Examination of Science Achievement in the 8th Grade Level in Turkey in Terms of National and International Exams Depending upon Various Variables

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Abstract

The aim of the present study is to examine the effect of demographic characteristics of students in Turkey upon their performance in TIMSS, an international assessment exam and Secondary Education Transition Examination which is a national exam (OGS). One of the fields of sciences, biology is taken into account as student performance. As a result of the t-test analysis, it was determined that gender has a statistically significant effect on the students' TIMSS and TEOG exam results; besides, it was found that female students are more successful compared to boys Whether students receive private tutoring which refers to the economic characteristics of the students has not statistically significant effect on TIMSS biology scores, while it has a positive and significant impact upon OGS biology scores. Moreover, findings revealed that parental educational level has a positive and significant effect on TIMSS and OGS scores of the students.

Keywords: TIMSS, TEOG, science achievement, Turkey, private tutoring

1. Introduction

In a globalized world, countries are affected in such a way that it is a must for them to struggle more and more in order to achieve success (Kagia, 2005; Popple, 2006). One of the ways for being able to achieve success against this struggle is to have several opportunities for education (Howard & Wheeler, 2015; Craig, 1998; Suárez-Orozco & Qin-Hilliard, 2004). Hence, education policies implemented by countries come into prominence (Balay, 2004; Bloom, 2004; Burbules & Torres, 2000; Genç & Eryaman, 2008). In terms of determining education policies, countries conduct evaluation studies at national and international levels so that specialists and researchers who prepared curriculum can check the functionality of their educational system (Aydın, Sarıer, & Uysal, 2012; Demirbaş, 2008; Beaton, Martin, & Mullis, 1997; O.E.C.D., 2008; Yıldırım, 2015). These evaluation studies are highly significant as the education quality and the level of achievement increase in line with the needs of global world through revising the curriculum (Mullis, Martin, Ruddock, O'Sullivan, Arora, & Erberber, 2005). One of the exams that will provide countries for comparing their levels at international level is Trends in International Mathematics and Science Study (TIMSS). TIMSS is a timely exam on mathematics and science achievement of those at 4th and 8th grade performed by Boston College in collaboration with International Association for the Evaluation of Educational Achievement (Oral & McGivney, 2011; Mullis et al., 2005; Uzun, Bütüner & Yiğit, 2010).

TIMSS assessment exam dates back to 20 years ago and it has been applied 6 times until now starting firstly in 1995. Almost 4000-5000 students took the assessment selected from 150-200 schools in each country. While the number of countries participating in the 4th grade was 29, that is 46 for the 8th grades in 1995. TIMSS conducted by only those at 8 grades in 1999 was administered in 38 countries. In 2003, the number of countries applied to the 4th Grade was 26 while it was 47 for the 8th grade. In 2007, the number of countries participating in the 4th grade was 37, whereas those participating in the 8th grade were 50. It was revealed that there was an increase especially in the number of countries participating in the 4th grade in 2011 while a decrease was observed in the 8th grade. This year, the number of countries participating in the 4th grade is 50 while this number is 42 for the 8th grade. Considering the latest TIMSS exam applied in 2015, it is clear that the number of countries participating in the 4th Grade were 48 while those participating in the 8th grade were 40 (IES, 2015).

TIMSS does not only measure students' achievement levels but it also provides information concerning the demographic characteristic of students participating in the exam. This examination also transfers information on the students' achievement related to gender, parental educational level, the features of the schools and basic education policies implemented by countries (Martin, Mullis, Gonzalez & Chrostowski, 2004). Thus, it

contributes to the recognition of the findings which affect the students' achievement or lead to failure (Martin et. al, 2004).

Even though TIMSS is applied at the 4th and 8th grade, it has a great importance since transition to the high school after Grade 8 is possible and 8 Grade topics are the basis for the periods following it. Besides, for countries where the national exams such as an entrance exam for high school, TIMSS for 8 grade has a particular significance as it leads countries in terms of their education policies and the comparison of national and international exam. TIMSS for 8 grades covers 4 main fields: biology, chemistry, physics and toponomy. Biology has the largest share with especially 28% of the questions in 8th grade science exam. Biology allows students to understand biogeography as well as establishing a relationship between people and the world. Compared to chemistry and physics which require much more mathematical computing, biology measures students' ability to read and interpret as well.

