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PISA 2018 SONUÇLARININ ÖĞRENCİ, ÖĞRETMEN VE TOPLUM DEĞİŞKENLERİYLE İLİŞKİSİ

RELATION OF PISA 2018 RESULTS WITH THE VARIABLES OF STUDENT, TEACHER, AND SOCIETY

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Öz

Uluslararası sınavlar ülkelerin eğitim sistemlerinin kalitesinin artırılması noktasında önemli göstergeler sunmaktadır. Uluslararası Öğrenci Ölçme Programı (PISA) saygın uluslararası sınavlardan bir tanesi olup eğitime dair geniş dönütler sağlamaktadır. 2018 yılında gerçekleştirilen PISA, 79 ülke ve ekonomiden katılan 15 yaşındaki yaklaşık 600 bin öğrenciye uygulanmıştır. Bu çalışma, PISA puanları ile öğrenci, öğretmen ve toplum değişkenleri arasındaki ilişkiyi incelemeyi amaçlamaktadır. Yaşam doyumu ve okula aidiyet duygusu öğrenci değişkenleri, öğretmen maaşı ve en az yüksek lisans derecesine sahip öğretmen oranı öğretmen değişkenleri ve yerel okul yönetiminde veli katılımı ve sosyoekonomik düzey ise toplum değişkenleridir. Bu amacı gerçekleştirmek için ilişkisel tarama modeli yürütülmüştür. PISA veri tabanından elde edilen 79 ülke ve ekonomiye ait veriler çoklu doğrusal regresyon analizi ile incelenmiştir. Çalışma sonuçları yaşam doyumu, en az yüksek lisans derecesine sahip öğretmen oranı, yerel okul yönetiminde veli katılımı ve sosyoekonomik düzeyin ayrı ayrı okuma, fen ve matematik okuryazarlık puanlarını yordadığını göstermiştir. Modele göre en fazla varyans matematik okuryazarlığı puanlarında açıklanmıştır. Okuma okuryazarlığı için yerel okul yönetiminde veli katılımının en güçlü yordayıcı olduğu sonucuna ulaşırlken; fen ve matematik okuryazarlığı içinse yaşam doyumunun en güçlü yordayıcı olduğu sonucuna ulaşılmıştır.

Anahtar Kelimeler: PISA, Yaşam Doyumu, Yüksek Lisans Derecesi, Sosyoekonomik Düzey, Okuryazarlık.

Abstract

International exams present important indicators for the quality of educational systems in many countries. Program for International Student Assessment (PISA) as one of the popular international exam is a widespread program providing feedback on education. PISA was administered to about 600000 15-year students from 79 countries and economies in 2018. The current study aims to

investigate the relationship between PISA scores and student, teacher and community variables. Student variables are life satisfaction and sense of belonging; teacher variables are teacher salary and proportion of teacher with at least Master's Degree; and community variables are parent involvement in local school government and socioeconomic status. In this aspect, a correlational study was conducted to achieve the purpose. Data coming from 79 countries and economies via the PISA database were analyzed in multiple linear regression. Results showed that life satisfaction, the proportion of teachers with at least a Master's Degree, parent involvement in local school government, and socio-economic status predicted separately reading, science, and math literacy. The model explained the most variance in the math literacy scores. Among the predictors, parent involvement in local school government was the strongest predictor for reading literacy while life satisfaction was the strongest predictor for both science and math literacy.

Keywords: PISA, Life Satisfaction, Master's Degree, Socio-economic Level, Literacy.

Introduction

The popularity of international exams has been increasing such that countries have the opportunity both to evaluate themselves and to compare themselves with another context. To name a few, Program for International Student Assessment (PISA), Trends in International Mathematics and Science Study (TIMSS), and Progress in International Reading Literacy Study (PIRLS) are the exams that have a widespread impact all over the world. PISA is organized every three years by the Organization for Economic Cooperation and Development (OECD). PISA is scored in terms of reading, science, and mathematics literacy. Considering the latest PISA, PISA 2018, some 600000 15-year students from 79 countries and economies were tested (PISA, 2019).

