution reveals that the ESCS distributions of the families of the students at the basic proficiency level do not differ greatly by year. When Figures 5 and 6 are considered together, the distribution of the ESCS status of the students at the basic proficiency level and below is found to be quite similar. In each implementation year, student performance declines despite socioeconomic and cultural characteristics. The distribution of the number of books owned by the students below the basic proficiency level in PISA 2012, 2015 and 2018 is given in Figure 7.



	0_10	11 _ 25	26 _ 100	101 _ 200	201 _ 500	More than 500
2012	41,6	31,2	15,4	4,3	2,1	1,4
2015	35,8	32,2	20,2	5,4	2,4	1,7
2018	28,9	35,0	22,4	7,7	3,4	1,9

Figure 7. *Distribution of the Number of Books for Low Performer Students*

As shown in Figure 7, the first striking finding is that the number of books belonging to this group pf students is very low. In 2012, students who had 25 or fewer books accounted for 72.8% of the whole group; while this figure was 68% in 2015, and 63.9% in 2018. While students with more than 100 books accounted for 7.8% of the whole group for 2012, 9.5% for 2015, and 13% for 2018. However, there is a noteworthy increase in the number of books owned for each interval from 2012 to 2018. The distribution of the number of books owned by the students at the basic proficiency level in PISA 2012, 2015 and 2018 is given in Figure 8.



	0_10	11 _ 25	26 _ 100	101 _ 200	201 _ 500	More than 500
2012	32,6	29,8	24,0	7,4	2,6	1,9
2015	23,4	29,1	30,2	9,6	4,5	2,5
2018	19,8	30,8	29,7	11,3	5,4	2,2

Figure 8. *Distribution of the Number of Books for Basic Performer Students*

As shown in Figure 8, the majority of the students have fewer than 100 books. In 2012, students who had 100 or fewer books accounted for 86.4% of the group; whereas this figure was 82.7% in 2015, and 80.7% in 2018. The students with 101 or more books accounted for 11.9% in 2012, 16.6% in 2015, and 18.9% in 2018. When Figures 7 and 8 are considered together, it can be said that the concentration in the distribution of books is similar for students at both proficiency levels, but more of the students at the basic proficiency level have 100 books or fewer. For both proficiency levels, an increase is observed in the percentage of students who own a book. Table 3 shows the change over time in the resources available at home to the students who are at the basic proficiency level (Level 2) and below (Level 1) in PISA Turkey 2012, 2015 and 2018.

Table 3. Resources Available at Home to Students at or below Basic Proficiency Level

Resources	2012		2015		2018	
	% Yes (Level 1)	%- Yes (Level 2)	% Yes (Level 1)	%- Yes (Level 2)	% Yes (Level 1)	%- Yes (Level 2)
Desk to study	69.5	81.4	75.7	85.8	80.9	88.3
Room of her/his own	54.3	64	61.3	71.6	65.6	72.9
Place to study	69	78.7	75.3	83.4	80.2	86.1
Computer	48.4	61.9	53	69	50.5	63
Educational Software	32	27.2	37.9	38.5	42.6	41.3
Internet Connection	40.7	50.3	49	61.9	60.3	73.1
Literature books	33.8	51.3	37.8	53.8	53.3	70.1
Poetry books	49.1	53.2	49.8	54.2	52.6	56
Art works	20.9	33	24.9	30	30.9	31.4
Textbooks	62.7	76.9	70.7	83.1	75.9	86.1
Technical books	29.7	34.6	35.4	40.8	36.6	36.8
Music and architecture books	-		5.7	40	38.8	40.7

As shown in Table 3, it is clear that the percentage of students having their own room, computer and study desk for both proficiency levels has increased over the years. According to the table, the percentage of students owning literature, poetry, technical, art, music and architectural books is quite low. In addition, the low number of works of art paintings, photographs, sculptures, and such is also striking. Although the percentage of students at the basic proficiency level having these resources is higher than the students below the basic proficiency level, the percentages for both groups are quite low. The distribution in Tables 7 and 8 confirms this conclusion. Another remarkable finding is related to software. Although most of the students have a computer and internet connection at home, very few have educational software.

