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| Research Article / Araştırma Makalesi |

Factors Related to the Mathematics Achievement of Resilient and Nonresilient Students with Different Genders in Top Performing Asian Countries

Yüksek Başarılı Asya Ülkelerinde Farklı Cinsiyetlerden Dirençli ve Dirençsiz Öğrencilerin Matematik Başarılarıyla İlişkili Faktörler [1]

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Keywords

1. Resilient and nonresilient students
2. Gender
3. Mathematics achievement
4. Multiple linear regression

Anahtar Kelimeler

1. Dirençli ve dirençsiz öğrenciler
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Abstract

Purpose: This study focused on the relationship between student-related factors and students' mathematics achievement in top performing five Asian countries, including, Singapore, Chinese Taipei, South Korea, Japan, and Hong Kong, in TIMSS 2019 at the eighth-grade level with the specific focus on resilient and nonresilient students with different genders.

Design/Methodology/Approach: The data consisted of the pooled sample of 19,652 students in total. Seven student-related factors indicated by previous researchers were tested across the resilient and nonresilient students in these Asian countries through linear multiple regression technique.

Findings: As a result, valuing of mathematics and liking mathematics were found to have significant positive relationship with resilient students' mathematics achievement while self-confidence and SES to be significantly related to only resilient male students' achievement. In addition, for the nonresilient students, valuing mathematics, SES, liking mathematics, and discipline climate of classroom were found to be significantly positively related to achievement for both genders.

Highlights: The study revealed that valuing and liking mathematics consistently contributed to higher mathematics achievement among both resilient and nonresilient students across genders. While self-confidence in mathematics and socioeconomic status (SES) were not significant for resilient female students, they emerged as important predictors for resilient male students as well as for both genders of nonresilient students. Moreover, classroom discipline climate positively influenced the achievement of nonresilient students but showed no effect on resilient students. In contrast, school belonging and experiences of bullying were not significantly related to mathematics achievement in the overall sample.

Öz

Çalışmanın amacı: Bu çalışma, öğrenciye ilişkin faktörler ile öğrencilerin matematik başarıları arasındaki ilişkiyi, TIMSS 2019 sekizinci sınıf düzeyinde Singapur, Çin Taipesi, Güney Kore, Japonya ve Hong Kong gibi başarı düzeyi yüksek beş Asya ülkesinde, dirençli ve dirençsiz öğrenciler ile cinsiyet farklılıklarına odaklanarak incelemiştir.

Materyal ve Yöntem: Veriler, toplamda 19.652 öğrenciden oluşan havuz örneklemi kapsamaktadır. Önceki araştırmalarda belirtilen öğrenciye ilişkin yedi faktör, bu Asya ülkelerinde dirençli ve dirençsiz öğrenciler arasında çoklu doğrusal regresyon yöntemiyle test edilmiştir.

Bulgular: Sonuç olarak, matematiğe değer verme ve matematiği sevmenin, dirençli öğrencilerin matematik başarısıyla anlamlı düzeyde pozitif ilişkili olduğu; öz güven ve sosyoekonomik statünün ise yalnızca dirençli erkek öğrencilerin başarısıyla anlamlı düzeyde ilişkili olduğu bulunmuştur. Ayrıca, dirençsiz öğrenciler için, matematiğe değer verme, sosyoekonomik statü, matematiği sevme ve sınıf disiplin ortamı hem kız hem erkek öğrencilerin başarısıyla anlamlı ve pozitif yönde ilişkili bulunmuştur.

Önemli Vurgular: Çalışma, matematiğe değer verme ve matematiği sevmenin, hem dirençli hem de dirençsiz öğrencilerin farklı cinsiyetlerdeki başarılarını tutarlı bir biçimde artırdığını ortaya koymuştur. Matematikte öz güven ve sosyoekonomik statü (SES), dirençli kız öğrenciler için anlamlı bulunmazken, dirençli erkek öğrenciler ve dirençsiz öğrencilerin her iki cinsiyeti için önemli yordayıcılar olarak öne çıkmıştır. Ayrıca, sınıfın disiplin iklimi dirençsiz öğrencilerin başarılarını olumlu yönde etkilerken, dirençli öğrenciler üzerinde anlamlı bir etkisi bulunmamıştır. Buna karşın, okula aidiyet ve zorbalık deneyimleri genel örneklemde matematik başarısı ile anlamlı bir ilişki göstermemiştir.