Although countries and economies use mean scores of the exam as feedback for their education system, this exam presents more than expected such that big data are shared to analyze relationships between many variables. Therefore, this opportunity draws the attention of researchers from different countries. It is possible to categorize the studies focusing on PISA scores as follows: studies investigating PISA scores in one country, studies comparing PISA scores of many countries, and studies examining changes in PISA scores of different periods.

Aksu, Güzeller, and Eser (2017) investigated PISA scores of Turkey and found out student-level factors like gender, motivation, and self-efficacy and school-level factors like school income, number of math teachers, and number of student in school predicted math literacy in PISA 2012. A study by Rautalin and Alasuutari (2009) concentrated on national PISA scores of Finland and concluded that these scores are valuable in the determination of policy agenda

and development of national education. In Spain, Peralman and Santin (2011) examined educational efficiency at the student level and found that school or classroom climate was the most efficient variable on PISA scores. In conclusion, studies investigating PISA scores in only one country showed that PISA scores were related to different school outcomes.

In the European region, Reparaz and Sotes-Elizalde (2019) investigated parental involvement over PISA results in Germany and Spain and found that though there were great efforts for parental involvement, not all factors of involvement enhance higher achievement in science for both German and Spanish contexts. A study by Oliver, McConney, and Woods-McConney (2019) showed the efficacy of inquiry-based instruction on science. The authors used the PISA 2015 scores of six countries and concluded that inquiry-based instruction is associated with science literacy. Further, Aytekin and Tertemiz (2018) compared PISA results of Turkey and South Korea in terms of economic indicators. Their study showed that why South Korea got higher scores than Turkey did was related to the economic development model of South Korea. To sum up, PISA allows comparing and contrasting the educational qualities of many countries.

The third category is based on changes over the PISA periods. Bozkurt (2016) compared PISA 2003 and PISA 2009 scores of Turkey in terms of reading literacy over reading aspect, question type, and text format and revealed out improvement in reading skills. Erdem-Kara and Tat (2019) investigated efficiency in the use of educational resources by comparing PISA 2009, PISA 2012, and PISA 2015 scores. The authors concluded that there was a decline in the efficiency of usage of educational resources in Turkey when compared to other OECD countries. Further, Hwang, Choi, Bae, and Shin (2018) investigated the relationship between equity and teacher instructional practices by using data coming from ten countries in PISA 2012 and PISA 2015. The authors mixed the results and emphasized that the frequency of student-centered methods was positively related to the gap in science and math literacy between low and high socioeconomic status.

The theoretical framework of the current study is based on the idea behind the Bio Ecological Theory of Bronfenbrenner (1977, 1986). According to this theory, the individual who is at the center is influenced by events in the environment. Considering the phenomenon, each event is placed in different layers which are microsystem, mesosystem, exosystem, macrosystem, and chronosystem. These layers include respectively phenomenon related to an individual's interaction with closer elements, the interaction between elements around the individual, societal conditions and policies, cultural and social interchanges, and changes over time. As a

result, the purpose of the current study is compatible with the bioecological theory since student performance is affected by different situations that appear in the layers of the theory.

PISA contributes to the education system of the countries and economies. The current study aims to examine the relationship between literacy scores and student, teacher, and community indicators. The research question is as below:

- How well do life satisfaction of students, sense of belonging at school, teacher salary, the proportion of teachers with at least a Master's degree, parent involvement in local school government, and socio-economic status predict PISA 2018 reading literacy scores?
- How well do life satisfaction of students, sense of belonging at school, teacher salary, the proportion of teachers with at least a Master's degree, parent involvement in local school government, and socio-economic status predict PISA 2018 science literacy scores?
- How well do life satisfaction of students, sense of belonging at school, teacher salary, the proportion of teachers with at least a Master's degree, parent involvement in local school government, and socio-economic status predict PISA 2018 math literacy scores?

Method

Design of the Study

The design of the current study is correlational research analyzing secondary data. A correlational study examines relationships between/among variables (Gall, Gall, & Borg, 2013). Correlational studies have predictor and criterion variables. For the study, predictor variables are life satisfaction, sense of belonging, teacher salary, the proportion of teachers with at least M.S. degree, parent involvement in local school government, and socioeconomic status (SES) while criterion variables are reading literacy, science literacy, and math literacy scores.