1.1 Problem of Research
In this regard, in the present study, how demographic characteristics of students in Turkey affect their performance in TIMSS, an international assessment exam and Transition to Secondary Education Examination which is a national exam will be examined and such research questions will be determined as follows:
1. Does students' gender differences have an impact on their TIMSS and OGS biology achievement?
2. Does students' receiving private tutoring affect their TIMSS and OGS biology achievement?
3. Does parental education have an effect upon the students' TIMSS and OGS biology achievement?

1.2 Research Focus

1.2.1 Turkey in terms of TIMSS examination and the Turkish Education System

With a view to determining its own educational systems as the other countries and doing policies and reforms, Turkey joined in TIMSS in 1999 for the first time which was followed by 2007 and 2011. In 1999, among 38 countries, Turkey became 31th in math exam and 33th in sciences and it was below the average of the countries participating in TIMSS in all fields of science and mathematics (EARGED, 2007). However, in 2007, Turkey was among the countries which have the highest increase depending on TIMSS examination. In 2011, Turkey ranked 24th out of 42 countries in mathematics while it became 21st in science (Büyüköztürk, Çakan, Tan, & Atar, 2014). Although Turkey has increased both mathematics and science scores and its rank since 1999 in which TIMMS was applied there for the first time, it was ranked below average in TIMSS exams (SETA, 2013).

Various studies have been conducted related to TIMMS in Turkey. The present study is carried out in order to compare transition to secondary school examination (OKS, SBS, TEOG) and TIMMS questions (biology) in terms of student achievement. Several exams are available organized in relation to the countries' national objectives as well as international exams allowing the countries to observe their level of success. One of the countries conducting a national exam in accordance with its objectives is Turkey. Turkey holds various exams so as to develop educational policies and measure student achievement. One of these exams is Transition to Secondary Education Examination (OGS) students started after 8 years of compulsory education. No matter how OGS varies in terms of name and content, it is possible to emphasize that there are no significant changes regarding the overall objectives of the exam. One of the changes is 2004-2008 Secondary School Selection and Placement Exam (OKS), 2008-2013 Level Determination Examination (SBS) and Basic Education Secondary Transition (TEOG) on an ongoing process since 2013 respectively. Students who achieve success in this exam will have the opportunity for receiving education at prestigious schools such as Anatolian high school and science high school. Therefore, the students have a chance for making a good investment in future (Sarıer, 2010). Besides, academic achievement of those who graduate from these schools is required to be high. Furthermore, the achievement of these high schools was found to be higher than the countries which have a high quality (Berberoglu & Kalender 2005; Çelen, Çelik, & Seferoğlu, 2011).

1.2.2   The Effect of gender on student achievement
The effect of gender on student achievement has been the subject of the research. When academic studies are evaluated, it has been found that there are different results on the academic achievement of students in science courses. In general, although it was found that science achievement is in favor of the male students (Bacharach, Baumeister & Furr, 2003; Evans, Schweingruber & Stevenson, 2002; Keeves, 1992; Nosek et al., 2009), in some studies, it is in favor of female students; moreover, several studies showed that there is no relationship between gender and academic achievement (Cole, 1997; Keeves, 1992). Based upon the results of TIMSS performed in

2007 at 8th grade, science scores are in favor of female students in 14 countries while they are in favor of boys in 11 countries; whereas there is no difference between the scores and gender in the other 24 countries including Turkey (Mullis, Martin & Foy, 2008). In the same report, considering biology questions, it was indicated that female students are more successful compared to boys in more than half of the countries, one of which is Turkey. On the other, male students are much more successful than female students in five countries while in the rest of the countries, there was no difference between biology achievements of students in terms of gender.