The second question of the research is related to determining which of the student and family variables predict the proficiency level of the students participating in the PISA Turkey 2012, 2015 and 2018. The logistic regression model explained in the data analysis is tested. -2LL values for the null model, in which there are no predictive variables, is 3258.82 for PISA 2012, 5179.51 for PISA 2015 and 4718.86 for PISA 2018. This log likelihood value is expected to decrease as the independent variables are added to the model. According to the first classification results, the classification accuracy is 61.18%; 52.61% and 55% respectively. Chi square values of models with no predictor variables for all implementation years are found to be statistically significant [$\chi 2(33) = 340.85$, $p=0.00$ for PISA 2012; $\chi 2(32) = 474.10$, $p=0.00$ for PISA 2015; $\chi 2(32) = 434.20$, $p=0.00$ for PISA 2018]. This indicates that the coefficients of the predictor variables that are not yet included in the model are significantly different from zero (Field, 2009). When the Omnibus test results related to model coefficients is examined, they are found to be all statistically significant for all implementation years. This statistic is an indication that there is a significant difference between the null model and the test model.

For the test model, the -2 log likelihood values are is 2446.56 for PISA 2012, 4655.78 for PISA 2015, and 4236.68 for 2018. All -2 log likelihood values are smaller than the null model, indicating that predictive variables function well. As regards the Nagelkerke R2 value, the test model accounts for 18% of the variance in the predicted variable for 2012 and 17% for 2015 and 2018. Based on the output of the Hosmer and Lemeshow test, the model has acceptable fit for all implementation years [$\chi^2(8) = 9.61$, $p=0.42$ for 2012; $\chi^2(8) = 8.12$, $p=0.45$ for 2015; $\chi^2_{(8)} = 6.42$, $p=0.60$ for PISA 2018]. Lastly, the classification accuracy of the test model shows an increase compared to the null model for all years. The percentage of correct classification was 68.46% for PISA 2012; 64.59% for PISA 2015 and 65% for PISA 2018. Table 4 shows the parameter estimations of the predictor variables in the model for PISA 2012.

Table 4. Estimations of Predictive Variables in PISA 2012

Year	Variables	β	S. E.	Wald	df	p	Odds Ratio (e-β)
2012	*Gender (1)*	*0.75*	*0.11*	*50.16*	*1*	*0.000*	*2.13*
	Preschool			4.76	2	0.124	
	Preschool (1)	0.30	0.15	4.33	1	0.071	1.35
	Preschool (2)	0.16	0.22	0.73	1	0.507	1.18
	Desk to study (1)	*0.31*	*0.14*	*5.39*	*1*	*0.049*	*1.38*
	Own room (1)	-0.02	0.12	0.45	1	0.631	0.98
	Place to study (1)	0.15	0.13	1.48	1	0.288	1.16
	Computer (1)	0.30	0.15	4.75	1	0.126	1.37
	Software (1)	*-0.32*	*0.12*	*8.03*	*1*	*0.025*	*0.73*
	Internet (1)	0.00	0.15	0.35	1	0.646	1.01
	Literature (1)	*0.50*	*0.11*	*21.14*	*1*	*0.004*	*1.67*
	Poetry (1)	*-0.29*	*0.11*	*6.96*	*1*	*0.034*	*0.75*
	Art (1)	-0.01	0.13	0.47	1	0.652	1.00
	Textbooks (1)	*0.32*	*0.12*	*7.44*	*1*	*0.022*	*1.39*
	Technical books (1)	-0.08	0.12	0.58	1	0.515	0.92
	Number of books			8.79	5	0.177	
	Number of books (1)	0.00	0.12	0.26	1	0.643	1.00
	Number of books (2)	*0.34*	*0.15*	*5.38*	*1*	*0.047*	*1.41*
	Number of books (3)	0.35	0.23	2.37	1	0.169	1.43
	Number of books (4)	0.06	0.33	0.46	1	0.624	1.09
	Number of books (5)	0.17	0.40	0.17	1	0.678	1.18
	ESCS	0.06	0.12	0.33	1	0.645	1.06
	Education of father			5.78	6	0.512	
	Education of father (1)	0.33	0.21	2.92	1	0.145	1.41
	Education of father (2)	0.27	0.23	1.78	1	0.329	1.32
	Education of father (3)	0.28	0.40	0.56	1	0.494	1.33
	Education of father (4)	0.33	0.29	1.50	1	0.314	1.40
	Education of father (5)	0.25	0.31	0.80	1	0.445	1.29
	Education of father (6)	0.53	0.40	2.01	1	0.243	1.73
	Education of mother			6.69	6	0.411	
	Education of mother (1)	-0.05	0.15	0.27	1	0.669	0.95
	Education of mother (2	-0.13	0.18	0.82	1	0.484	0.88
	Education of mother (3)	-0.98	0.55	3.51	1	0.152	0.41
	Education of mother (4)	0.04	0.28	0.64	1	0.496	1.06
	Education of mother (5)	-0.06	0.30	0.21	1	0.724	0.95
	Education of mother (6)	-0.47	0.38	1.51	1	0.227	0.63
	Grade repetition (1)	*-0.97*	*0.12*	*71.38*	*1*	*0.000*	*0.38*
	Constant	-0.55	0.45	1.53	1	0.245	0.58