Sampling

The sample was the 79 countries and economies selected for PISA 2018. These countries and economies were representatives of some 600000 15-year students who participated in PISA 2018. PISA selected a sample from the population by considering some criteria such as socio-economic status, school location, and gender.

Data Collection

Secondary data coming from data of PISA 2018 were run in the study. Considering the purpose of the study, secondary data were filtered from PISA 2018 dataset. In this dataset, both student and school data are belonging to 612004 students from 21903 schools in 79 countries and economies.

Data Analysis

Big data of PISA 2018 were analyzed with simultaneous multiple linear regression in licensed software. The reasons for the selection of simultaneous multiple linear regression are a manageable number of predictors and all predictors' equal contribution to the outcome variable. Assumptions of normality of residuals, homoscedasticity, independence of errors, influential observations, absence of multicollinearity, and linearity of residuals as the assumptions of regression analysis (Field, 2009) were considered.

Findings

To run simultaneous multiple regression, in the beginning, adequacy of sample size and assumptions of analysis were checked. According to Stevens (2009), 15 observations per predictors were suitable to continue regression analysis. The study had 79 participants and six independent variables such that a ratio of about 14 is acceptable. The normality of residuals was assumed by appropriate shapes of histograms such that shapes demonstrated almost normal distribution. Scatter plots were considered to check homoscedasticity. Since scatterplots did not show a pattern, the assumption was also provided. Figure 1 presented all of these shapes.

