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Investigation of the Variables Affecting the Math Achievement of Resilient Students at School and Student Level *

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Abstract

The main aim of the study is to investigate how the opportunity to learn, school climate, and school resources, when they are considered as variables together, affect the Math achievement of resilient Turkish students by using a Hierarchical Linear Model (HLM). Recent studies state that resilient students are achieving higher than their peers who have low socio-economic status. Therefore, it is important to find out the variables which affect the achievement of students who have a low socio-economic status. In the study, the main characteristics of resilient students are revealed through a literature review in this field; and a model is formed through the factors which affect achievement levels generally at both school and student levels. The study group includes 317 students who are defined as resilient in the PISA 2012 Turkish sample. According to the results of the study, at student level, the variables of *Experience with Applied Mathematical Tasks* and *Mathematics Teaching*; and at school level, the variables of *Quality of School Educational Resources* and *Student-related Factors Affecting School Climate* are found to be effective in the mean math achievement of resilient students. When the models are examined, in the one including both school and student level variables together, it is determined that the variables of *Experience with Applied Mathematical Tasks, Quality of School Educational Resources* and *Student-related Factors Affecting School Climate* explain 44% of the variability between schools. Besides, it can be seen in the study that the variables at student level have partially meaningful effects.

Keywords

Resilient students
Student achievement
Opportunity to learn
School climate
School resources

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Introduction

Education systems aim to provide a quality education to all students; however, studies carried out over many years show that socio-economic status hinders academic achievement, and low socio-economic level and low achievement are correlated (Bartley, 2006; Cunningham, 2006; Erberber, Stephens, Mamedova, Ferguson, & Kroeger, 2015; Gary, 1999; Hanushek & Woessmann, 2010; Lacour & Tissington, 2011; Maughan, 1988; McCoy, 2005; OECD, 2011; UNESCO, 2006; Wang, 1997). It can be seen that students who are socio-economically disadvantaged have a lower education output compared to their peers who have a better economic status (Erberber et al., 2015). However, recent studies reveal the exact opposite results of this, and show that students who come from a socio-economically disadvantaged background showed high achievement and this gave hope to their peers who also have a socio-economically disadvantaged status. Disadvantaged students managed to show high achievement despite their limited conditions (Erberber et al., 2015; OECD, 2010, 2011; Wang, 1997). In the literature, researchers and educators define students who have low socio-economic income and show high achievement as disadvantaged high-achieving students (Wang, Haertel, & Walberg, 1994; Wyner, Bridgeland, & Dilulio, 2007).

In the field of education, socio-economically disadvantaged students who show high achievement are defined as resilient students. Social resiliency is defined as the ability to get it together (Benard, 1991) or to heal quickly after change, challenges and misfortune (Pulley & Wakefield, 2001). Resiliency, in other words showing resistance to negative events and challenges, is an active adaptation process which a person shows in the event of challenging situations along with the ability to get it together (Benard, 1991, 1996; Burns, 1996; Chung, 2008; Fuller, 1998; Johnson, 2008; LeFalle, 2010; Wolin & Wolin, 1993). Resiliency is also defined as the ability to respond more positively than expected even in negative and disadvantaged conditions (Gilligan, 2007). Werner and Smith (1998) define the concept of resiliency as to bear with difficult processes in order to be successful and to overcome differences which are thought to be impossible. Although there are not specific definitions about resiliency, the common explanation is to be exposed to difficult conditions and to adapt in a positive manner to those conditions (Luthar, Cicchetti, & Becker, 2000). The common point in all the definitions of resiliency can be interpreted as an individual being successful in overcoming all challenges.

"Educational resiliency" (Kitano & Lewis, 2005; Morales, 2014; Wang & Gordon, 1994) or "academic resiliency" (Erberber et al., 2015; Grotberg, 2001) are two different terms used to describe resilient students. However, when the details of the definitions are considered, it can be seen that resilient students are defined as successful individuals despite having difficult life conditions. Resilient students encounter important risk factors during their educational life and become successful by overcoming those factors (Kitano & Lewis, 2005; Morales, 2014). Academically resilient students are those who are academically successful despite having a disadvantaged socio-economic status (Erberber et al., 2015). Academic resiliency is the ability to cope with difficult and stressful pressures in the academic environment (Grotberg, 2001). McMillan and Reed (2010) define resilient students as those who become successful thanks to their characteristics, abilities, and faith, regardless of their background and present conditions. Resilient students show high achievement in their school and outside lives despite environmental challenges (Wang et al., 1994). Experimental studies reveal that resilient students have different learning approaches compared to their peers. In those studies, it can be seen that resilient students try harder in their lessons, participate more in class activities, are more punctual to their classes, spend more quality time at school and outside, and participate more in both academic and extracurricular activities compared to their peers (Borman & Overman, 2004; Catterall, 1998; Finn & Rock, 1997; Lee, Winfield, & Wilson, 1991; OECD, 2011; Shumow, Vandell, & Posner, 1999).