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INTRODUCTION

Numerous studies have been conducted to investigate factors associated with student achievement. While the factors are compiled around constructs as teacher-related, family-related, school-related, etc., researchers also brought student-related factors into attention, such as attitudes toward mathematics (e.g. Abazaoğlu, Yatağan, Yıldızhan, Arifoğlu, & Umurhan, 2015; Doğan & Barış, 2010; Uzun, Bütüner, & Yiğit, 2010), valuing of mathematics (e.g. Atar, 2011; Doğan & Barış, 2010; Yayan & Berberoğlu, 2004), self-confidence in mathematics (e.g. Abazaoğlu et al., 2015; Akyüz, 2014; Atar, 2011; Doğan & Barış, 2010; Güven & Çabakçor, 2013; Yayan & Berberoğlu, 2004), school belonging (e.g. Akyüz & Pala, 2010; Engin-Demir, 2009), and home educational resources (e.g. Akyüz, 2006; 2014; Kılıç, Çene, & Demir, 2012; Özer & Anıl, 2011; Yayan & Berberoğlu, 2004). Among these factors, students' socio-economic status (SES) has also been getting attention of the researchers for a long time. Many studies have reported that students with higher SES are more likely able to achieve higher than their peers (Abazaoğlu et al., 2015; Akyüz, 2014; Akyüz & Pala, 2010; Alacacı & Erbaş, 2010; Demir, Kılıç, & Ünal, 2009; 2010; Dinçer & Kolasın, 2009; Dinçer & Uysal, 2010; Engin-Demir, 2009; Kılıç et al., 2012; Nilsen, Blömeke, Hansen, & Gustafsson, 2016; Özer & Anıl, 2011; Reardon, 2011; Xie & Ma, 2019). Even though students from families with lower SES are more likely to achieve poorly, many of these students are not vulnerable to their circumstances and still perform well in school, whom are called "academically resilient" since they overcome their disadvantageous situation (Agasisti, Avvisati, Borgonovi, & Longobardi, 2018; Agasisti & Longobardi, 2014; Avcı, 2022; Erberber, Stephens, Mamedova, Ferguson, & Kroeger, 2015; Martin & Marsh, 2006; Masten, 2014; OECD, 2018; Sandoval-Hernandez & Bialowolski, 2016). While the interestingness of these students seems quite an issue, identifying the reasons behind their unexpected success is still challenging for researchers (Erberber et al., 2015; Radisic & Petterson, 2020).

When examining the relevant literature in terms of revealing the characteristics that lead resilient students to be successful in mathematics at school, it was encountered with numerous studies, in which the factors indicated are mostly overlapped with the ones indicated in the studies mentioned above. The characteristics that are possibly linked to success of resilient students by researchers include their attitude toward mathematics (Frempong Visser, Feza, Winnaar, & Nuamah, 2016; Martin & Marsh, 2006; Sandoval-Hernandez & Bialowolski, 2016), valuing of mathematics (Erberber et al., 2015), self-confidence in mathematics (Martin and Marsh, 2009; OECD, 2012; Sandoval-Hernandez, & Cortes, 2012), relationships with their peers (Doll, Zucker, & Brehm, 2004; Lessard, Butler-Kisber, Fortin, & Marcotte, 2014), bullying they are faced with (Erberber et al., 2015), school climate in which they are instructed (Kyriakides, Creemers, Antoniou, & Demetriou, 2010; Martin, Foy, Mullis, & O'Dwyer, 2013; Maxwell, Reynolds, Lee, Subasic, & Bromhead, 2017; OECD, 2018), and disciplinary climate of their schools (Agasisti et al., 2018; Güzel & Berberoğlu, 2005; Ma, Jong, & Yuan, 2013; OECD, 2018; Shin, Lee, & Kim, 2009). Discipline issues are reported as an essential factor of resilience especially in Asian countries (Ma et al., 2013; Shin et al., 2009) where disciplined class environment is defined a class with free of disruption (Kyriakides & Creemers, 2008; Hopkins, 2005).