1.2.3   The Effect of Private Tutoring upon Student Achievement

Private tutoring is considered as non-formal education centers established for the purpose of supporting formal education and addressing students' academic shortcomings (Okçabol, 1996). One of the main functions of these centers is to be more in such countries as Japan and South Korea which particularly passed the next degree through an examination (Davies, 2004). A significant function of these centers in Turkey is to prepare students for OGS an exam for the transition to high school (Gök, 2005). A fundamental function that will determine the quality of education received by the students, private tutoring centers are shaped by parents' income level (Aslankurt 2013, Tansel and Bircan, 2008). Families with high-income enroll their children to a better quality centers whereas those with middle-income choose places depending on their income. Moreover, families with normal and low-income enroll their children to these centers instead of meeting their basic needs just for a better future. Within the scope of some studies which examine the effect of private tutoring upon academic achievement revealed that these centers increase student achievement (Altun & Çakan, 2008; Lavy & Schlosser, 2005; Dang 2007; Banerjee, Cole, Duflo & Linden, 2005). Similarly, the studies conducted in Turkey found that private tutoring has an effect upon student achievement (Berberoğlu & Tansel, 2014; Alkan, Çarkoğlu, Filiztekin & İnceoğlu, 2008).

1.2.4   The effect of Parental Educational Status on Student Achievement

That parental educational level has an impact on students' science and mathematics achievement is indicated within the studies (Engin-Demir, 2009; Sabah & Hammouri, 2010; Uzun et al., 2010). In countries with a high level of family support and education, student achievement was found to increase positively (Ceylan & Akerson, 2014; Ramírez, 2006; Martin et al., 2004). The fact that parents have a high quality of education ensures students' academic achievement (Öztürk & Uçar, 2010). Achievement scores of Turkish students in science and math tests are 454 while science achievement rank is 31 in TIMSS 2007, which shows that they performed poorly compared to the other countries in terms of scores and rank (IES, 2015). This may occur due to the fact that 7% of parents' level of education in Turkey is university graduates, 3% of them are vocational school graduates, 20% of them are high school graduates, 52% of them are primary school graduates and 16% of them are those who left primary school (EARGED, 2011). Consequently, the studies conducted revealed that there is a possible relationship between the parental educational levels and student achievement (Aypay, Erdoğan & Sözer, 2007; Martin et al., 2004; Sabah & Hammouri, 2010; Ramírez, 2006; TIMSS, 2007; Thomson, 2008; Uzun et al., 2010).

2.   Methodology of Research

2.1 General Background of Research

Descriptive method was used in the present study. The aim of the study is to put forward the difference between the students' achievement scores obtained from biology questions available in TIMSS and OGS exams and gender, receiving private tutoring as well as parental educational level.

2.2   Sample of Research

The data was randomly collected from 732 8th grade students in 6 public secondary schools and 2 private tutoring centers in Kahramanmaras, Turkey since it refers to the fact that a researcher chooses a part of the universe randomly depending upon the sample size. Afterwards a few classes were chosen from each school and private teaching centers through random sampling method. All the students in the selected class were included in the sample. The demographic characteristics of the working group are presented in Table 1.

Table 1. The Distribution of Demographic Characteristics of the Working Group

		The number of the Participants				Percentage
		TIMSS	**OGS**	SCIENCE	TOTAL	
Gender	Female	343	343	343	721	% 47.6
	Male	378	378	378		% 52.4
Private tutoring Center	Private tutoring	453	453	453	720	% 62.9
	No private tutoring	267	267	267		% 37.1
The Highest Education Degree of the Parents (Mother-Father)	Primary	86	86	86	732	% 11.8
	Secondary	157	157	157		% 21.5
	High School	232	232	232		% 31.7
	University	256	256	256		% 35.0

The working sample was determined as 732 students. However, based upon Table 1, it has been indicated that the total number of the different variables changes. Thus, given the validity of the data, the number of the sample for each variable differs.