When the studies about resilient students in the literature are considered, it can be seen that school facilities support student achievement (Benard, 1993; Cunningham, 2006; Erberber et al., 2015; Grassi, 2014; McMillan & Reed, 2010; Morrison, 2001). The common finding in the studies regarding school impact is that the school climate is an important variable in explaining student achievement. There are numerous pieces of research stating that school climate and educational resources are important variables in explaining student achievement, and that they even directly affect achievement (Freiberg, Driscoll, & Knights, 1999; Hoy & Hannum, 1997; Kober, 2001; Loukas & Robinson, 2004; Norton, 2008; Shindler, Jones, Taylor, & Cadenas, 2004). It is possible to find studies which reveal that school climate supports student development, academic success and skills; and the common finding of those studies is that there are less disciplinary problems, less violence and less absenteeism in schools which have a more positive environment (Cohen, 2013; Gregory et al., 2010; Lee, Cornell, Gregory, & Fan, 2011; Thapa, Cohen, Guffey, & Higgins-D'Alessandro, 2013). School climate, which is defined as the characteristics and quality of school life, is accepted as the norm which is based on experiences in school: values, goals and human relations, practices of education, training and leadership, and a comprehensive concept reflected by the organizational structure (Cohen, 2013). School climate can be summarized as the characteristics of the school, relations among parents, teachers and administrators, and the school infrastructure (Adeogun & Olisaemeka Blessing, 2011). On the other hand, the school's educational resources are identified as an indicator of the quantity of educational personnel, the quality of education and training materials, and the school infrastructure (Greenwald, Hedges, & Laine, 1996; OECD, 2013; Rivkin, Hanushek, & Kain, 2005). Resiliency is considered important to overcome the challenges that an individual, an organization, and society encounter, in order to make plans together to take action, and to enhance the conditions (Brennan, 2008). It is true that there is a limited number of studies about resilient students and those studies have been conducted to specify individual characteristics of resilient students (Benard, 1991; Masten, 2001; Reis, Colbert, & Hebert, 2005; Williams & Bryan, 2013; Wolin & Wolin, 1993). Studies about resilient students who are academically successful help us to understand why some students are successful while their peers who have similar background and life experience are not (Grassi, 2014; Padron, Waxman, & Lee, 2012). It becomes more important to specify the variables in the literature which affect the success of resilient students who show high achievement by overcoming difficult conditions (Condly, 2006; Grassi, 2014). Thinking about how resilient students maintain success in their educational life, and the reasons for their failures, will make us focus more on the variables affecting academic achievement (Grassi, 2014; Waxman & Huang, 1996). Recent studies claim that school climate is an important variable which is positively correlated with increasing academic achievement, a positive learning environment, effective risk management, and teacher satisfaction (Cohen, 2013; Cohen & Geier, 2010). A positive school environment is also effective in decreasing negative social and emotional outputs (Astor, De Pedro, Gireath, Esqueda, & Benbenishty, 2013). The studies show that there is a positive correlation between school climate and academic resiliency, and that a positive school climate supports the academic achievement of students who show high achievement despite being disadvantaged (Luthar et al., 2000; Rutter, 2006; Thapa et al., 2013; Wang & Degol, 2015). That relation between school climate and resiliency has attracted the attention of researchers, and it is considered important to conduct further research in order to increase student resilience and academic achievement.

In the light of the literature review, this study aims to determine the effect of the variable of opportunity to learn while evaluating the Math achievement of resilient students. In the study, the literature review reveals the main characteristics of students who show high achievement despite having low socio-economic status; and therefore, a theoretical model has been designed based on the factors affecting levels of achievement at both school and student levels. In the model, while student-related variables include the opportunity to learn, school-related variables are limited to the school climate and the school's educational resources. In accordance with the model, it is aimed to evaluate the

Math achievement of students who show high achievement despite having low socio-economic status with the variables of opportunity to learn, school climate, and school resources.

The main aim of this study is to use a hierarchical linear model analysis to investigate how the variables of opportunity to learn, school climate, and school resources together affect the PISA 2012 Math achievement of Turkish students who show high achievement despite having low socio-economic status. Therefore, the study looks for answers to the questions below:

1. Do the math achievements of resilient students show significant differences among schools?
2. Do the math achievements of resilient students vary according to their *School Climate* and *School Resources*?
3. Does the predictive power of *Opportunity to Learn* of resilient students regarding Math achievement differ among schools?
4. How does the mean math achievement of resilient students change in terms of learning factors depending on *School Climate* and *School Resources*?