Research on resilience in terms of the gender differences revealed opposite results. While some of these indicated that female students are more resilient than male students (Allan, McKenna, & Dominey, 2014; DuMont, Widom, & Czaja, 2007; McLafferty, Mallet, & McCauley, 2012; Parker, Hogan, Easabrook, Oke, & Wood, 2006; Sun & Stewart, 2007), some indicated the opposite (Li, 2008; Martin & Marsh, 2006; 2008; Sander & Sanders, 2009). Although there are studies focused on the differences in resilience of different genders, there is a lack of studies focusing on revealing the factors behind the difference of resiliency of students from different genders, with the best understanding on a relevant literature review. Therefore, this study aimed to investigate how student-related factors are associated differently with mathematics achievement between resilient students with different genders. The research question shaping the form of the research is:

1. To what extent student-related factors indicated by previous researchers (SES, school belonging, bullying, liking mathematics, discipline climate of classroom, self-confidence in mathematics, and valuing of mathematics) are related with mathematics achievement of resilient and nonresilient students with different genders in top performing five Asian countries in TIMSS 2019?

METHOD

Sample

The sample of this study is consisted of eighth-grade students of top performing five Asian countries of mathematics part of TIMSS 2019 assessment, namely Singapore, Chinese Taipei, Korea Republic, Japan, and Hong Kong SAR. Thirty-nine countries and 7 jurisdictions were participated voluntarily in TIMSS 2019 assessment while the five Asian countries mentioned above are the top achievers by substantial margin (Mullis, Martin, Foy, Kelly, & Fishbein, 2020). These countries are the specific focus of this study due to the high standards and severe academic pressure that define these educational systems. The ways in which kids demonstrate resilience in such settings may be different from those in systems with mediocre or low performance. A greater comprehension of how students perform under demanding academic conditions is made possible by analyzing resilience in these circumstances. Therefore, pooled sample of these countries was examined for the groups of resilient female, resilient male, nonresilient female and nonresilient male students. When defining these groups, TIMSS 2019 "Intermediate International Benchmark of mathematics" was used as a cut score to determine successful students while "few resources" category of the variable "Home Educational Resources" was used as a cut score to determine advantaged students, as Erberber et al. (2015) described. As a result, students who perform above 475 points at mathematics assessment and are classified in or below few

resources category consist of resilient students in each individual country. Likewise, students who perform above 475 points at mathematics assessment and are classified above few resources category or who perform below 475 points at mathematics assessment and are classified in or below few resources category consist of nonresilient students. Sample sizes for each of these individualized groups are given below in Table 1.

Table 1. Sample sizes for resilient and nonresilient students by gender

	Resilient Students (Ach.>475 & HER<=few resources)	Nonresilient Students (Ach.>475 & HER>few resources) or (Ach.<475 & HER<=few resources)
Female	587	9202
Male	663	9200
Total	1250	18402

Data Sources

In TIMSS 2019 assessment, each student received an achievement booklet to assess their mathematical knowledge while they received a questionnaire to determine the factors behind their achievement (Mullis, 2017). The determination of the variables used to assess factors associated with student achievement was based on the relevant literature review. Table 2 shows the variables used in this study. While student achievement, which was the outcome variable, was assessed through a plausible value created by TIMSS, remaining variables, explanatory variables, were assessed through relevant variable created by TIMSS. In addition to the results for the singular questionnaire items posed to students, TIMSS developers also created some scaled variables that were derived from the combination of the singular items. In this study, these scaled variables used to assess student-related factors of their achievement. Table 2 shows these scaled variables along with the items used to derive them and the cut scores for the categories created to scale them. The data for this study were obtained online from IEA's website for the TIMSS 2019 International Data Sets.