First of all, the Wald statistics were analyzed to determine the significance of the variables. Accordingly, for PISA 2012, the variables that statistically significantly predicted whether the students were below or at the basic proficiency level were found to be the gender of the student, whether there was a study desk at home, whether there was an educational software at home, whether the student had literature, textbooks and poetry books, the number of books at home, and whether or not the student repeated a grade. When the beta coefficients of these variables are examined, the presence of positive and negative values is striking. The positive coefficient increases the predicted probability (being at the basic proficiency level), while the negative coefficients decrease it. Odds ratios of 1 and above increase the probability of the phenomenon occurring, while a ratio below 1 decrease. For example, looking at Table 6, the Wald statistic of the gender variable is observed to be significant ($p<0.05$). As such, the gender variable significantly predicts being at or below the basic proficiency level. Looking at the beta coefficient, it can be seen that the coefficient is positive (0.75). Therefore, being female increases the probability of being at the basic proficiency level. Finally, when we look at the odds ratio of the gender variable, we observe that the ratio is 2.13. Thus, being female increases the probability of being at the basic proficiency level 2.13 times. When making interpretations based on the odds ratios for other variables, having a study desk at home increases students' probability of being at the basic proficiency level 1.38 times; having literature books increases it 1.67 times, having textbooks increases 1.39 times, and having 26-100 books at home increases this probability 1.41 times. On the other hand, having educational software at home reduces the likelihood of being at the basic proficiency level 0.73 times; having poetry books reduces it 0.75 times, and repeating a grade results reduces 0.38 times. Table 5 shows the parameter estimations of the predictive variables in the model for PISA 2015.

Table 5. Parameter Estimations of Predictive Variables in PISA 2015

Year	Variables	β	S. E.	Wald	df	p	Odds Ratio (e-β)
2015	*Gender (1)*	*0.22*	*0.07*	*10.24*	*1*	*0.025*	*1.25*
	Desk to study (1)	0.04	0.11	0.71	1	0.566	1.05
	Own Room (1)	0.03	0.09	0.98	1	0.537	1.03
	Place to study (1)	0.14	0.10	2.17	1	0.224	1.15
	Computer (1)	*0.25*	*0.10*	*6.61*	*1*	*0.044*	*1.29*
	Software (1)	*-0.34*	*0.08*	*19.04*	*1*	*0.001*	*0.71*
	Internet (1)	*0.28*	*0.10*	*8.86*	*1*	*0.021*	*1.32*
	Literature (1)	*0.36*	*0.08*	*20.56*	*1*	*0.007*	*1.44*
	Poetry (1)	*-0.21*	*0.08*	*7.51*	*1*	*0.040*	*0.81*
	Art pieces (1)	-0.11	0.09	2.81	1	0.264	0.90
	Textbooks (1)	*0.32*	*0.10*	*11.81*	*1*	*0.013*	*1.39*
	Technical books (1)	-0.13	0.08	3.10	1	0.209	0.88
	Art, music and architecture books (1)	-0.10	0.08	1.82	1	0.306	0.91
	Number of books			35.07	5	0.000	
	Number of books (1)	0.13	0.09	3.41	1	0.198	1.15
	Number of books (2)	*0.47*	*0.10*	*21.04*	*1*	*0.003*	*1.61*
	Number of books (3)	*0.62*	*0.16*	*16.78*	*1*	*0.001*	*1.88*
	Number of books (4)	*0.62*	*0.21*	*8.88*	*1*	*0.019*	*1.88*
	Number of books (5)	0.56	0.27	4.80	1	0.130	1.79
	Education of mother			34.34	6	0.000	
	Education of mother (1)	0.08	0.11	0.99	1	0.449	1.08
	Education of mother (2)	-0.19	0.14	2.15	1	0.248	0.83
	Education of mother (3)	-0.38	0.17	5.26	1	0.058	0.68
	Education of mother (4)	0.15	0.19	1.26	1	0.512	1.18
	Education of mother (5)	*-0.58*	*0.18*	*11.05*	*1*	*0.005*	*0.57*
	Education of mother (6)	*-0.56*	*0.20*	*8.35*	*1*	*0.016*	*0.57*
	Education of father			10.85	6	0.249	
	Education of father (1)	0.01	0.16	0.26	1	0.662	1.01
	Education of father (2)	-0.15	0.17	1.20	1	0.459	0.87
	Education of father (3)	0.16	0.22	0.79	1	0.465	1.18
	Education of father (4)	0.18	0.23	1.10	1	0.510	1.21
	Education of father (5)	-0.03	0.21	0.24	1	0.698	0.98
	Education of father (6)	0.06	0.24	0.41	1	0.628	1.08
	Grade repetition (1)	*-1.31*	*0.12*	*118.78*	*1*	*0.000*	*0.27*
	ESCS	*0.21*	*0.08*	*8.93*	*1*	*0.047*	*1.24*
	Constant	-0.36	0.32	1.84	1	0.302	0.72