Method

The Research Model

The research model is a model which aims to describe a phenomenon as it is. It is stated in the study that this type of investigation is more appropriate for a correlational scanning model because the achievements of socio-economically disadvantaged Turkish students in the PISA exam, which is international and has a hierarchical structure at school and student level, are explained through the variables shown in Tables 1 and 2 (Fraenkel & Wallen, 2006). According to Karasar (2010), scanning patterns are studies which aim to display phenomena as they are.

The Study Group

The PISA 2012 Turkish population covers 15-year-old students. The sampling design used for the PISA assessment was a two-stage stratified sample design where first schools, then students are randomly selected from among 12 regions and 13 school types (OECD, 2013). In the PISA Turkish sample, there are 4848 students from 170 schools. The study group of this research is composed of 529 students from 104 schools who are from low socio-economic levels, and successful according to the results of the PISA test for Turkey. In the selection of successful students from a low socio-economic level, the students who are in the bottom bracket of 33% according to the economic-social and cultural status (ESCS) index are defined as "socio-economically disadvantaged students" (OECD, 2013). Students who are above 67% in the ranking of the PISA 2012 Math average score are specified as "successful students." According to these specifications, the number of students who are in the bottom 33% of the ESCS index of the country, and at the same time whose reading skills are above 67% in average score ranking, and who are specified as resilient students, is found to be 317 (n = 317, μ_{math} = 531.79, sd = 44.71).

Data Collection Methods

Data in the study are derived from the PISA 2012 database. Data belonging to the variables which are aligned with the aim of the study are derived from school and student questionnaires. The peak variable of the study, math achievement (PVMATH), is obtained through five different math achievements (PVMATH1-PVMATH5) from the PISA 2012 dataset. The domains, at school level, forming the variables of school climate and school resources are given in Table 1; and the domains, at student level, forming the variables of opportunity to learn are given in Table 2. In the PISA technical report, the variables of opportunity to learn are specified under three subcategories, namely, content, teaching practices, and teaching quality (OECD, 2014).

Table 1. School Level Variables

School Resources	
TCSHORT	Shortage of Teaching Staff
SCMATEDU	Quality of School Educational Resources
SCMATBUI	Quality of Physical Infrastructure
School Climate	
STUDCLIM	Student-related Factors Affecting School Climate
TEACCLIM	Teacher-related Factors Affecting School Climate
TCMORALE	Teacher Morale
TCFOCST	Teacher Focus

Table 2. Student Level, Opportunity to Learn Variables

Opportunity to Learn / Content	
EXAPPLM	Experience with Applied Mathematical Tasks
EXPUREM	Experience with Pure Mathematical Tasks
FAMCON	Familiarity with Mathematical Concepts
FAMCONC	Familiarity with Mathematics Concepts – Corrected for Overclaiming
Opportunity to Learn / Teaching Practices	
TCHBEHTD	Teacher Behavior, Teacher-Directed Instruction
TCHBEHFA	Teacher Behavior, Student Orientation
TCHBEHSO	Teacher Behavior, Formative Assessment
Opportunity to Learn / Teaching Quality	
TEACHSUP	Mathematics Teaching
COGACT	Cognitive Activation
DISCLIMA	Disciplinary Climate
MTSUP	Teacher Support
CLSMAN	Classroom Management

Data Analysis

In this study, the PISA 2012 data show a hierarchical structure at student and school level. In the case that students are treated independently in the data of a hierarchical structure like PISA, there might be bias in the analysis, and similarities in the same group might be disregarded (Heck, Thomas, & Tabata, 2014). Besides, multi-level analysis allows the variability in student success to be examined both inside the school and among the schools, and it helps to determine important differences among schools (Raudenbush & Bryk, 2002). Multi-level analysis is also important to test the hypothesis in cross levels. As in this study, how upper level variables (school variable) affect lower level variables (student variables) can be tested. In this study, a two-level hierarchical linear model is used since two levels, student and school, are investigated.

Missing Values

In the PISA 2012 student booklet, rotation is applied for the first time which includes questions related to content. In this rotation process, providing that items 0–28 remain constant, students are questioned on other items on a rotation basis. This results in a lot of missing values. Kaplan and Su (2016) suggests a solution to the missing value problem in their study by comparing the methods of predictive mean matching, Bayesian linear regression, and proportional odds logistic regression, and the most accurate method is found to be predictive mean matching. This study employed the method suggested by Kaplan and Su (2016). In the study, missing data values are assigned to the items and indexes at the same time by using the predictive mean matching method. The missing data assignment process is conducted by using R software, "mice" package (van Buuren & Groothuis-Oudshoorn, 2011).

Once the missing data problem concerning the PISA 2012 forms was solved, equations and models regarding the hierarchical linear model were completed. Then, the hypothesis regarding the hierarchical linear model was tested and then it was decided which values were appropriate to be tested. For the analysis of all hierarchical linear models, HLM 7.0 software is used. Each model is explained together with their variables.