Table 2. Student-related variables and correspondent items in TIMSS 2019

Variable	Relevant items in TIMSS 2019
SES (BSBGHER)	Number of books in the home: – 0-10, – 11-25, – 26-100, – 101-200, – >200. Number of home study supports: – None, – internet connection or own room, – both internet connection and own room. Highest level of education of either parent: – Finished some primary or lower secondary or did not go to the school, – Finished lower secondary, – Finished upper secondary, – Finished post-secondary education, – Finished university or higher.
School belonging (BSBGSSB)	What do you think about your school? Tell how much you agree with these statements (Agree a lot, agree a little, disagree a little, disagree a lot). – I like being in school. – I feel safe when I am at school. – I feel like I belong at this school. – Teachers at my school are fair to me. – I am proud to go to this school.
Bullying (BSBGSB)	During this school year, how often have other students from your school done any of the following things to you, including through texting or the Internet? – Made fun of me or called me names. – Left me out of their games or activities. – Spread lies about me. – Stole something from me. – Damaged something of mine on purpose. – Hit or hurt me (e.g., shoving, hitting, kicking) – Made me do things I didn't want to do. – Sent me nasty or hurtful messages online. – Shared nasty or hurtful messages about me online.

Variable	Relevant items in TIMSS 2019
	– Shared embarrassing photos of me online. – Threatened me.
Liking mathematics (BSBGSLM)	How much do you agree with these statements about learning mathematics (Agree a lot, agree a little, disagree a little, disagree a lot)? – I enjoy learning mathematics. – I wish I did not have to study mathematics. – Mathematics is boring. – I learn many interesting things in mathematics. – I like mathematics. – I like any schoolwork involving numbers. – I like to solve mathematics problems. – I look forward to mathematics lessons. – Mathematics is one of my favorite subjects.
Discipline climate of classroom (BSBGDML)	How often do these things happen in your mathematics lessons? – Students don't listen to what the teacher says. – There is disruptive noise. – It is too disorderly for students to work well. My teacher has to wait a long time for students to quiet down. – Students interrupt the teacher. – My teacher has to keep telling us to follow the classroom rules.
Self-confidence in mathematics (BSBGSCM)	How much do you agree with these statements about mathematics (Agree a lot, agree a little, disagree a little, disagree a lot) (*reverse coded)? – I usually do well in mathematics. – Mathematics is more difficult for me than for many of my classmates*. – Mathematics is not one of my strengths*. – I learn things quickly in mathematics. – Mathematics makes me nervous*. – I am good at working out difficult mathematics problems. – My teacher tells me I am good at mathematics. – Mathematics is harder for me than any other subject*. – Mathematics makes me confused*.
Valuing of mathematics (BSBGSVM)	How much do you agree with these statements about mathematics (Agree a lot, agree a little, disagree a little, disagree a lot)? – I think learning mathematics will help me in my daily life. – I need mathematics to learn other school subjects. – I need to do well in mathematics to get into the university of my choice. – I need to do well in mathematics to get the job I want. – I would like a job that involves using mathematics. – It is important to learn about mathematics to get ahead in the world. – Learning mathematics will give me more job opportunities when I am an adult. – My parents think that it is important that I do well in mathematics. – It is important to do well in mathematics.

Data Analysis

In order to assess the extent to which student-related factors indicated by previous researchers are related with mathematics achievement of resilient and nonresilient students with different genders, linear multiple regression technique was used. While student achievement was used as an outcome variable, student-related factors indicated before were used as explanatory variables so that variability in students' mathematics achievement could be explained through student-related variables. This hypothesized model is given in Equation 1 below. After creating this hypothesized model, it was tested in the pooled sample of five Asian countries, which are the top achievers in TIMSS 2019. This multilevel model was estimated with a special package called *lme4* (Bates, 2022) in R statistical software (R Core Team, 2021).