2.3 Instrument and Procedures

At the beginning of the study, 6 forms (booklets) consisted of biology questions which are applied in TIMSS 2007 exam and the transition to secondary school exams (OGS) between the years of 2005-2014 was constructed. Each form was consisted of 31 questions: 16 biology questions from TIMSS 2007 and 15 biology questions from OGS exam questions. The question distribution of each form is presented in Table 2. With a view to obtaining the demographic characteristics of the students such as gender, receiving private tutoring or not, parental educational level, a Survey was added at the end of the forms.

Table 2. The Distribution of Forms and Questions

	# of Questions	FormA	FormB	FormC	FormD	FormE	Form F
TIMMS	16	x	x	x	x	x	x
OGS_2005	9	x					
OGS_2006	9		x				
OGS_2007	9			x			
OGS_2008	9				x		x
OGS_2009	6						x
OGS_2010	6				x		
OGS_2011	6			x			
OGS_2012	6		x				
OGS_2013	6	x					
OGS_2014_1	6					x	
OGS_2014_2	9					x	

All of the forms were conducted in each class instead of applying each form to one class so as to avoid the errors made by students and making a comparison between the forms. Thus, the average scores of TIMSS questions which are common in each form were found to be approximate. Table 3 indicates how many people completed each form; moreover, it presents 95% confidence interval and general average of TIMSS questions common in each form.

Table 3. The number of people completing forms and TIMSS Results

Forms	The Number of People	Average scores of TIMSS	%95 confidence interval
Form A	121	8.84	(8.18, 9.51)
Form B	119	8.99	(8.50, 9.48)
Form C	134	8.53	(8.10, 8.98)
Form D	117	8.12	(7.58, 8.66)
Form E	128	8.47	(7.92, 9.02)
Form F	113	8.57	(8.01, 9.13)

Based upon the 95% confidence interval for each form, average score of TIMSS questions of each form were statistically identical since confidence interval for each form is in conflict with one another. In this regard, it is clear that all of the forms did not differ in terms of difficulty; besides, it is evident that the sample chosen for each form is academically homogeneous.

2.4   Data Analysis

Prior to data analysis, the scores of each student were calculated as a percentage in order to standardize the scores as TIMSS and OGS questions are not equal. To illustrate, when 12 out of 16 TIMSS questions are correct, the score will be $12 \div 16 = .75$. Afterwards, SPSS 21.0 program was used for the analysis of data; accordingly, correlation percent-frequency, t-test, one-way analysis of variance (ANOVA) and befferoni test were conducted.

3.   Results of Research

As presented below, the distribution of Total Score, OGS and TIMSS was analyzed with the aim of understanding whether the scores normally distributed or not, which leads researchers to use parametric or non-parametric test for data analysis.
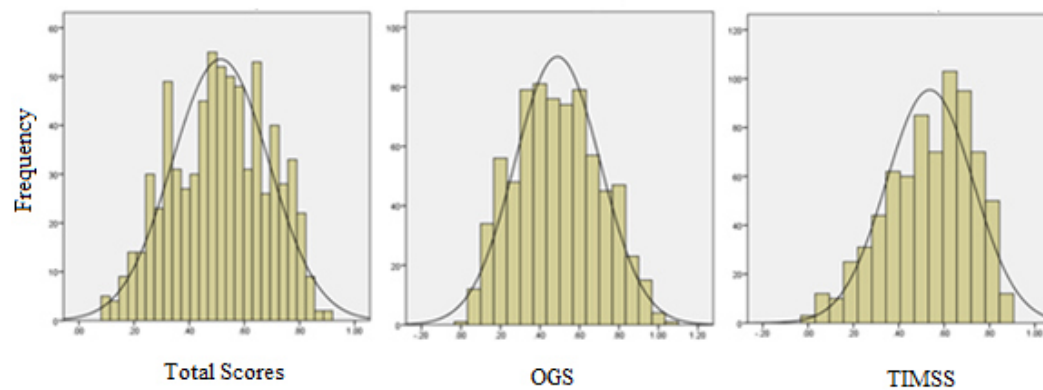