Model 1: Random Effects ANOVA Model

Since the Random Effects ANOVA Model does not involve any variables explaining neither Level 1 (variables in student level) nor Level 2 (variables in school level), it is also named as an Intercept-Only Model. The RE-ANOVA model provides information related to point estimate and confidence interval for the mean, variability of the dependent variable, within-group variability, between-groups variability, intraclass correlations, and variance rate among Level-2 units (Raudenbush & Bryk, 2002). Equations in student and school level in Model 1 regarding the study are shown below:

Student Level (Level 1): $PVMATH_{ij} = \beta_{0j} + r_{ij}$

School Level (Level 2): $\beta_{0j} = \gamma_{00} + u_{0j}$

Model 2: Means-as-Outcomes Model

In this model, in which means are dependent variables, predictions are made via the use of Level 2 variables, and group means are predicted by Level 2 variables (Raudenbush & Bryk, 2002). Equations in student and school level in Model 2 regarding the study are shown below:

Student Level (Level 1): $PVMATH_{ij} = \beta_{0j} + r_{ij}$

School Level (Level 2):

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{TCSHORT}) + \gamma_{02}(\text{SCMATEDU}) + \gamma_{03}(\text{SCMATBUI}) + \gamma_{04}(\text{STUDCLIM}) + \gamma_{05}(\text{TEACCLIM}) + \gamma_{05}(\text{TCMORALE}) + \gamma_{05}(\text{TCFOCST}) + u_{0j}$$

Model 3: Random Coefficient Model

In the Random Coefficient Model, intercepts and slopes show random variability in the groups. In the model, there are no variables regarding Level 2 which explain constant and slope parameters, but equivalence is constructed with the use of variables of Level 1 (Raudenbush & Bryk, 2002). Equations in student and school level in Model 3 regarding the study are shown below:

Student Level (Level 1):

$$PVMATH_{ij} = \beta_{0j} + \beta_{1j}(\text{EXAPPLM}) + \beta_{2j}(\text{EXPUREM}) + \beta_{3j}(\text{FAMCON}) + \beta_{4j}(\text{FAMCONC}) + \beta_{5j}(\text{TCHBEHTD}) + \beta_{6j}(\text{TCHBEHFA}) + \beta_{7j}(\text{TCHBEHSO}) + \beta_{8j}(\text{TEACHSUP}) + \beta_{9j}(\text{COGACT}) + \beta_{10j}(\text{DISCLIMA}) + \beta_{11j}(\text{MTSUP}) + \beta_{12j}(\text{CLSMAN}) + r_{ij}$$

School Level (Level 2):

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

$$\dots$$

$$\beta_{12j} = \gamma_{120}$$

Model 4: Intercepts-and-Slopes-as-Outcomes Model

In the model in which intercepts and slope coefficients are dependent variables (ICCD), intercepts and slopes show random variability in the groups. In the model, variables regarding Level 2 which explain constant and slope parameter and the variables regarding level 1 are used together to construct an equivalence (Raudenbush & Bryk, 2002). Equations in student and school level in Model 4 regarding the study are shown below:

Student Level (Level 1):

$$PVMATH_{ij} = \beta_{0j} + \beta_{1j}(\text{EXAPPLM}) + \beta_{8j}(\text{TEACHSUP}) + r_{ij}$$

School Level (Level 2):

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{TCSHORT}) + \gamma_{04}(\text{STUDCLIM}) + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

Results

In the findings of the study, first, descriptive statistics belonging to student and school level variables and the result variable which are obtained through assigning multiple imputed values are shown in Table 3. Student level variables handled in the study are scaled in a way that mean is 0, and standard deviation is 1, considering all the OECD countries. Therefore, the fact that student and school level variables given in Table 3 have minus values shows that Turkish students and Turkish schools are below the OECD average.