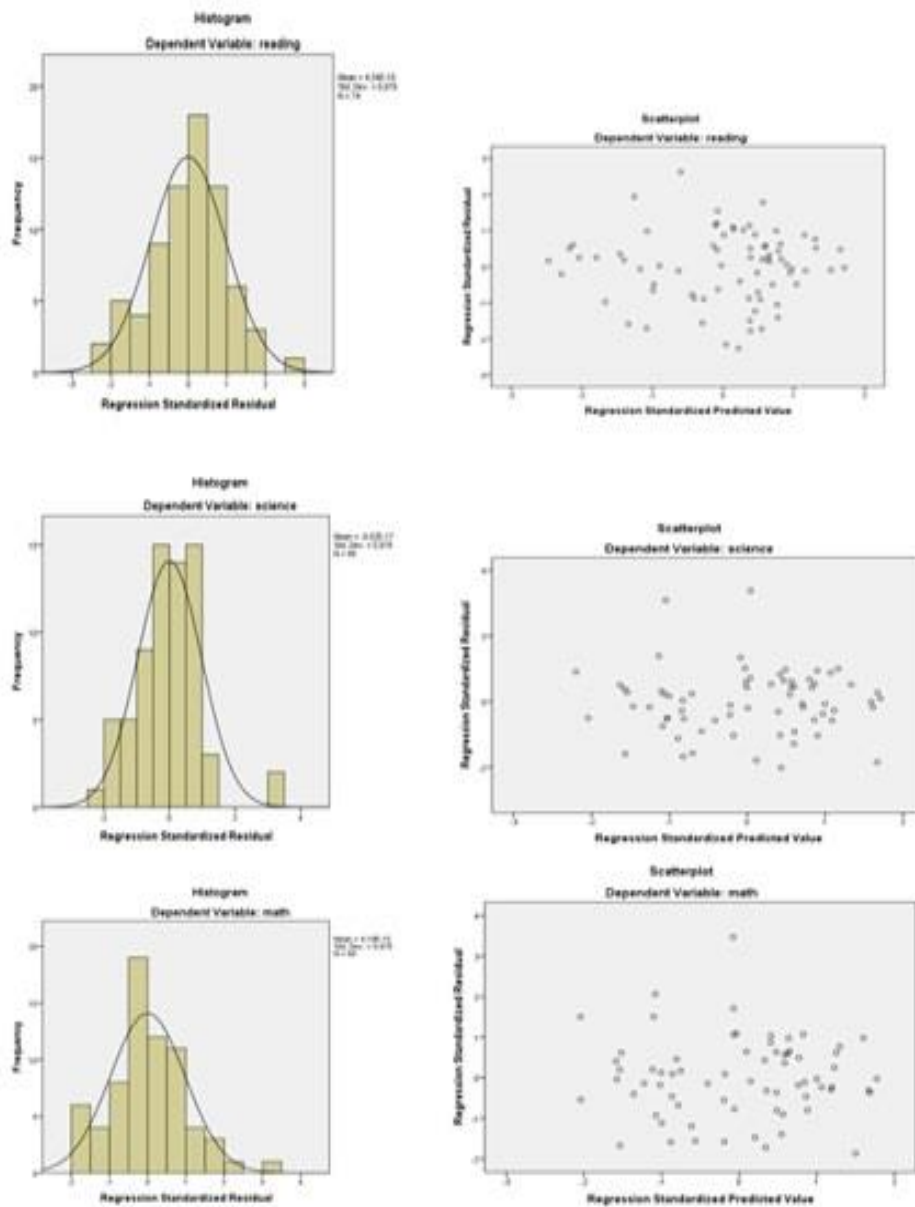


Figure 1. The Histograms of Standardized Residuals and Scatter Plots

Independence errors were checked by the Durbin-Watson coefficient which should be between 1.00 and 3.00 for the errors to be unrelated (Durbin & Watson, 1951). The current study showed respectively 2.02, 1.97, and 2.17 values of Durbin-Watson for reading, science, and math scores so that assumption is confirmed. Influential observations were checked by considering DFBeta. Tabachnick and Fidell (2007) stated that DFBeta values should be smaller than 1.00 such that DFBeta values in the current study confirmed the assumption. The absence of multicollinearity was checked through Tolerance values and Variance Influence Factor (VIF) values. VIF value with lower than 10 and Tolerance values with greater than .10

(Field, 2009). Multicollinearity was absent since Tolerance values and VIF values were respectively between .57 and .89 and between 1.12 and 1.74. Finally, the linearity of residuals was checked by partial regression plots and this assumption was confirmed as Figure 2 depicted some of those.