Figure 1. The Distributions of Total Score, OGS and TIMSS Scores

Different methods are available for checking is the distribution provided in Figure 1 is normal. One of them is the method of analyzing the coefficient of skewness (Büyüköztürk, 2010). Based on the coefficient of skewness method, each distribution is considered as normal since of skewness coefficient of each distribution is between -1 to +1 (Total Score$_{skewness\ coefficient}$= .-13, OGS $_{Skewness\ coefficient}$= .13, TIMSS$_{Skewness\ Coefficient}$= -.48). Another way to test normality is the graph (Q-Q plot) method (Punch & Etöz, 2005). Q-Q plots of each distribution are presented in Figure 2.
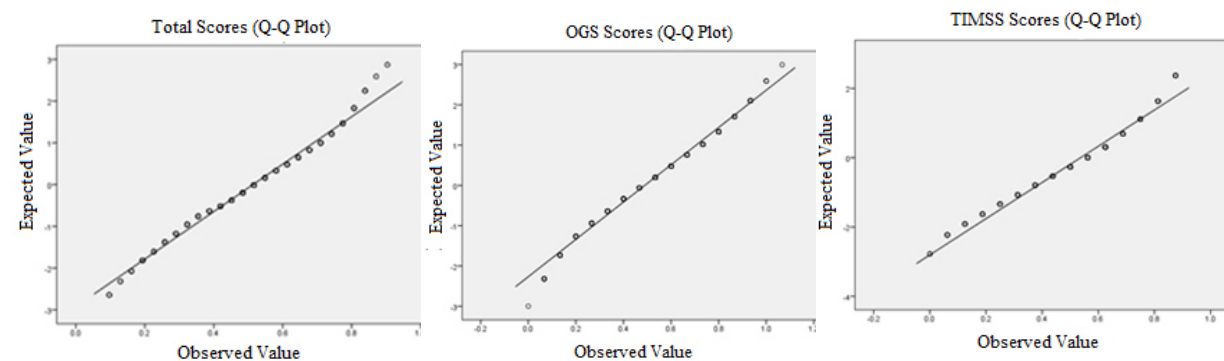

Figure 2. Q-Q plots of the Distribution of Total Score, TIMSS and OGS Scores

Depending on the presented Q-Q plots, as Total Score, OGS and TIMMS scores are distributed around each line, these score are considered to be normally distributed. Hence, T -test and ANOVA which are parametric tests will be used.

3.1 The examination of OGS and TIMSS 2007 science (biology) achievement scores of 8 Grade students in terms of gender

The Distribution of 8th grade students' achievement scores of science (Biology) in Turkey in terms of gender is presented in Table 4.

Table 4. The distribution of Students' Scores in terms of Gender

Scores	Gender	N	$\bar{X}$	S	t
TIMSS	Female	347	.58	.17	5.72**
	Male	385	.50	.20	
OGS	Female	347	.54	.22	6.66**
	Male	385	.45	.21	
Total Score	Female	347	.56	.19	6.67**
	Male	385	.47	.17	

**p<0.01

According to Table 4, the average TIMSS biology scores of female students are $\bar{x}$=.58 while that of male students are $\bar{x}$=.50. In other words, female students answered 58% of TIMSS biology questions correctly while male students answered 50% of them correctly. The difference between the two groups is statistically significant. Thus, female students are more successful compared to male students related to TIMSS biology questions ($t_{(727)}$=5.72, p<0.01). Considering OGS biology scores, it was revealed that the average scores of female students are $\bar{x}$=.54 whereas those of male students are $\bar{x}$=.45. Namely, 54% of female students YGS biology question, male students gave the correct answer to 45%. T-test results show that female students are more successful in OGS biology questions compared to male students ($t_{(730)}$=6.66, p<0.01). Considering the sum of TIMSS and OGS biology questions, it was found that the average of female students is $\bar{x}$ = .56 while that of male students is $\bar{x}$=.47. It was determined that female students are statistically much more successful in biology questions than male students ($t_{(730)}$=6.67, p<0.01).

3.2   The examination of 8th grade students' achievement in OGS and TIMSS 2007 science (biology) in terms of receiving private tutoring

The distribution of 8th grade students' achievement in biology depending upon receiving private tutoring is presented in Table 5.