Table 3. Descriptive Statistics for Assigned Variables

Variables	N	$\bar{X}$	Std
Student Level			
Opportunity to Learn / Content			
(EXAPPLM) Experience with Applied Mathematical Tasks	317	-0.22	1.12
(EXPUREM) Experience with Pure Mathematical Tasks	317	0.17	0.92
(FAMCON) Familiarity with Mathematical Concepts	317	0.64	0.81
(FAMCONC) Familiarity with Mathematics Concepts – Corrected	317	0.53	1.01
Opportunity to Learn / Teaching Practices			
(TCHBEHTD) Teacher Behavior, Teacher-Directed Instruction	317	0.42	0.99
(TCHBEHFA) Teacher Behavior, Student Orientation	317	0.14	0.97
(TCHBEHSO) Teacher Behavior, Formative Assessment	317	0.03	0.93
Opportunity to Learn / Teaching Quality			
(TEACHSUP) Mathematics Teaching	317	0.24	0.88
(COGACT) Cognitive Activation	317	-0.07	0.87
(DISCLIMA) Disciplinary Climate	317	0.17	0.92
(MTSUP) Teacher Support	317	0.42	0.99
(CLSMAN) Classroom Management	317	0.44	1.09
School Level			
School Resources			
(TCSHORT) Shortage of Teaching Staff	104	0.94	1.01
(SCMATEDU) Quality of School Educational Resources	104	-0.41	0.86
(SCMATBUI) Quality of Physical Infrastructure	104	-0.31	0.95
School Climate			
(STUDCLIM) Student-related Factors Affecting School Climate	104	-0.23	1.09
(TEACCLIM) Teacher-related Factors Affecting School Climate	104	-0.36	1.07
(TCMORALE) Teacher Morale	104	-0.25	1.01
(TCFOCST) Teacher Focus	104	0.08	0.98
Outcome Variable			
PV1MATH	317	531.79	44.71
PV2MATH	317	522.58	53.76
PV3MATH	317	523.89	53.02
PV4MATH	317	526.71	53.93
PV5MATH	317	522.89	52.33

Once Table 3 is examined, it can be determined that disadvantaged Turkish students are below the average of the OECD countries in the variables of *Experience with Applied Mathematical Tasks* (EXAPPLM) and *Cognitive Activation* (COGACT). On the other hand, it can be seen that disadvantaged Turkish students showed better performance than all the OECD students in other student variables. At school level, it is determined that the variables of *the Shortage of Teaching Staff* (TCSHORT) and *Teacher Focus* (TCFOCST) are higher than the OECD average.

Findings on the first sub-problem: Regarding the math achievement of resilient students who participated in PISA 2012, the analysis results of the Random Effects ANOVA model, which determine whether there is a significant difference between school mean mathematics scores, are shown in Table 4. $H_0 = \tau_{00} = 0$ hypothesis is tested to determine whether the variance of schools' mean math achievement is different from zero.

When the analysis results of the Random Effects ANOVA model are examined, it can be seen that the within school mean math achievement shows statistically significance differences ($\tau_{00} = 730.80$; $\sigma^2 = 1303.46; SE = 3.59$; $p = 0.000$). For the general average of math achievement, weighted least squares approximation is 527.38, and standard error of the approximation is 3.59. For the general average of math achievement, a confidence interval of 95% is estimated with $CI = 527.38 \pm 1.96(3.59)$. According to that, the real value of the general mean math achievement is estimated to be 95% likely between 531.09 and 523.67. At student level, the variance of mean math achievement within school is predicted as 730.80. The intraclass correlation is estimated to be $\rho = \tau_{00}/(\tau_{00} + \sigma^2) = 730.80/(730.80 + 1303.46) = 0.36$. When the value of intraclass correlation is examined, it is concluded that 36% of the variability in math achievement results from the difference within schools. According to this result, it is determined that 64% of the variance in math achievement results from the difference among students within school. In the analysis of the Random Effects ANOVA model, reliability for average school mathematics achievement is predicted as 0.71. According to that, it can be said that sample means tend to be true indicators of the population means.

Findings on the second sub-problem: The results of Means-as-Outcomes Model which determines whether the math achievement of resilient students who participated in PISA 2012 is different depending on the variables of *School Climate* and *School Resources* are shown in Table 4.

The zero hypothesis is tested to determine whether the relation between schools' mean scores of *School Climate* and *School Resources* and the mean math achievement is different from zero. According to the hypothesis results, the effect of mean scores of *School Climate* and *School Resources* on the mean math achievement is statistically significance at the 0.05 level regarding the *Quality of School Educational Resources* and the *Student-related Factors Affecting School Climate* (p < 0,001). By looking at the fixed effects, the effect of the *Quality of School Educational Resources* on mean math achievement is predicted as 11.05, and this value means that one point of change in the variable of the average *Quality of School Educational Resources* is equal to the change of approximately 11.05 (SE = 4.54, p = 0.017) in mean math achievement. *Student-related Factors Affecting School Climate* on mean math achievement is predicted as 14.57 (SE = 4.15, p = 0.000), and this value means that one point of change in the variable of the average *Student-related Factors Affecting School Climate* is equal to the change of approximately 14.57 in mean math achievement.