As shown in Table 5, the variables that significantly predict students' being at or below the basic proficiency level are gender, having a computer, software, internet connection, literature and poetry books and textbooks, the number of books, mother's education level, student's grade level repetition, and socioeconomic and cultural status of the family. Accordingly, provided that all other variables are constant, the probability of the student being at the basic proficiency level is increased by being a girl 1.25 times, by owning a computer 1.29 times, by having internet connection 1.32 times, by having literature books 1.44 times, and by having reference books to help lessons 1.39 times. Further, having 26-100 books increases this probability 1.61 times, having 101-200 books increases it 1.88 times, and having 201-500 books increases it 1.88 times. When all the variables are held constant, a one-unit increase in students' ESCS status increases the probability of students to be at the basic proficiency level 1.24 times. On the other hand, having educational software at home leads to 0.71 times more likelihood in being at the basic proficiency level; having poetry books at home causes 0.81 times decrease; the mother's having an associate degree increases it 0.57 times, while her having a bachelor's and master's degree reduces it 0.57 times. If the student repeats a grade, the probability of being at the basic proficiency level decreases 0.27 times. Table 6 shows the parameter estimations of the predictive variables in the model for PISA 2018.

Table 6. Parameter Estimations of Predictive Variables in PISA 2018

Year	Variables	β	S. E.	Wald	df	p	Odds Ratio (e-β)
2018	*Gender (1)*	*0.30*	*0.08*	*16.15*	*1*	*0.001*	*1.36*
	Desk to study (1)	0.16	0.12	2.08	1	0.265	1.18
	Own Room (1)	-0.06	0.09	0.59	1	0.538	0.94
	Place to study (1)	0.14	0.11	1.72	1	0.239	1.15
	Computer (1)	0.22	0.09	6.04	1	0.083	1.25
	Software (1)	*-0.39*	*0.08*	*23.70*	*1*	*0.000*	*0.68*
	Internet (1)	*0.25*	*0.10*	*6.66*	*1*	*0.027*	*1.28*
	Literature (1)	*0.46*	*0.09*	*29.28*	*1*	*0.000*	*1.59*
	Poetry (1)	-0.22	0.09	7.44	1	0.062	0.80
	Art pieces (1)	-0.13	0.09	2.02	1	0.183	0.88
	Textbooks (1)	*0.27*	*0.11*	*6.22*	*1*	*0.025*	*1.31*
	Technical books (1)	*-0.24*	*0.09*	*8.44*	*1*	*0.010*	*0.78*
	Art, music and architecture books (1)	*-0.22*	*0.09*	*7.41*	*1*	*0.025*	*0.80*
	Number of books			43.26	5	0.000	
	Number of books (1)	0.08	0.10	1.10	1	0.466	1.08
	Number of books (2)	*0.53*	*0.11*	*22.08*	*1*	*0.000*	*1.71*
	Number of books (3)	*0.63*	*0.16*	*16.82*	*1*	*0.000*	*1.89*
	Number of books (4)	*0.84*	*0.21*	*15.60*	*1*	*0.002*	*2.33*
	Number of books (5)	0.33	0.27	1.97	1	0.300	1.41
	Education of mother			40.07	6	0.000	
	Education of mother (1)	0.06	0.13	0.43	1	0.635	1.06
	Education of mother (2)	0.00	0.14	0.23	1	0.677	1.00
	Education of mother (3)	*-0.63*	*0.17*	*13.57*	*1*	*0.002*	*0.54*
	Education of mother (4)	0.06	0.19	0.40	1	0.713	1.07
	Education of mother (5)	-0.36	0.18	4.25	1	0.063	0.70
	Education of mother (6)	*-0.65*	*0.20*	*10.61*	*1*	*0.003*	*0.53*
	Education of father			7.42	6	0.338	
	Education of father (1)	-0.04	0.19	0.32	1	0.629	0.96
	Education of father (2)	-0.06	0.19	0.34	1	0.633	0.95
	Education of father (3)	0.04	0.23	0.38	1	0.599	1.05
	Education of father (4)	0.05	0.24	0.65	1	0.558	1.07
	Education of father (5)	-0.27	0.23	1.83	1	0.314	0.77
	Education of father (6)	-0.04	0.26	0.44	1	0.633	0.98
	Grade repetition (1)	*-1.14*	*0.13*	*83.59*	*1*	*0.000*	*0.32*
	ESCS	*0.27*	*0.08*	*12.33*	*1*	*0.002*	*1.31*
	Constant	0.01	0.36	0.32	1	0.688	1.03

