

Students' Mathematics Achievement and Its Relationship with Parents' Education Level, and Socio-Economic Status In Turkey

Rusli

Ministry of Marine and Fisheries Republic of Indonesia, SUPM Sorong, Sorong, West Papua, Indonesia
rusliazis.ra@gmail.com

Abstract. This paper aimed to investigate the impact of gender, parents' education level, and socio-economic status on students' mathematics performance. Population of this paper was obtained from PISA 2009 conducted in Turkey. The method used in this study was an independent *t-test* analysis, Oneway ANOVA, correlation and linear regression. The results of this study revealed that gender differences and mathematics achievement in Turkish students who participated in PISA 2009 are statistically significant but practically is not significant. Parents' education level of Turkish students in this research has an impact on Turkish students' mathematics achievements. The most significant difference is found between group ISCED 5A, 6 and none highest education level of parents and practically this difference is significant. The last main point of the result in this study is Index of Economic, Social, and Cultural Status (ESCS) has a positive impact on mathematics achievement. ESCS and mathematics achievement show a positive and linear relationship. ESCS is a significant predictor of mathematics achievements.

Keywords: mathematics achievement, gender, parents' education level, socio-economic status

INTRODUCTION

Students' successful in learning is influenced by several factors including gender, parents' education level, and socio-economic status. There is a widespread acknowledgment of the influence of gender, parents' education level, and socio-economic status on mathematics achievement. With regard to gender differences, socio-economic status and mathematics achievement, a research conducted in 2008 in Turkey concluded that there is a statistically significant difference in mathematics achievement in favour of cities based on their economic development level and its effect size was quite small indicating in practically its difference is not significant. In addition, the research also showed that the development of socio-economic of the areas was not an essential factor for gender differences in mathematics performance (Isiksal & Cakiroghi, 2008, p. 113).

In relation to parents' education level and mathematics achievement, the role of students' parents is very essential for the students' future particularly in providing their children with science and knowledge including mathematics. Good parental awareness and good guidance in mathematics is hoped to create and develop children who have good learning outcomes in mathematics so that they are ready to face the variety of science in the future that it will always continue to evolve over time.

Dalyono (2010) claims that parental awareness and parental guidance are influenced by parent education level. He asserts that parents who have only basic education with parents who have middle education and even universities have a difference in educating children. Additionally, he argues that parents who have elementary education tend to direct their children to basic knowledge and basic skills. Parents with secondary education tend to be able to direct the skills and broader knowledge not only basic skills and knowledge itself. Parents with a college education, they tend to direct the child to be able to follow the recent development of science and technology.

Therefore, it is interesting to investigate gender differences and mathematics achievements, parents' education and mathematics achievements, and socio-economic status associated with mathematics achievements. This paper will focus on examining these three issues. The purpose of this paper is to investigate gender differences in mathematics achievements, parents' education level and mathematics achievements, and mathematics achievements related to socio-economic status in Turkey. The mathematics achievements in Turkey in this paper are demonstrated by the plausible value in math of PISA survey conducted in 2009.

RESEARCH QUESTIONS AND HYPOTHESIS

There are three research questions will be dealt with in this study, which are as follows.

1. Is there a difference between mathematics achievements by gender?
2. Is there a difference between mathematics achievements by parents' education?
3. What is the influence of Index of Economic, Social, and Cultural Status (ESCS) on mathematics achievements?

The hypothesis of this study is as follows.

1. The null hypothesis (H_0) and the alternative hypothesis (H_a) of the research question number one are as follows.

H_0 : There is no a significant difference between mathematics achievements by gender

H_a : There is a significant difference between mathematics achievements by gender

2. The null hypothesis (H_0) and the alternative hypothesis (H_a) of the research question number two are as follows.

H_0 : There are no differences in mathematics achievements based on parents' education

H_a : There is a difference in mathematics achievements between at least one pair of groups

3. The null hypothesis (H_0) and the alternative hypothesis (H_a) of the research question number three are as follows.

H_0 : There is no influence of Index of Economic, Social, and Cultural Status (ESCS) on mathematics achievements

H_a : There is influence of Index of Economic, Social, and Cultural Status (ESCS) on mathematics achievements

DATA AND METHODS

Data source and participants

The data source of this paper is gained from the 2009 administration of the Programme International Assessment (PISA), which is a standardised assessment programme developed internationally by engaging countries and conducted to 15-year-olds student in schools(OECD, 2010). The target population of this research is 15-year-olds students who engaged in PISA from Turkey in 2009. The data included 4996 students consisting of 2551 male and 2445 female in Turkey. A brief summary of gender from the sample of this study is presented in Table 1 below.