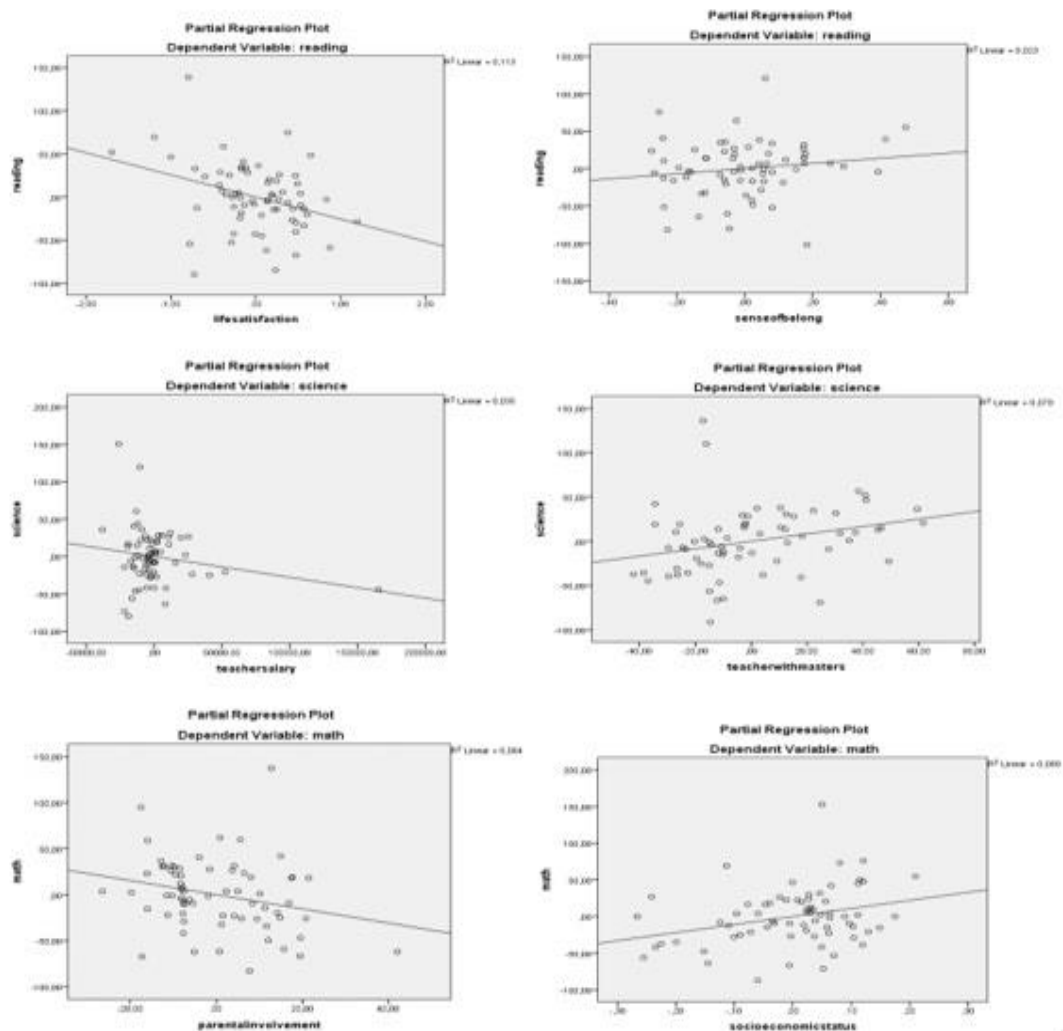


Figure 2. Partial Regression Plots

For reading literacy, model was significant $F(6, 61) = 10.44, p = .00; R^2 = .51$ such that this model explained 51% of the variance in reading literacy. Effect size was found large according to Cohen's (1992) standards. The significant predictors were parent involvement in local school government ($\beta = -.34, p < .05$), life satisfaction ($\beta = -.30, p < .05$), and proportion of teacher with at least M.S. degree ($\beta = .24, p < .05$). In order to check unique contributions of predictors to reading literacy, squared semi-partial correlation coefficient was calculated. Parent involvement in local school government ($sr^2 = .13$) was the more powerful

predictor than proportion of teacher with at least M.S. degree ($sr^2 = .09$) and life satisfaction ($sr^2 = .06$).

Table 1

Results of Multiple Regression Analysis of Reading Literacy

Model	B	β	t	p	sr^2	R^2	F
Model (constant)	589.29		7.52	.00		.51	10.44
Sense of belonging	34.48	.12	1.21	.23	.01		
Life satisfaction	-25.64	-.30	-2.79	.01	.06		
Teacher salary	.01	-.14	-1.43	.16	.02		
The proportion of teachers with M.S.	.45	.24	2.47	.02	.09		
Parent involvement in loc. sch. gov.	-1.06	-.34	-2.89	.01	.13		
SES	77.38	.19	1.77	.08	.02		

Reading literacy= 589.29 + 34.48*(sense of belonging) + -25.64*(life satisfaction) + .01*(teacher salary) + .45*(proportion of teacher with M.S) + -1.06*(parent involvement in local school government) + 77.38*(SES)

For science literacy, model was significant $F(6, 62) = 10.09$, $p = .00$; $R^2 = .49$ such that this model explained 49% of the variance in science literacy. Effect size was found large according to Cohen's (1992) standards. The significant predictors were respectively life satisfaction ($\beta = -.33$, $p < .05$), parent involvement in local school government ($\beta = -.31$, $p < .05$), and proportion of teacher with at least M.S. degree ($\beta = .22$, $p < .05$). In order to check unique contributions of predictors to science literacy, squared semi-partial correlation coefficient was calculated. Life satisfaction ($sr^2 = .14$) was the more powerful predictor than parent involvement in local school government ($sr^2 = .05$) and proportion of teacher with at least M.S. degree ($sr^2 = .04$).