As shown in Table 6, the variables that significantly predict a student's being at or below the basic proficiency level are gender, software, and internet connection at home, literature books, textbooks, books on technical and art and architecture, number of books, mother's education level, whether the student has repeated a grade or not, and the socioeconomic cultural status of the family. The probability of being at the basic proficiency level is increased 1.36 times by being female; 1.28 times by having internet connection; 1.59 times by having literature books, and 1.31 times by having resources to help learning the subjects. Examining the odds ratios for the variable of the number of books, a significant predictor, it was determined that the probability of having 26-100 books increases the likelihood of being at the basic proficiency level 1.71 times; having 101-200 books increases this probability 1.89 times, and having 201-500 books increases it 2.33 times. Moreover, a 1-unit increase in students' ESCS status increases their probability of being at the basic proficiency level 1.31 times. On the other hand, having educational software at home decreases the likelihood of being at the basic proficiency level 0.68 times; having technical books 0.78 times; having books on art, music and architecture 0.80 times; and the mother's vocational high school graduation 0.54 times; whereas her having a bachelor's and graduate degree reduces it 0.53 times. Repeating a grade reduces the probability of a student to be at the basic proficiency level 0.32 times.

The third research question focuses on the change of the statistically significant predictors of students' performances over the implementation years. To answer this question, the results of logistic regression was studied. Here, it is observed that there are 8 significant predictors in the model for 2012 and 11 predictors for 2015 and 2018. Based on this finding, it was concluded that, over time, an increasing number of variables play a role in the students' being below or at the basic proficiency level.

DISCUSSION & CONCLUSION

This study aimed to reveal the family characteristics and the resources of the students whose reading comprehension performance is at or below the basic proficiency level in PISA Turkey 2012, 2015 and 2018, to identify the year-by-year changes, and to find out the significant predictors of the students' proficiency levels. To this end, the gender, educational software, literature books and textbooks, number of books and grade repetition variables are found to be common classifiers of students' performance levels over last three PISA implementations. However, various variables are concluded to be predictors for each of the last three PISA implementations. Namely, students' gender, having a desk to study and educational software as well as poetry books and textbooks, number of books students have at home and grade repetition are determinant of students' low and basic performance levels for PISA 2012. For PISA 2015, students' gender, having a computer, educational software, internet connection, literature and poetry books as well as textbooks, number of books, educational statues of mother, grade repetition and ESCS index are resulted to be classifiers of students' low and basic level performances. Finally, students' gender, having an educational software, internet connection as well as having literature books, textbooks, technical and art books, number of books, education statues of mother, grade repetition and ESCS index are turned out to be significant classifiers of students' low and basic performance levels for PISA 2018 Turkey.