$$Y_{ij} = \gamma_{00} + \sum_{p} \gamma_{p0} X_{pij} + r_{ij} \quad (1)$$

where

Y_{ij} is the mathematics achievement of a student *i* in the country *j;*

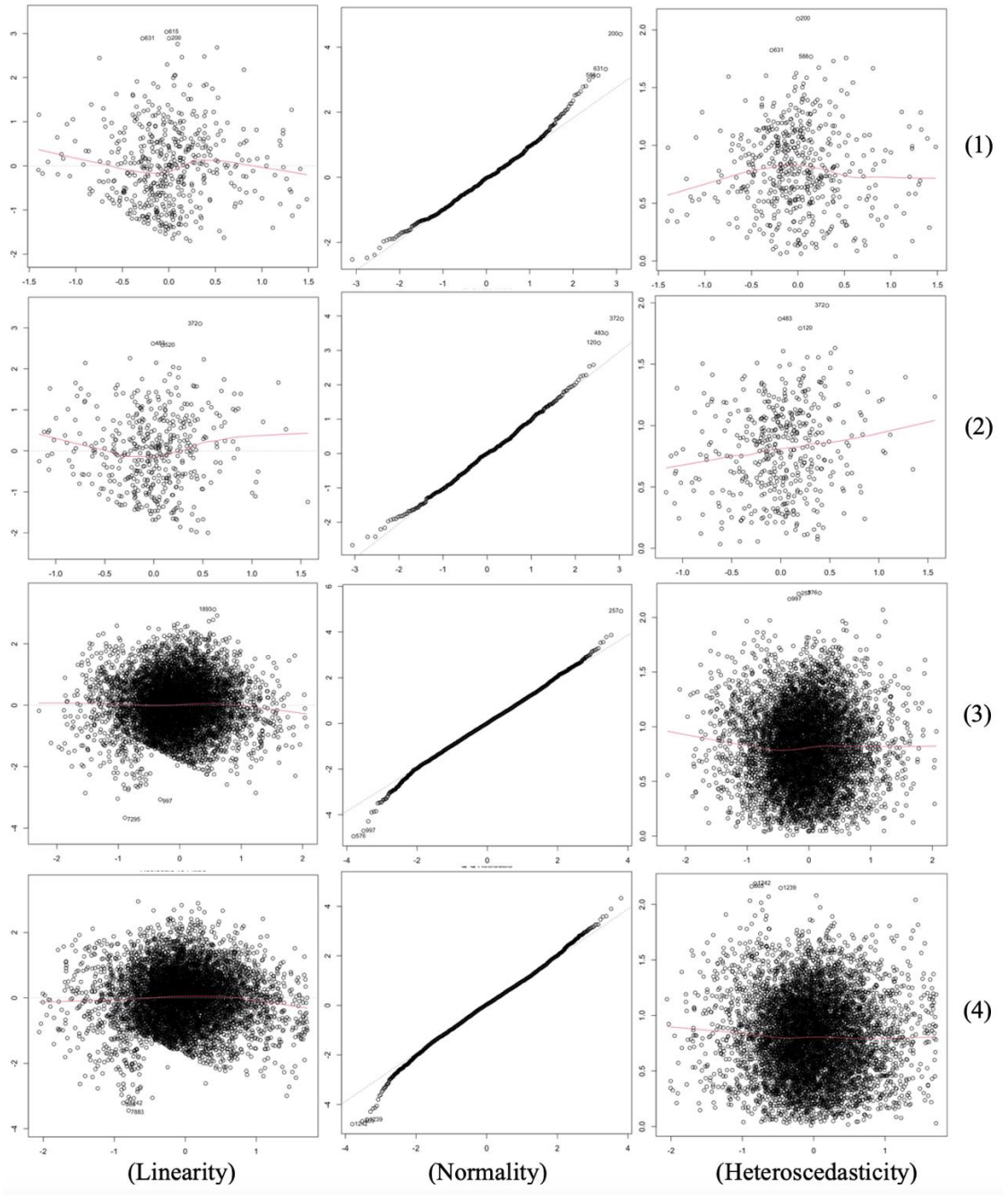
γ_{00} is the intercept term;

γ_{p0} are the fixed regression coefficients representing the direction and strength of the relationship between student level variables (X_{pij}) and Y_{ij};

X_{pij} are student variables predicting achievement of student *ij*; and

r_{ij} is a random "student effect" that is the deviation of student r_{ij}'s mathematics achievement score from the estimated score.