Table 5. The distribution of the scores of students who receive private tutoring

Scores	Private tutoring center	N	$\bar{X}$	S	t
TIMSS	Private tutoring	455	.54	.19	1.41
	No Private tutoring	274	.52	.19	
OGS	Private tutoring	455	.51	.22	3.15**
	No Private tutoring	274	.46	.20	
Total Score	Private tutoring	455	.53	.18	2.70**
	No Private tutoring	274	.49	.16	

**p<0.01

According to Table 5, TIMSS biology scores of students receiving private tutoring are $\bar{x}$=.54 whereas the scores of those who do not go are $\bar{x}$=.52. It was also found that there is no statistical difference between the group who receive private tutoring and who do not in terms of TIMSS scores ($t_{(727)}$=1.41, p=0.16). On the other, taking into account OGS biology questions, it was revealed that the average scores of students who receive private tutoring are $\bar{x}$=.51 while the average of those who do not is $\bar{x}$=.46. Statistically, students receiving private tutoring are more successful compared to those who do not regarding OGS biology scores ($t_{(727)}$=3.15, p<0.01). Furthermore; examining total scores of biology, it was found out that the average scores of students who receive private

tutoring are $\bar{x}$=.53 while the average scores of those who do not are $\bar{x}$=.49, which means that students who receive private tutoring are more successful in biology than those who do not ($t_{(727)}$=, p<0.01).

3.3   The examination of 8th grade students' achievement in OGS and TIMSS 2007 science (biology) in terms of parental educational status

The distribution of 8th grade students' achievement in biology depending upon parents' highest educational level is illustrated in Table 6.

Table 6. The Distribution of Students' Scores in terms of Parental Educational Status

Scores	Educational Level	N	$\bar{X}$	S
TIMSS	Primary	86	.49	.20
	Secondary	157	.49	.18
	High School	232	.53	.20
	University	256	.59	.18
OGS	Primary	86	.45	.20
	Secondary	157	.46	.19
	High School	232	.46	.21
	University	256	.55	.23
Total Score	Primary	86	.47	.17
	Secondary	157	.48	.16
	High School	232	.50	.18
	University	256	.57	.18

When the distribution among parents are examined, it was revealed that the average biology scores of students whose parents are university graduates are $\bar{x}$=.59 whereas the average scores of those whose parents are primary or secondary school graduates are $\bar{x}$=.49; moreover, the average scores of students whose parents are secondary school gradutes are $\bar{x}$=.53. ANOVA test results showed that parental educational level has a significant effect on the students' TIMSS scores ($F_{(3, 727)}$ = 11.05, p<0.01). Based upon Befferoni test performed for comparing each group dually, only the students whose parents are university graduates were found to be statistically successful than the other groups as shown in Table 7.

However, it was not found a significant difference between TIMSS scores of the students whose parents are primary, secondary and high school graduates. In addition, comparing OGS biology scores, it was clarified that the average scores of students whose parents are university graduates are $\bar{x}$=.55 whereas the average scores of those whose parents are high or secondary school graduates are $\bar{x}$=.46 and that of students whose parents are primary school graduates are $\bar{x}$=.45. ANOVA test results showed that parental educational level significantly affects students' OGS scores as in their TIMMS scores ($F_{(3, 727)}$ = 9.20, p<0.01). With reference to Befferoni test presented in Table 7, while the students whose parents are university graduates were found to be statistically successful than the other groups, there is no statistical difference among OGS scores of students whose parents are primary, secondary and high school graduates.

According to Table 6, the average biology scores of students whose parents are university, high, primary and secondary school graduates are $\bar{x}$=.57, $\bar{x}$=.50, $\bar{x}$=.48 ve $\bar{x}$=.47, respectively. ANOVA test results highlighted that parental educational level has a significant impact upon the students' biology scores ($F_{(3, 727)}$ = 13.32, p<0.01). Regarding Befferoni test presented in Table 7, merely the students whose parents are university graduates were found to be statistically successful than the other groups.