Table 1 A Summary of Turkish Students who Participated in PISA 2009

Variable	Per cent	Valid per cent
Gender		
Female	48.9	48.9
Male	51.1	51.1
Total		
Percentage	100	100
N	4996	4996

Methods

There are three methods used in investigating the research questions. In dealing with research question number one, an independent *t*-test analysis will be used in investigating the difference between mathematics achievements

by gender. Research question number two will be dealt with by using Oneway ANOVA in examining the difference between mathematics achievement by parents' education. Correlation and Linear Regression are used in examining relationship between Index of Economic, Social, and Cultural Status (ESCS) and mathematics achievement.

RESULTS

T-test

Female students ($N=2445$) was associated with mathematics achievement $M=441.21(SD=90.39)$. By comparison, male students ($N=2551$) was associated with a numerically larger mathematics achievement $M=452.36(SD=93.16)$. To investigate the research question number one, an independent t -test was undertaken to assess if a difference existed between the mean of mathematics achievement of male and female. As can be seen clearly in Table 2 below, female and male distributions were normally distributed for the purposes of performing a t -test (i.e., skewness $< |2.0|$ and kurtosis $< |2.0|$); (Schmider, Ziegler, Danay, Beyer, & Böhner, 2010 ; see Table 2).

Table 2 Descriptive Statistics associated with Mathematics Achievement

	<i>N</i>	<i>M</i>	<i>SD</i>	Skewness	Kurtosis
Female	2445	441.21	90.39	.318	-.02
Male	2551	452.36	93.16	.349	-.19

In the Table 3 below demonstrates presentation of t -test results with unequal variances for mathematics achievements by sex.

Table 3 Results of an Independent t -test for Mathematics Achievements by Sex

* $p < .01$

The independent samples t -test was associated with a statistically significant effect, $t(4993.25) = -4.29, p < .01$. There is a statistically significant difference between mathematics achievements by gender. Results indicate that male is associated with a statistically significant larger mean of mathematics achievement than female. Cohend's d

Variable	Sex						95% CI for Mean Difference		t	df
	Male			Female						
	M	SD	SE	M	SD	SE				
Mathematics achievements	452.36	93.16	1.84	441.21	90.39	1.83	-16.24, -6.05	-4.29*	4993.25	

was estimated at .12 that is a small effect based on Cohend's guidelines (Sullivan, 2012). The 95% confidence interval was -16.24 to -6.05. As a result, the null hypothesis is rejected.

One-Way ANOVA

The descriptive statistics related to mathematics achievements across the seven group of the highest educational level of parents are presented in Table 4. It can be seen clearly that students with parents none highest educational level is associated with the numerically smallest mean of the mathematics achievements $M = 388.64 (SD = 79.22)$ and the students with ISCED 5A, 6 as the highest educational level of parents is associated with numerically the highest mean of mathematics achievements $M = 517.62 (SD = 92.28)$. In the highest educational level of parents, accounting for 6 (.1%) of respondents answered N/A and 93 (1.9%) was missing data. The percentage of missing data is less than 5% so it is acceptable and it would not impact on the estimation of the whole population (Dong & Peng, 2013). In order to examine the hypothesis the difference between mathematics achievements by parents' education, ANOVA was undertaken. Before performing the ANOVA, the assumption of normality was tested and concluded to be met as distributions of the seven groups were associated with skewness and kurtosis less than $|2.0|$ and $|2.0|$ respectively (Schmider et al., 2010 ; see Table 4).

Table 4 Descriptive Statistics for Parents' Education Level across Mathematics Achievements

Parents' education level	<i>N</i>	<i>M</i>	<i>SD</i>	<i>Skewness</i>	<i>Kurtosis</i>
None	145	388.64	79.22	.22	.58
ISCED 1	1568	424.28	81.43	.32	.18
ISCED 2	1209	423.88	81.07	.40	.24
ISCED 3B,C	92	417.15	83.49	.77	.55
ISCED 3A,4	971	471.63	85.79	.30	-.70
ISCED 5B	198	479.64	93.40	.22	-.39
ISCED 5A,6	714	517.62	92.28	-.14	-.43

*Notes: N/A: 6 (.1%); Missing: 93 (1.9%)

In order to investigate possible differences in mathematics achievements between students based on their highest educational level of parents (HISCED), a one-way analysis of variance was conducted. We find evidence that there is a difference in mathematics achievement based on HISCED status ($F= 149.51$ (6, 4890), $p<0.001$). Thus, the null hypothesis of no differences in mathematics achievements based parents' education was rejected. The $\omega^2 = .154$ indicated that roughly 15% of the variation in the mean of mathematics achievements is attributable to differences between the seven groups of parents' education level.