Before testing the hypothesized model, it is very essential to check the assumptions of the linear multiple regression technique, which are linearity of the data, normality of residuals, homogeneity of residual variance (heteroscedasticity), and multicollinearity (Tabachnick & Fidell, 2013). Figure 1 and Table 3 show the result for the tests for each assumption for each individual model.



(residuals vs. fitted values) (Normal Q-Q plot) (fitted values vs. standardized residuals)

(1): Resilient male, (2): Resilient female, (3): Nonresilient female, (4): Nonresilient male

Figure 1. Plots for the assumptions of Linear Multiple Regression Models

As shown in Figure 1, plots for the residuals vs. fitted values show no fitted pattern across different models, which indicates that linearity assumption was met. On the other hand, normal Q-Q plots for the theoretical quantiles vs. standardized residuals approximately follow the straight line, which implies that the assumption of normality of residuals was met. In addition, plots for the fitted values vs. standardized residuals are spread approximately equally along the ranges of predictors, which suggests nonconstant variances in the residual errors, in other words heteroscedasticity assumption was met. Last but not the least, in addition to these three assumptions, the multicollinearity assumption was also checked. In order to check this assumption, bivariate correlations among the explanatory variables were examined (Table 3). According to Tabachnick and Fidell (2013), multicollinearity occurs when there is a bivariate correlation of greater than *.90* between any two of the explanatory variables. As

shown in Table 3, the strongest correlation among the explanatory variables was observed to be .67, which indicates no issue in terms of multicollinearity.

Table 3. Bivariate correlations among explanatory variables

	BSBGHER	BSBGSSB	BSBGSB	BSBGSLM	BSBGDML	BSBGSCM
BSBGSSB	.05					
BSBGSB	-.05	.14				
BSBGSLM	-.00	.33	.03			
BSBGDML	-.00	.17	.30	.10		
BSBGSCM	.02	.10	-.00	.67	-.02	
BSBGSVM	.04	.37	-.05	.63	.03	.43

FINDINGS

In the linear multiple regression models, all regression coefficients were fixed and tested for resilient and nonresilient students with different genders in top performing five Asian countries in TIMSS 2019. Table 4 shows the results for each individual model. As shown, sample size for each sample decreased from the values given in Table 1 due to default missing data management of the statistical package by list-wise deleting missing values.

Table 4. Results from the Linear Multiple Regression Models with Mathematics Achievement as the Dependent Variable

	Resilient Male	**Resilient Female**	**Nonresilient Male**	**Nonresilient Female**
Variables	*Estimate (S.E.)*	*Estimate (S.E.)*	*Estimate (S.E.)*	*Estimate (S.E.)*
γ_{00} =Intercept	-.001 (.041)	.042 (.046)	-.020 (.010)	.024* (.010)
γ_{10} =SES	.079* (.040)	.074 (.046)	.315** (.010)	.297** (.010)
γ_{20} =School belonging	.004 (.044)	-.050 (.047)	-.006 (.011)	.007 (.011)
γ_{30} =Bullying	-.054 (.044)	.048 (.047)	-.018 (.011)	-.000 (.011)
γ_{40} =Liking math	.148* (.065)	.193** (.074)	.088** (.015)	.087** (.016)
γ_{50} =Disc. climate of class.	-.028 (.054)	.082 (.067)	.027* (.012)	.096** (.012)
γ_{60} =Self-confidence in math	.087* (.042)	-.020 (.046)	-.012 (.011)	.063 (.011)
γ_{70} =Valuing of math	.345** (.056)	.224** (.063)	.318** (.014)	.293** (.014)
N	498	436	7015	7054
Adjusted R-squared	.20	.16	.30	.30

*p<.05, **p<.01. Standard errords were given in the parantheses. *Disc. climate of class.*: discipline climate of classroom