When the random effects are considered, the variance in math achievement of the students within school is predicted as 1317.99. After controlling the average scores of *School Climate* and *School Resources,* the variance in school mean math achievement (between school variance) is estimated as 411.43. When the average scores of *School Climate* and *School Resources* are controlled, the true value of general mean math achievement is estimated to be 95% likely between 531.09 and 523.67 ($531.86 \pm 1.96(20.28^{1/2})$. When the variance predicted for the school average in math achievement in Model 1 and Model 2 are compared, the value for the variance between schools is determined as $(\tau_{00}(Model\ 1) - \tau_{00}(Model\ 2))/\tau_{00}(Model\ 1) = (730.80 - 411.43)/730.80 = 0.44$. According to the findings, it is concluded that approximately 44% of the variability in math achievement between schools is explained by the average scores of *School Climate* and *School Resources.* In the analysis of Means-as-Outcomes Model, the reliability prediction for the mean math achievement of schools is called a conditional reliability prediction. The reliability of the school mean math achievement where the average scores of *School Climate* and *School Resources* are the same is estimated at approximately 0.66. To sum up the results, it can be seen that the variance between schools, gathered in Model 1, increased from 36% to 44% when the variables of *School Climate* and *School Resources* are added to Model 2. The variables of the *Quality of School Educational Resources* and the *Student-related Factors Affecting School Climate* are seen to contribute to explaining the math performance of resilient students between schools.

Table 4. Fixed Effects Estimations of Models Predicting Resilient Students Math Achievement

Fixed Effects	Model 1			Model 2			Model 3			Model 4		
	Coefficient	SE	p	Coefficient	SE	p	Coefficient	SE	p	Coefficient	SE	p
Intercept, γ_{00}	527.379	3.567	<0.001	531.861	4.854	<0.001	527.307	3.563	<0.001	526,831	3.093	<0.001
Student Level												
OtL: Content												
EXAPPLM, γ_{10}							5.791	1.94	0.003*	4.567	2.21	0.041*
EXPUREM, γ_{20}							-0.122	3.24	0.970			
FAMCON, γ_{30}							6.062	3.74	0.107			
FAMCONC, γ_{40}							3.603	2.32	0.123			
OtL: Teaching Practices												
TCHBEHTD, γ_{50}							-2.552	3.20	0.427			
TCHBEHFA, γ_{60}							4.051	3.40	0.235			
TCHBEHSO, γ_{70}							-4.265	3.72	0.253			
OtL: Teaching Quality												
TEACHSUP, γ_{80}							7.001	3.33	0.030*	3.612	2.79	0.198
COGACT, γ_{90}							-2.721	3.603	0.451			
DISCLIMA, γ_{100}							-1.792	3.18	0.574			
MTSUP, γ_{110}							-3.433	3.18	0.282			
CLSMAN, γ_{120}							-2.195	2.21	0.322			
School Level												
School Resources												
TCSHORT, γ_{01}				0.151	3.65	0.967						
SCMATEDU, γ_{02}				11.054	4.54	0.017*				8.368	3.78	0.029*
SCMATBUI, γ_{03}				-7.151	4.09	0.084						
School Climate												
STUDCLIM, γ_{04}				14.578	4.15	0.000*				12.921	2.90	0.000*
TEACCLIM, γ_{05}				-2.197	4.46	0.624						
TCMORALE, γ_{06}				2.337	3.65	0.967						
TCFOCST, γ_{07}				4.681	3.73	0.213						
Intercept Variance, τ_{00}	730.80			411.43			745.19			420.31		
Level 1 Variance, σ^2	1303.46			1317.99			1259.14			1293.93		
Intraclass Correlation, ρ	.36			.24			.37			.25		

OtL= Opportunity to Learn

Findings on the third sub-problem: Whether the variables of *Opportunity to Learn* have the ability to predict the math achievement of resilient students who participated in PISA 2012 and differ between schools is examined via the Random Coefficient Model and shown in Table 4.

A hypothesis is made to test whether the effect of the three variable groups belonging to opportunity to learn (Content, Teaching Practices and Teaching Qualities) on mean math achievement is different from zero. According to the results of these zero hypotheses, the variables of the *Experience with Applied Mathematical Tasks* (EXAPPLM) and the *Mathematics Teaching* (TEACHSUP) have a significant effect on the math achievement of disadvantaged students (p < 0,001). When the results of Model 3 are examined, an increase is observed in τ_{00} values according to both Model 1 and Model 2 even though the variables of the *Experience with Applied Mathematical Tasks* and *Math Achievement* are significant. In that case, it is determined that although there are significant effects among student level variables, in other words, the variables of *Opportunity to Learn,* they do not contribute to explaining the variance between schools.

Findings on the fourth sub-problem: Lastly, to find out the answer to the question "How does the mean math achievement of resilient students change in terms of learning factors depending on *School Climate* and *School Resources*?" an Intercepts-and-Slopes-as-Outcomes Model is made by considering the variables which significantly predict the mean math achievement of resilient students.