Table 5 Results of ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6383981.41	6	1063996.90	149.513	.000
Within Groups	34799356.5	4890	7116.43		
Total	41183337.9	4896			

To evaluate the nature of the discrepancies between the seven groups means further, the statistically significant ANOVA was followed-up with Tukey's b post-hoc tests(Field, 2009). These results are presented in Table 6 and indicate that students who their parents' highest educational level is ISCED 5A, 6 ($M = 128.98$) scored significantly higher than group 1(none), group 2(ISCED 1), group 3(ISCED 2), group 4 (ISCED 3B, C), group 5 (ISCED 3A, 4), and group 6 (ISCED 5B). The effect size for these significant pairs difference is estimated at 1.53, 1.10, 1.11, 1.19, .54, and .45 respectively. The mean differences of students who their parents are none highest educational level ($M = 388.64$) and students who their parents' educational level are ISCED 3B, C ($M = 417.15$) are not statistically significant differences. The effect size of this pairwise is approximately .34.

Table 6 Tukey Post Hoc Results and Effect Size of Mathematics Achievements by the Highest Educational Level of Parents

Group	Mean	Mean Differences ($\bar{X}_i - \bar{X}_j$)						
		(Effect Size is indicated in parentheses)						
		1.	2.	3.	4.	5.	6.	7.
1. None	388.64	0.00						
2. ISCED 1	424.28	35.64*	0.00					
3. ISCED 2	423.88	35.24*	.40	0.00				
4. ISCED 3B, C	417.15	28.51	7.13	6.73	0.00			
5. ISCED 3A, 4	471.63	82.98*	47.34*	47.74*	54.47*	0.00		
6. ISCED 5B	479.64	91.00*	55.35*	55.76*	62.49*	8.01	0.00	
7. ISCED 5A, 6	517.62	128.98*	93.33*	93.74*	100.47*	45.99*	37.98*	0.00
		(1.53)	(1.10)	(1.11)	(1.19)	(0.54)	(0.45)	

*.The mean difference is significant at the .05 level.

Correlation

To investigate the relationship between Index of Economic, Social, and Cultural Status (ESCS) and mathematics achievements, Pearson's correlation was computed. The result indicates that there was a positive and significant correlation between ESCS and mathematics achievement, $r = .45$, $n = 4967$, $p < .001$. This value suggests that there was medium effect of ESCS on mathematics achievements (Cohen, 1992; Field, 2009). R-squared was .20, which implies that 20% of variance for mathematics achievement is associated with the variance of ESCS. In this case, missing data is 29 (.58%), which is very small and less than 5%. This missing data would not affect on the estimation for the whole population.

Linear Regression

To investigate the hypothesis of research question number three, simple linear regression further was conducted to assess if ESCS predicted mathematics achievements. Prior to analysis, the assumption of normality of independent variable (ESCS) was examined and concluded to be met as its distribution was associated with skewness and kurtosis less than $|2.0|$ and $|2.0|$ respectively (Schmider et al., 2010 ; see Table 7). The assumption of linearity was met by generating scatter plots of the outcome variable against the explanatory variable (see Figure 1).

Table 7 Descriptive Statistics ESCS and Mathematics Achievements

	<i>M</i>	<i>SD</i>	Skewness	Kurtosis
ESCS	-1.16	1.20	.32	-.51
Mathematics achievements	446.91	91.98	.34	-.11



Figure 1 Scatter Plots of ESCS against Plausible Value in Math

The results of linear regression were significant, $F(1, 4965) = 1281.46$, $p < .001$, $R^2 = .20$, suggesting that approximately 20% of the variation in mathematics achievements score was predicted by ESCS score. ESCS was a significant predictor of mathematics achievements, $B = 34.56$, $p < .001$ which suggest that for every one unit

increase in ESCS then mathematics achievements increased by 34.56 units. Therefore, we rejected the null hypothesis. Results of liner regression are presented in Table 8.