The findings of the study show that the parents of both the basic proficiency level and below the basic proficiency level groups are mostly primary school graduates, and some of the parents did not complete their primary school education. The findings about the educational status of the parents of the students at or below the basic proficiency level are in line with the literature (Gooding, 2001; Li & Qui, 2018; Ngure & Odundo, 2017; Shoukat, Ilyas, Azam & Ch, 2013). According to Bourdieu (1986), higher level of education increases parental cultural capital, which is transferred to children. This idea is based on the view of Laosa (1982) that "education has a lifelong effect on the behavior of individuals". Accordingly, the type and level of education received by individuals determines how they will behave as parents. Shaping the interactions between the parent and the child, this also determines what kind of personality the child will have. In other words, the decision of whether the individual has the affective characteristics that he/she needs to be successful or not is made in the family. Another argument attempts to explain the direct correlation between the education level of the parents and the school success of their children by stating that highly educated parents have high expectations from their children; that is, highly educated parents hold high academic expectations from their children. Therefore, students with such parents work harder and show higher performance (Steinmayr, Dinger, & Spinath, 2010). Considering the findings obtained from these studies as a whole, one of the reasons why underachieving students cannot display the high-level cognitive competencies expected from them may be the low educational level of their parents. In the current study, the education of parents of the students who are both below and at the basic proficiency level is mostly concentrated at primary and secondary school levels. Furthermore, there is a parent group of about 10% who have almost no formal education, and it is noteworthy that the percentage of parents with a high school or lower degree is around 80%.

It was also observed that the ESCS index indicates a higher socioeconomic and cultural status for both groups over time, but no change was found in the student performances due to this change. As indicated by the findings, under-performing is not only a problem of economically and socio-culturally disadvantaged groups. The related literature shows that the economic and sociocultural level of the family plays a role in student success (Broer, Bai, & Fonseca, 2019; Dowson & McInerney, 1998; Sirin, 2005). Low ESCS status is indicative of low economic and sociocultural status. When Figures 5 and 6 are examined, for all the years, the families of the student performing at the basic level and below can be seen to concentrate below the range of [0; 1]. When the resources available to the students at their homes were examined, it was observed that the students at the basic proficiency level and the students below this level did not have much difference.

The findings of the current study on the gender variable, which significantly predicts being at the basic proficiency level for all implementation years, is supported by the research findings in the literature. Here, the reference group is male students and the predicted gender is female, which is similar to the studies in the literature. Kutlu, Yıldırım, Bilican, and Kumandaş (2009) found that gender is a significant classification variable in students' reading comprehension success. Their research showed that being a girl means 1.86 times higher success in reading comprehension. Analyzing the characteristics related to reading comprehension success with progressive linear modeling, Yıldırım (2012) revealed that being a girl has a positive effect on success. The

findings by Alumran and Punamaki (2008), Bursal, Buldur and Dede (2015), Kukulu, Korukcu, Ozdemir, Bezci and Calik (2013), and Yıldırım (2012) also indicate that female students are more successful than male students. Considering the higher student scores at the level of basic proficiency, it was concluded that findings of this study were parallel to those reported in the related research literature.

Another finding of the study is that the resources the students have at home increase the probability of their being at the basic proficiency level. Thus, having a study desk, computer, internet connection, literature-related books and textbooks, in addition to having a higher number of books and a higher level of socio-and cultural status increase the probability of students' being at the basic proficiency level. This finding falls in with the literature. Güvendir (2014) emphasizes that students' academic performances develop as the number of books they have increase in numbers. Akyüz (2014) mentions the importance of resources students have and number of books on 8 grade students' mathematical performance. According to the research findings by Aslan (2017), the increase in students' families socio-economic and cultural statues results in higher students' performance. Families with higher economical economic inputs can allocate more resources for their children's education.

Another finding of the study is that having an educational software at home increases the probability that the student will perform below the basic proficiency level, which contradicts the findings of the literature indicating that educational software helps increase in student achievement (Kingsley & Boone, 2008; Zengin, Furkan & Kutluca, 2012). A closer look into these studies reveals that they have examined educational software as an alternative to the traditional method. However, the software in the current study is the one used by students at home. There are several reasons why the use of software appears to drive the student to perform below the basic proficiency level: for one, the software may not have the capability of assisting cognitive growth in students, and the other reason could be that students may not be able to use educational software effectively, given the distractive effect of the internet and PCs. Another reason may be that the type of assignments and tasks that students can do using educational software are not given by the teachers. If teachers do not assign the appropriate tasks to be done through educational software, their students will not use their educational software even if they have it at home.