Table 2

Results of Multiple Regression Analysis of Science Literacy

Model	B	β	t	p	sr^2	R^2	F
Model (constant)	612.51		7.82	.00		.49	10.09
Sense of belonging	32.13	.12	1.21	.23	.01		
Life satisfaction	-28.76	-.33	-3.14	.00	.14		
Teacher salary	.01	-.15	-1.50	.14	.03		
The proportion of teachers with M.S.	.42	.22	2.31	.02	.04		
Parent involvement in loc. sch. gov.	-.94	-.31	-2.59	.01	.05		
SES	80.95	.20	1.86	.07	.03		

Science literacy= 612.51 + 32.13*(sense of belonging) + -28.76*(life satisfaction) + .01*(teacher salary) + .42*(proportion of teacher with M.S) + -.94*(parent involvement in local school government) + 80.95*(SES)

Lastly, for math literacy, model was significant $F(6, 62) = 11.88, p = .00; R^2 = .54$ such that this model explained 54% of the variance in math literacy. Effect size was found large according to Cohen's (1992) standards. The significant predictors were respectively life satisfaction ($\beta = -.34, p < .05$), proportion of teacher with at least M.S. degree ($\beta = .28, p < .05$), socioeconomic status ($\beta = .26, p < .05$), and parent involvement in local school government ($\beta = -.24, p < .05$). In order to check unique contributions of predictors to math literacy, squared semi-partial correlation coefficient was calculated. Life satisfaction ($sr^2 = .08$) was the more powerful predictor than proportion of teacher with at least M.S. degree ($sr^2 = .07$), socioeconomic status ($sr^2 = .05$), and parent involvement in local school government ($sr^2 = .03$).

Table 3

Results of Multiple Regression Analysis of Math Literacy

Model	B	β	t	p	sr^2	R^2	F
Model (constant)	594.19		7.41	.00		.54	11.88
Sense of belonging	44.72	.16	1.65	.11	.02		
Life satisfaction	-30.93	-.34	-3.29	.00	.08		
Teacher salary	.01	-.14	-1.40	.17	.01		
The proportion of teachers with M.S.	.57	.28	3.08	.00	.07		
Parent involvement in loc. sch. gov.	-.77	-.24	-2.07	.04	.03		
SES	109.93	.26	2.47	.02	.05		

Math literacy = $594.11 + 44.72*(\text{sense of belonging}) + -30.93*(\text{life satisfaction}) + .01*(\text{teacher salary}) + .57*(\text{proportion of teacher with M.S.}) + -.77*(\text{parent involvement in local school government}) + 109.93*(\text{SES})$

Conclusion and Discussion

The current study showed that life satisfaction of the students, parent involvement in local school government, proportion of teacher with at least M.S. degree, and socio-economic status determined achievement in PISA 2018. More specifically, the model explained more variance in the outcome variable was the model constructed for math literacy. Further, although all of the variables predicted reading, science, and math literacy scores, life satisfaction did a more unique contribution to models than parent involvement in local school government, the proportion of teachers with M.S., and socio-economic status did.

Life satisfaction was found as the strongest variable in literacy scores in the current study. However, the current study showed an interesting finding such that students having less life satisfaction showed more performance than those having more life satisfaction. Although the current study has consistent results with the literature in terms of the presence of a relation,

the study differentiates from the literature in terms of the direction of the relation. Diseth, Danielsen, and Samdal (2012) detected a positive and significant relationship between achievement level and life satisfaction. A study by Crede, Wirthwein, McElvany, and Steinmayr (2015) showed the relationship between academic achievement and life satisfaction under the mediation effect of maternal education. The literature has many studies showing the relation between life satisfaction of the students and academic achievement (Balkis, 2013; Gilman & Huebner, 2006; Heffner & Antaramian, 2016; Suldo & Shaffer, 2008). The reasons for negative relation gain importance in this aspect. One reason may be methodological. The current study preferred the inclusion of all countries in one analysis without mediating or moderating variables to show the big picture. Mediating or moderator effect of any other variables like the country could change the results for developed countries and developing or undeveloped countries. In other words, large between-country differences in life satisfaction of students in PISA are present most probably. On the other hand, contextual factors may reveal this finding. The student from different contexts might have attributed different meanings to life satisfaction.