Table 8 Results of Linear Regression with ESCS predicting Mathematics Achievements

	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>p</i>
Constant	487.63	1.62		301.64	.00
ESCS	34.56	.97	.45	35.80	.00

DISCUSSION

In this study, analysis of data showed that gender differences and mathematics achievement is statistically significant. Findings of the data analysis revealed that male is associated with a statistically significant larger mean of mathematics achievement than female. Although, the mean difference of mathematics achievements between male and female is statistically significant, the effect size was quite small suggesting that the mean difference of mathematics achievement by gender was not significant practically. The findings in this study are similar to the previous research done in Turkey in 2008 by Isiksal and Cakiroghi. They found that gender differences regarding mathematics achievement of Turkish middle school students based on level of the economic development city was statistically significant but it was not significant practically (Isiksal & Cakiroghi, 2008).

In relation to mathematics achievements by parents' education, statistical findings in this research revealed that there was a significant difference in mathematics achievements by parents' education. Students who their parents' education level ISCED 5A, 6 showed significant mean difference compare to the others group. The effect size between ISCED 5A, 6 and four groups, which are none, ISCED 1, ISCED 2, and ISCED 3B, C was quite large indicating that it practically was significant and the effect size between ISCED 5A, 6 and ISCED 3A, 4 and ISCED 5B was quite small suggesting that it practically was not significant (Cohen, 1992). Therefore, it implies that parents' education level is a critical factor for students' mathematics achievements. Interestingly, the mean difference between students with parents none highest education level and students who their parents' education level ISCED 3B, C was not significant statistically. The effect size of this pairwise was quite small indicating that the difference of mathematics achievement between these two groups was not practically significant (Cohen, 1992).

Regarding to the influence of Index of Economic, Social, and Cultural Status (ESCS) on mathematics achievements, correlation analysis revealed that there was positive and significant relationship between these two variables. ESCS has a medium influence on mathematics achievement. Linear regression showed an increase in one unit in ESCS would increase mathematics achievements roughly 34.56. It means that there are positive linear relationship between ESCS and mathematics achievement. Additionally, the results of regression linear also indicated that ESCS score predicted approximately 20% variation of mathematics achievement. Therefore, it could be concluded that ESCS is significant predictor of mathematics achievement. And indeed, ESCS score has a positive influence on mathematics achievement. Based on correlation and linear regression analysis, it could be said generally that if Index of Economic, Social, and Cultural Status (ESCS) of students in Turkey were good then students' performance in mathematics would increase.

In conclusion, there are three main issues of the findings in this study. First of all, the finding of this study has revealed that gender differences and mathematics achievement in Turkish students who participated in PISA 2009 are statistically significant but practically is not significant. Secondly, parents' education level of Turkish students in this research has an impact on Turkish students' mathematics achievements. The most significant difference is found between group ISCED 5A, 6 and none highest education level of parents and practically this difference is significant. The last main point of the result in this study is Index of Economic, Social, and Cultural Status (ESCS) has a positive impact on mathematics achievement. ESCS and mathematics achievement show a positive and linear relationship. ESCS is a significant predictor of mathematics achievements.

REFERENCES

1. Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155-159. doi: 10.1037/0033-2909.112.1.155

2. Dalyono, M. (2010). *Educational Psychology*. Jakarta: Rineka Cipta.
3. Dong, Y., & Peng, C.-Y. J. (2013). *Principled missing data methods for researchers*. SpringerPlus, 2(1), 1-17.
4. Field, A. P. (2009). *Discovering statistics using SPSS*. London: Sage.
5. Isiksal, M., & Cakiroghi, E. (2008). Gender differences regarding mathematics achievement: The case of Turkish middle school students. *School Science and Mathematics*, 108(3), 113-120.
6. OECD. (2010). *PISA 2009 at a Glance*.
7. Schmider, E., Ziegler, M., Danay, E., Beyer, L., & Bühner, M. (2010). Is it really robust? Reinvestigating the robustness of ANOVA against violations of the normal distributions assumptions. *Methodology: European Journal of Research Methods*, 6(4), 147-151.
8. Sullivan, G. M., & Feinn, R. . (2012). Using Effect Size—or Why the P Value Is Not Enough. *Journal of Graduate Medical Education*, 4(3), 279-282.