Results from the linear multiple regression models indicated that the extent to which covariates explain the total variance in students' mathematics achievement are seemingly low, ranging between 16% and 30%; however, it is reasonable to have this level of r-squared values when considering the fact that there were only seven student-related variables included in the models. As shown in Table 4, significance and magnitude of the relationships between explanatory variables and the outcome variable differs among different models conducted for resilient and nonresilient students with different genders. Since regression coefficients were estimated by the standardized measures, it is reasonable to compare them amongst each other in terms of the magnitude of their relationships with student achievement (Lorah, 2018).

As a result of the linear multiple regression models for the resilient students, it was observed that *valuing of mathematics* ($\gamma_{70\text{-male}}$ =.345, p<.01; $\gamma_{70\text{-female}}$ =.224, p<.01) and *liking mathematics* ($\gamma_{40\text{-male}}$ =.148, p<.05; $\gamma_{40\text{-female}}$ =.193, p<.01) had the first- and second-most strong significant positive relationship either with male or female resilient students' mathematics achievement. In addition, *self-confidence in mathematics* ($\gamma_{60\text{-male}}$ =.087, p<.05) and *SES* ($\gamma_{10\text{-male}}$ =.079, p<.05) were the other two significant positive predictors for students' mathematics achievement only for resilient male students, not for the resilient female. However, other student-related variables (*school belonging, bullying,* and *discipline climate of classroom*) were not found to have significant relationship neither with male nor female resilient students' mathematics achievement.

When examining the results of the linear multiple regression models for the nonresilient students, it was observed that *valuing of mathematics* ($\gamma_{70\text{-male}}$ =.318, p<.01; $\gamma_{70\text{-female}}$ =.293, p<.01), *SES* ($\gamma_{10\text{-male}}$ =.315, p<.01; $\gamma_{10\text{-female}}$ =.297, p<.01), *liking mathematics* ($\gamma_{40\text{-male}}$ =.088, p<.01; $\gamma_{40\text{-female}}$ =.087, p<.01) and *discipline climate of classroom* ($\gamma_{50\text{-male}}$ =.027, p<.05; $\gamma_{50\text{-female}}$ =.096, p<.01) were the ones having significant positive relationship with nonresilient male and female students' mathematics achievement although the order of the magnitude of the relationships of these variables with student achievement vary between male and female groups.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

According to some researchers, students with higher SES are more likely to perform higher than their peers (Abazaoğlu et al., 2015; Akyüz, 2014; Akyüz & Pala, 2010; Alacacı & Erbaş, 2010; Demir, Kılıç, & Ünal, 2009; 2010; Dinçer & Kolasın, 2009; Dinçer & Uysal, 2010; Engin-Demir, 2009; Kılıç et al., 2012; Nilsen, Blömeke, Hansen, & Gustafsson, 2016; Özer & Anıl, 2011; Reardon, 2011; Xie & Ma, 2019). However, students with lower SES are not always vulnerable to their circumstances and achieve higher than their peers in some instances (Agasisti, Avvisati, Borgonovi, & Longobardi, 2018; Agasisti & Longobardi, 2014; Avcı, 2022; Erberber, Stephens, Mamedova, Ferguson, & Kroeger, 2015; Martin & Marsh, 2006; Masten, 2014; OECD, 2018; Sandoval-Hernandez & Bialowolski, 2016). Since identifying the reasons behind this unexpected situation gets attention (Erberber et al., 2015; Radisic & Petterson, 2020), in addition to the lack of research especially on gender differences, this study focused on revealing the differences between resilient and nonresilient students with different genders in terms of their mathematics achievement in top performing Asian countries in TIMSS 2019.