Table 7. The Comparison of Parental Education Degrees as Double

Scores	Education Levels	Mean Difference	S	p
TIMSS	Primary-Secondary	.00	.03	1.00
	Primary-High School	-.03	.02	.95
	Primary-University	-.09	.02	.00
	Secondary-High School	-.04	.02	.42
	Secondary- University	-.10	.02	.00
	High School- University	-.06	.02	.00
OGS	Primary-Secondary	-.01	.03	1.00
	Primary-High School	-.01	.03	1.00
	Primary- University	-.09	.03	.00
	Secondary-High School	-.00	.02	1.00
	Secondary- University	-.09	.02	.00
	High School- University	-.06	.02	.00
Total Score	Primary-Secondary	-.00	.02	1.00
	Primary-High School	-.02	.02	1.00
	Primary- University	-.09	.02	.00
	Secondary-High School	-.02	.02	1.00
	Secondary- University	-.09	.02	.00
	High School- University	-.07	.02	.00

4. Discussion and Conclusion

Evaluation studies at the national and international level play a significant role in order that countries can control their own internal dynamics and compete with other countries. Especially, students and schools within countries compete through national exams while countries are compared regarding international exams. It was observed that demographic characteristics of individuals have a key role in these evaluation studies. Different from the other studies, the present study investigates how these variables affect both national and international exams concurrently. Thus, Turkey case was selected and TIMSS exam and secondary school entrance exam (OGS) were taken into consideration. Afterwards, TIMSS 2007 questions and OGS biology questions of the last 10 years were selected and test forms were generated. Through t-test analysis, gender was found to be significant in terms of biology questions available in TIMMS and OGS exams. It was determined that female students are more successful in biology questions compared to boys in both exams. This results is in parallel to the result which indicates that female students are more successful than boys concerning biology questions in TIMMS exam (Mullis, Martin, & Foy, 2008; Sisman, Acat Aybay, & Karadağ, 2011).

Another research subject determined in the current study was to find the effect of private tutoring upon OGS and TIMMS biology questions. Through t-test analysis, it was pointed out that private tutoring has a positive impact on OGS exam results while it does not have an effect on TIMMS exam results. Berberoglu and Tansel (2014) found that private tutoring does not have an effect upon sciences through using data from university entrance exam. Similarly, in another study conducted in Korea, it was determined that private tutoring does not significantly affect PISA science scores (Choi, Calero, & Escardíbul, 2011). The result of these studies is in parallel to the results of biology results of TIMMS exam of the current research while it differs in terms of OGS questions. This could be explained in several ways. Firstly, unlike previous studies, the present study has focused on merely biology rather than sciences. Secondly, data used in the study only include 8th grade students.

Lastly, it was examined how parental educational level affects TIMMS and OGS results. Besides, it was revealed that parents' level of education has a positive and significant effect on both exams through ANOVA and befferoni tests. Taking into consideration that parental educational degree increases "Parental involvement in education" (Bogenschneider, 1997), parental involvement and student achievement were found to be related direct and indirect (Dotterer & Wehrspann, 2015).

In short, unlike previous studies, in the present study the effect of demographic characteristics of students upon their achievement was measured using both national and international exams. Even though the results found in this study are parallel to the previous studies, private tutoring used as a variable provides a new contribution to the literature. In particular, the notion that private tutoring prepares students for the exam content is supported by data since private tutoring in Turkey exists only for national exams. As a result, students who receive private tutoring were found to be more successful in OGS exam; however, the fact that it does have a significant effect

on TIMMS is an expected result since it suggested that classrooms outgoing students YGS'de more successful, while TIMMS is a result of a significant impact not expected because the classrooms in the information more OGS 'has put forward the views parallel processing as the curriculum schools that make up the content (Bray, 2003).

As the study includes several limitations, the obtained results cannot be generalized to the entire population. For instance, since this study is solely based upon 8th grade students and biology questions, the results of the study are not to be generalized to the students from different grades and another subject as well. Likewise, the findings of the study cannot be generalized for Turkey as the data were only collected from Kahramanmaraş. So that the study can be more significant, it is foreseen that it be applied to different grade levels and different courses in many provinces of Turkey.

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