Another remarkable finding of the study is related to the education level of the mother. The probability of a student's performing below the basic proficiency level increases when s/he has a mother with a vocational high school degree, or a mother with an associate degree, or a mother with undergraduate/graduate education. This finding contradicts with the literature. According to the literature, as the education level of the parents increases, the academic success of the child also increases, in other words, the education level of the parents of the students with high academic success is usually higher (Brown & Iyengar, 2008; Davis-Kean, 2005; Ekinci, 2011; Hanushek, 2016; Kodippili, 2011; Schreiber, 2002). Families with higher education have higher expectations from their children and therefore, the children of these families are more successful at school (Lippman et al., 2008). Nelson (2009) did not find a relationship between maternal education level and academic achievement. Considering the Turkish education system, it is known that vocational and technical education institutions do not expect academic success. Another interesting finding of the study is that mothers' receiving undergraduate and graduate education reduces the probability of students being at the basic proficiency level, which may be related to Turkey's higher education policies. The rapidly increasing number of universities and the increase in distance and open education programs have enabled many individuals to obtain a university degree. In addition, both the increase in the number of non-thesis master's programs and the increase in the number of students admitted to these programs may have lowered the quality of education at the undergraduate and postgraduate level. Even though mothers have earned this type of diploma, they may not be able to pass the standards of this education on to their children because they may have not actually attained the qualifications required by this type of education. This issue is worth examining further through future studies. Another variable that increases the probability of performing below the basic proficiency level is class repetition. OECD (2016b) states that students who repeat a grade are most likely to not reach the basic proficiency level. The issue of grade repetition in Turkey is an issue that is kept on the agenda of the Turkish Ministry of National Education (MoNE). MoNE usually transfers the students who need to repeat a grade to a higher grade conditionally or makes it dependent on the parents' decision. Edis and Yılmaz (2020) surveyed the opinions of 50 classroom teachers about grade repetition. 84% of the teachers stated that not repeating the grade would lead students to have difficulties in their upper grades, 76% stated that students would be negatively affected by their future examinations, 100% stated that the grade repetition decision should not be left to the parents, and 80% reported that students' study behaviors would be affected negatively. Bedel (2013) found that grade repetition increases the level of state anxiety in students. Grade repetition draws attention as a factor that reduces student achievement.

When the total correct classification percentage of the tested model is analyzed on a yearly basis, it is seen that the highest correct classification percentage was in 2012 (68.46%), while the other implementation years were lower (around 65%). Yet, the number of significant variable increase in numbers over years. This result may stand for that the impact of family and students' characteristics loosen its power on students' performance. The first suggestion can be made here is that other variables (affective variables, school variables) that may explain the differences between low and basic performers can be examined. Another suggestion that can be made based on the findings is to ensure that students are interested in artistic activities such as literature, poetry, music and architecture. When the home resources available to the children are examined, the biggest difference between the groups is observed in the lack of books on art, literature, architecture and music. It is important that the MoNE and provincial and district national education directorates are not limited to 100 literary classics and support students in reading classical and contemporary books. School libraries should be enriched and opportunities should be provided to students to buy discount books. Offering open access to the books by strengthening students' PC capacities and technical support, and enriching the visuals and audio recordings of the books will contribute to fostering student success as well.

Statements of Publication Ethics

This research was conducted using data from the PISA assessment collected by the OECD and open to all researchers. Ethics committee approval is not required as data is not collected by the researchers. All the rules stated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" have been complied with in the whole process from the planning of this research to its implementation, from data collection to data analysis. None of the actions specified under the title of "Actions Contrary to Scientific Research and Publication Ethics", which is the second part of the directive, were not carried out. During the writing process of this research, scientific, ethical and citation rules were followed; no falsification was made on the data. This work has not been submitted anywhere for evaluation.

Researchers' Contribution Rate

The first author mainly played a role in the development of the research problem and the interpretation of the analysis results, and the second author mainly took part in the readings based on the literature related to the research problem and the conducting the analysis.

Conflict of Interest

As the authors of the study, we declare no conflict of interest.

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