As a result of this study, *valuing of mathematics* and *liking mathematics* found to have significantly positive relationships with mathematics achievement of either resilient or nonresilient students with different genders, as previous researchers suggested (Erberber et al., 2015; Frempong Visser, Feza, Winnaar, & Nuamah, 2016; Martin & Marsh, 2006; Sandoval-Hernandez & Bialowolski, 2016). However, *self-confidence in mathematics* and *SES* were not found to have significant relationship with mathematics achievement of resilient female students as opposed to previous researchers' findings (Martin and Marsh, 2009; OECD, 2012; Sandoval-Hernandez, & Cortes, 2012) while these variables had significant positive relationship with resilient male students' achievement. This raises an important concern that how mathematics performance of female resilient students is not significantly related to their self-confidence and SES. It was also found as a result of this study that self-confidence was not also found to have significant relationship with mathematics achievement for nonresilient students. This could mean that female resilient students overcome their SES issues differently than their male counterparts while they overcome self-confidence issues differently than everybody else. This is also supported by previous research that female students are more resilient than the male (Allan, McKenna, & Dominey, 2014; DuMont, Widom, & Czaja, 2007; McLafferty, Mallet, & McCauley, 2012; Parker, Hogan, Easabrook, Oke, & Wood, 2006; Sun & Stewart, 2007). As a result, dealing with self-confidence and SES issues could be the key factors on becoming more resilient. However, there is a need for an in-depth analysis on these matters.

In addition, *discipline climate of classroom* was found to have a significant positive relationship with students' mathematics achievement for nonresilient students but not for resilient students. This is exactly opposite of previous researchers' statement indicating that discipline issues are reported as an essential factor of resiliency in Asian countries (Ma et al., 2013; Shin et al., 2009). It is very interesting that discipline issue is a significant positive indicator of nonresilient students. When disruptiveness of a classroom decreases by 1 standard deviation (SD), students' mathematics achievement increases by .027 SD (p<.05) for the nonresilient male and .096 (p<.01) for the nonresilient female. Since nonresilient students were defined as successful with higher SES or not successful with lower SES, it could be possible that students who are not successful and having lower SES could be the ones having discipline problems in the classroom. This might be the reason of how they did not overcome their disadvantageous situation as their resilient peers did. These findings indicated that it should not only be examined the reasons behind the success of resilient and nonresilient students but should also be examined the gender differences so that it could be revealed how different gender groups of resilient students overcome their disadvantageous situation.

On the other hand, *school belonging* and *bullying* were found not to have significant relationship with mathematics achievement for the entire sample, as opposed to previous researchers' findings (Erberber et al., 2015; Kyriakides, Creemers, Antoniou, & Demetriou, 2010; Martin, Foy, Mullis, & O'Dwyer, 2013; Maxwell, Reynolds, Lee, Subasic, & Bromhead, 2017; OECD, 2018). Therefore, as a result, it is highly suggested to future researchers that they should specifically focus on why

1. *self-confidence in mathematics* and *SES* for female resilient students,
2. *discipline climate of classroom* for resilient students, *self-confidence in mathematics* for nonresilient students, and
3. *school belonging*, and *bullying* for either resilient or nonresilient students

are not significant predictors of mathematics achievement as opposed to what previous research suggested. Conducting in-depth analyses on these manners could reveal the reality behind the performance of different genders of resilient and nonresilient students. Especially revealing the connection of the self-confidence in mathematics and SES to the process of how female resilient students become more resilient could potentially help students with lower SES, their teachers, and educational administrators to enhance these students' mathematical understanding.

LIMITATIONS OF THE STUDY

Since this study used a cross-sectional multi-country data, it was not very possible to make causal inferences on the relationship between student-related variables and students' mathematics achievement. Therefore, the findings of this study would be beneficial to the researchers who are able to investigate these issues in the real classroom environment through in-depth analyses. Results from multi-country data would help them to see a bigger picture of the issues when conducting a smaller-scale study. In addition, responses of students to the questionnaire items may vary among different countries, which was defined as *measurement invariance* (Steenkamp & Baumgartner, 1998).

Declaration of Conflicting Interests

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Statements of publication ethics

I hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Ethics Committee Approval Information

Since the study involves no human subjects, whose identities can be identified, it was exempted from requiring ethical approval. It was used encrypted data (TIMSS 2019) from IEA's website.

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