When the random effects are considered, the variance in math scores of the students within school is predicted as 1293.93. After controlling the average scores of *School Climate* and *School Resources,* the variance of schools' mean math achievement (between schools) is estimated as 420.31. When the estimated variance values predicted for the mean math achievement of schools in Model 1 and Model 4 are compared, between school variance is determined as $(\tau_{00}(Model\ 1) - \tau_{00}(Model\ 4))/\tau_{00}(Model\ 1) = (730.80 - 420.31)/730.80 = 0.44$. When the new model (Model 4) and Model 3 are compared, it is noticed that there is a significant decrease in τ_{00} values. By using τ_{00} values, the decrease in the variance of interception is estimated as $(\tau_{00}(Model\ 3) - \tau_{00}(Model\ 4))/\tau_{00}(Model\ 3) = (745.19 - 420.31)/745.19 = 0.44$. Adding a variable from school level to Model 3 has decreased the intercept variance in school level by 44%. When the variables of the *Experience with Applied Mathematical Tasks* and the *Mathematics Teaching* is kept constant, it can be said that the variables of the *Quality of School Educational Resources* and the *Student-related Factors Affecting School Climate* explain 44% of the difference in school interceptions.

When the results of all models are examined, it can be seen that only in Model 2 the variables of *School Climate* and *School Resources* increased the variance between schools from 36% to 44%; and Model 4, which includes both school and student level variables, increased the variance by 44%. In that case, it can be said that although the variables of the *Experience with Applied Mathematical Tasks and the Mathematics Teaching* which are added to the student level have significant effects, they do not contribute to explaining the variance in the mean math achievement of resilient students.

Discussion and Conclusion

In this study, it is investigated by using a hierarchical linear model analysis how *Opportunity to Learn, School Climate* and *School Resources* variables together affect the PISA 2012 Math achievement of Turkish resilient students. With this aim, among the 4848 students from the Turkish sample, 317 resilient students, which correspond to 6,53% of the total sample, were identified for analysis. Looking at the findings, it is determined that two student level variables in Model 3 and two school level variables in Model 2 predict the PISA 2012 math achievement of the Turkish resilient students. In Model 4, which includes both student and school level variables, it is determined that although the variable of the *Experience with Applied Mathematical Tasks* at student level is a significant predictor, its ability to explain the variance between schools is nearly zero. Besides, the variables of the *Quality of School Educational Resources* and the *Student-related Factors Affecting School Climate* are significant predictors in explaining the math achievement of resilient students, and they explain 44% of the difference between schools ($p < 0.00$).

Experience with Applied Mathematical Tasks and the *Mathematics Teaching* indexes at student level provide substantial information about the math achievement of resilient students who participated in PISA 2012.

Findings of the study reveal that teacher support has an important role in the success of resilient students. The index of *Mathematics Teaching* reflects both individual and within school relationships and deal with various aspects of teacher support. The variable is based on the fact that the teacher is interested in the learning process of all the students and this results in the high achievement of students who have a low socio-economic status. It is also based on the fact that the teacher provides students with extra help when needed. Another sub-statement of teacher support means providing professional support to resilient students. Resilient students are those who have teacher support, receive help until they fully understand, and express their opinions. It is stated that being able to express opinions without being judged by the teacher or counselor is an important factor in the success of resilient students (McMillan & Reed, 2010). When the literature review is examined, the presence of school staff who show genuine interest in students plays an important role in student success (Coburn & Nelson, 1989; Geary, 1988; McMillan & Reed, 2010; Morrison, 2001; Mothner, 1995; Sagor, 1996). Contrary to the literature, when the last model is taken as a reference, it does not have a significant effect on the math achievement of resilient students who receives teacher support.

The index of the *Experience with Applied Mathematical Tasks* exists in both Model 2 and Model 4 as the student level predictor of the math achievement of resilient students. Math problems in the index are applied problems which focus on the upper level cognitive skills of students. In the index, there are expressions such as understanding the scientific tables in the text, calculating the number of tiles needed to cover a specific surface, calculating real distance on maps in different scales, calculating the weekly amount of electricity consumed by electrical appliances in a house. Another variable in the study which is the *Experience with Pure Mathematical Tasks* does not create any difference in the math achievement of the students in any of the models. The important point here is that the sub-statements of the index of the *Experience with Pure Mathematical Tasks* consists of questions at knowledge level. When those two variables are compared, it is concluded that upper level skills are more effective in predicting the math achievement of resilient students. In the literature, there are some studies related to the fact that increasing problem-solving skills affects the achievement of resilient students (Benard, 1993). However, there is no comparison in the studies based on the skill levels; therefore, this finding is considered important.