The current study showed that community indicators were linked to literacy scores in PISA 2018. Especially, both parent involvement in local school government and socioeconomic status were correlated with math scores. Further, parent involvement in local school government was the second powerful variable considering unique contributions. This conclusion was consistent with the idea behind the studies in the literature. Many studies are showing a close relationship between parent involvement and academic achievement in the literature (Boonk, Gijsselaers, Ritzen, & Brand-Gruwel, 2018; Borgonovi & Monnt, 2012; Oswald, Zaidi, Cheatham, & Brody, 2018; Şengönül, 2019). However, although the common idea was the fact that parent involvement would increase academic achievement, the current study detected that there was a negative relationship between parental involvement in local school government and literacy scores. A similar conclusion was found in the study by Sebastian, Moon, and Cunningham (2017) such that the authors found that there was a negative relationship between teacher-initiated parent involvement and student achievement. The reason why negative relations emerged may be related to the willingness of parents to be involved in educational activities. Socioeconomic status as a significant indicator for society draws the attention of researchers for many contexts. Like the current study, its impact on or relation with other variables is examined. In this respect, the current study showed that an increase in socioeconomic status would increase performance in the math field. This finding

was consistent with the literature. Perry and McConney (2010) searched to examine the relationship between SES and student achievement in PISA 2013 and concluded that an increase in SES increased student achievement in the Australian case. Thein (2016) investigated PISA 2009 and PISA 2012 math scores and found that SES made a difference in math literacy scores in both PISA 2009 and PISA 2012 implementations. In the literature, there are also studies showing a kind of relation between SES and academic achievement apart from PISA (Battle & Lewis, 2002; Lam, 2014; McCoach & Colbert, 2010; Şirin, 2005). Therefore, the current study presented important evidence of the strong relationship between community indicators and academic achievement.

The proportion of teachers with at least an M.S. degree was positively found to be related to achievement. The current study showed that an increase in the proportion of teachers with at least an M.S. degree would increase performance in reading, science, and math field. This finding was parallel to teacher education findings in the literature. Studies in the literature have a trend showing a positive effect on teacher education and professional development on academic achievement (Goldhaber & Brewer, 1996; Rice, 2003; Rivkin, Hanushek, & Kain, 2005). As a result, supporting teachers would return to positive school outcomes.

The current study has some implications in terms of research, theory, and practice. In terms of research, the researcher of the current study did not come up with a study examining PISA 2018 by using data of all countries in the literature review part of the study. Descriptive reports were presenting the results of their own countries. Thus, the current study had an attempt to fill a gap in the literature. Considering theory, the relationship between academic achievement and student, teacher, and society indicators can be showed evidence on the theoretical base of academic achievement or student performance. Finally, the current study may provide an opportunity for policy-makers or educational leaders to re-organize educational activities. Satisfying students, supporting teachers, and improving societal conditions would be beneficial for student performance.

The researcher has recommendations in terms of research, theory, and practice by considering the limitations and findings of the study. First of all, the current study was based on secondary and quantitative data analysis. Therefore, further researchers could conduct empirical studies within both quantitative and qualitative methods using primary data from large samples. Moreover, studies in the future may focus on other indicators such that especially multi-level analyses like HLM could be performed to analyze relations in student, school, and country levels. In terms of theory, the current study concentrated only on some antecedents of literacy.

Therefore, further studies may support more compact theories focusing on core or grouped variables. To illustrate, equity policies may be studied through political economy theories. Practical recommendations to practitioners like stakeholders, policy-makers, and educational administrators were related to implementing the findings and implications of the current study. Schooling activities should be re-organized to increase the life satisfaction of the students. Teachers should improve themselves through professional development opportunities while educational leaders provide opportunities for teachers to get upper-level education degrees. Finally, the community should be both supported by economic, social, and cultural activities and encouraged to be involved in the schooling activities.

Investigation of this relation brings the significance of the study in terms of research, theory, and practice. Considering research, PISA literature flourished with a study analyzing PISA 2018 results for all participating countries and economies. Further, the researcher of the current study did not come up with a study analyzing PISA 2018 in the national context. The theoretical significance was based on how some indicators are mostly related to literacy or academic achievement of the students. Finally, practitioners, administrators, and policy-makers may consider implications and recommendations for both taking feedback and doing readjustments on the education system.

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