According to research findings, it is found that indexes of the *Quality of School Educational Resources* and the *Student-related Factors Affecting School Climate* at school level explain 44% of the variance between schools in the PISA 2012 math achievement of Turkish resilient students. Konstantopoulos (2005) found that school-related variables explain 50% of the variance in the achievement of the resilient students. On this point, the findings of the study show similarities with previous studies. Different from the previous ones, this study's *School Climate* indexes consist of only student-related expressions, and it is different in that aspect from the previous studies (Byfield, 2008; Erberber et al., 2015; Evans-Winters, 2005; Finn & Rock, 1997; Grassi, 2014; McMillan & Reed, 2010; Morrison, 2001; Padron et al., 2012; Sagor, 1996; Williams & Bryan, 2013). The contribution of a one-point increase in the variables of the *Student-related Factors Affecting School Climate* is the highest among other variables in the math achievement of resilient students in PISA 2012 ($\gamma_{SchoolClimate} = 12.9; p = 0.00$). In the sub-statements of the index of the *Student-related Factors Affecting School Climate*, student behaviors of skipping class and being late to class are also measured. The variable of the *Student-related Factors Affecting School Climate* also includes participating in mandatory events at school, respecting teachers, alcohol and drug abuse at school, and bullying. A school which has the specified school climate characteristics has an effect on the PISA 2012 math achievement of resilient students. In the study conducted by Erberber et al. (2015), it is specified that one of the variables to be used to define resilient students is the expression "being exposed to bullying." Findings of this study confirm that research.

The contribution of a one-point increase in the variables of the *Quality of School Educational Resources,* which predicts the PISA 2012 math achievement of resilient students as significant, to the PISA 2012 math achievement of resilient students is estimated as ($\gamma_{EduResources} = 8.3$ ($p = 0.029$). The variable of the quality of educational resources expresses the lack of lab equipment, educational materials, internet connection, educational computer software, and library materials in PISA 2012. Findings show a resemblance with the study done by Erberber et al. (2015). This is especially true for resilient students who need more support and help, and it is expected that opportunities should be available as regards school climate to increase the achievement of those students (Waxman, Gray, & Padron, 2003).

In light of the results of the study, it is thought that the reason why the math achievement of resilient students is high despite both problems in school climate and limited educational resources is simply because of students' own motivation. In the literature, it is possible to find studies revealing that individual motivation, self-arrangement skills, and having individual goals have positive effects on the success of resilient students (Erberber et al., 2015; Evans-Winters, 2005; Finn & Rock, 1997; Grassi, 2014; Lefalle, 2010; McMillan & Reed, 2010; Waxman et al., 2003). To be helpful in explaining the variance between schools, the effect of the variables related to students' individual motivation regarding math achievement can be investigated.

In light of the results of the study, it is determined that applied questions contributed to the increase in the of success of resilient students, except for questions on knowledge level. Therefore, taking Bloom's Taxonomy into consideration, the effect of questions involving upper level skills on math achievement can be investigated. In the study, it is also confirmed in Model 2 that teacher support is effective in the math achievement of resilient students. In the final model, it is thought that dealing with more variables related to teachers can help explain the variance between schools in the math achievement of students having a low socio-economic status. By taking into consideration the suggestions in previous studies, the effect of variables on math achievement such as a school's technological facilities and family support, which are thought to increase the variance in school level, can be investigated.

In the study, it can be concluded that the variables of teacher support, experience in applied mathematics, classroom practices focusing on upper level skills, school educational resources, and the school climate related to students can explain the math performance of resilient students. This finding supports many studies explaining student success (Benard, 1993; Cunningham, 2006; Finn & Rock, 1997; Grassi, 2004; Morrison, 2001; Mothner, 1995; Sagor, 1996). Education is a remarkable force which helps increase the academic success of all students, and the quality of life and welfare of individuals, and therefore of society. Education, and therefore school, has such power that the effect of the socio-economic backgrounds of families decrease in defining the future of their children (OECD, 2011). Education and school climate, each of which is a powerful force, need to touch students' life to make a difference. Results of the study draw attention to the difference school climate can create and emphasize the school variable in the success of resilient students despite their disadvantaged conditions. Starting from the fact that no success is coincidence, it is important to increase and support the practices which support success. Therefore, it is necessary that practices and arrangements should be dealt with and overviewed in a more detailed way, considering that the learning environment in schools is an important variable in explaining success. Improvements can be made to strengthen the effects of school on resilient students. It is important that supportive practices in school should be encouraged so that resilient students in particular who need more support can realize their academic achievements.

When the limitations of the study are considered, this study focused only on math literacy. The study uses data from PISA 2012. PISA practices in previous years can be taken into consideration, and if there are any, similarities and differences can be discussed. School variables are handled as the second level in this study. Additionally, variables in teacher levels can be handled, and their effects can be discussed at another level. Also, disadvantaged low-achieving students can be added to the study, and by comparing them with resilient students, the results can be interpreted. Strengths of the study show that investigating the effect of school on the academic achievement of resilient students is highly important. Also, dealing with the variable of school level where the majority of learning takes place is one of the strengths of this study. Besides, the study gains importance with the perspective it brings to the method used regarding imputation of missing values in the PISA test and the use of data sets in the hierarchical linear model.

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