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The Effects of Student and School Factors on Mathematics Achievement in TIMSS 2011

TIMSS 2011'de Öğrenci ve Okul Faktörlerinin Matematik Başarısına Etkisi

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Abstract

The purpose of this study is to compare and contrast the multilevel effects of student and school factors on the mathematics achievement of eighth-grade students in Turkey, Singapore, the USA and Finland through multilevel modelling using the Trends in International Mathematics and Science Study (TIMSS) 2011 eighth-grade data. The results showed that the TIMSS 2011 mathematics scores of eighth-grade students were positively affected by self-confidence in mathematics and home educational resources at student level, and school composition by students' economic background at school level in all countries in the study.

Keywords: Trends in International Mathematics and Science Study (TIMSS), mathematics achievement, school factors, student factors, multilevel statistical analysis

Öz

Çalışmanın amacı, TIMSS 2011 verilerini kullanarak Türkiye, Singapur, ABD ve Finlandiya'daki 8. sınıf öğrencilerinin, öğrenci ve okul düzeylerindeki özelliklerinin matematik başarısına etkisini karşılaştırmaktır. Çok düzeyli istatistiksel analizin yapıldığı çalışmada elde edilen bulgulara göre öğrenci düzeyinde öğrencilerin matematik özgüvenleri ve evdeki eğitimsel kaynaklar ile okul düzeyinde okulun öğrencilerin ekonomik düzeylerine göre yapısı değişkeni tüm ülkelerde öğrenci başarısını pozitif yönde anlamlı etkilemektedir.

Anahtar Sözcükler: Uluslararası Matematik ve Fen Eğilimleri Araştırması, matematik başarısı, okul faktörleri, öğrenci faktörleri, çok düzeyli istatistiksel analiz

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Introduction

Determining the mathematics level of students is the focus of many of the international assessment programs such as PISA (The Programme for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study). Many countries participate in these international assessment studies to track their rank in international settings so that they can monitor their progress among other countries, and examine the reasons behind differences. Countries prepare their national reports (for example see Yıldırım, Yıldırım, Ceylan & Yetişir, 2013) using the data of these international studies to monitor their educational systems.

Student achievement is affected by many factors from different sources such as personal, home, community and school factors. Different researchers in different countries conduct studies considering different factors which explain the cause of achievement gaps in the education literature, and which develop different models to explain the factors affecting academic achievement. Some of these studies (e.g. Coleman et al., 1966) pointed out that school has little role in explaining student achievement compared with student demographics and home environment. Edmonds (1979) put emphasis on school-related factors, explaining effective school characteristics such as strong principal leadership, high expectations for student achievement, emphasis on basic skills, an orderly environment, and frequent and systematic evaluation of students. Walberg (1986) also put emphasis on the relationship of school-based factors and socio-environmental factors with academic achievement. In addition to these factors, Koutsoulis and Campbell (2001) added factors related to family background, parental support, and student motivation such as self-concept and attitude toward school to Walberg's model. The literature shows that all these factors have direct and indirect effects on the science and mathematics achievement of students (Wang, Haertel & Walberg, 1993). Drawing upon the literature, this study places a specific focus on the influences of family resources, student factors and school climate on the mathematics achievement of students.

The purpose of this study is to compare and contrast the effects of individual student and school factors related to environmental and affective characteristics on the mathematics achievement of eighth-grade students in Turkey, Singapore, the USA and Finland. Comparative research about these countries is important to see what contributes to the quality of education for the development of the countries. The student-level factors were determined as socioeconomic status (SES) of families, bullying at school, like learning mathematics, self-confidence in mathematics, engaged mathematics learning and parent education level. The school-level factors were school emphasis on achievement, school resources, disciplinary climate and safety of school, and school composition by students' economic background. These multilevel effects were examined through Hierarchical Linear Modelling (HLM) using the Trends in International Mathematics and Science Study (TIMSS) 2011 eighth-grade database.

The key objectives of the TIMSS (Mullis, Martin, Foy & Arora, 2012) describe the context in which the teaching and learning process of mathematics and science take place, and assess the changes in the mathematics and science achievement of students over time. The TIMSS 2011 data for the four countries were examined through HLM to answer the following research questions:

1. How much do schools vary in their mean mathematics achievement in Turkey, Singapore, Finland and the USA?
2. Which student- and school-level factors are significantly related to the mathematics achievement of eighth-grade students in Turkey, Singapore, Finland and the USA?
3. How much of the variance in student achievement is explained by student- and school-level factors within and across these four countries?

Literature Review

The teaching and learning process is a complex event, and it is influenced by many factors directly and indirectly. Although there is no one single model that completely explains how learning takes place, it is clear that learner characteristics and school factors are important elements in the teaching and learning process.

Previous studies have shown that socioeconomic status (SES) is strongly associated with student outcomes (Şirin, 2005). In the studies, it was mentioned that parents with high SES were able to provide their children with high quality materials to encourage them in their various learning activities and that the SES of parents greatly influenced the academic performance of their children in English and mathematics (Olatunde, 2010). Previous studies also suggest that besides the socioeconomic background of students, that of their peers' socioeconomic, namely the socioeconomic composition of schools, also affects student achievement (Agirdag, Van Houtte & Van Avermaet, 2012). Parent education level is also related to the educational success of an individual (Sandefur, Meier & Campbell, 2006).

There is a positive relationship between affective characteristics and mathematics achievement. Although affective characteristics about mathematics achievement is a broad domain and measured by several dimensions in mathematics attitude scales (Fennama & Sherman, 1976), especially two of the dimensions, namely self-confidence and like learning mathematics, are mostly related to mathematics achievement. Self-confidence is the perceived ease, or difficulty, of learning mathematics, and like learning mathematics means the affective, emotional and behavioral reactions of students concerning their interest in learning mathematics. There is a positive interaction between both mathematics attitude and mathematics achievement (Ma & Kishor, 1997a) and self-confidence in mathematics and mathematics achievement (Ma & Kishor, 1997b). The positive relations between mathematics attitude and mathematics achievement in general and self-confidence in mathematics and mathematics achievement in particular have been documented for also the problem solving context (Hembree, 1992). As regards the TIMSS context, a positive association between both factors and mathematics achievement has also been found (Shen, 2002; Wilkins, 2004).

Bullying at school also affects student success at school. Students in classes where physical or verbal aggression is more common have lower achievement levels than students in less violent classroom settings. The most common and frequent forms of bullying found in the evidence are insults, name-calling and nicknames; hitting, direct aggression and theft; and threats, rumour-spreading and social exclusion or isolation. Studies support the conclusion that primary students who have been bullied at school show significantly poorer mathematics and reading achievement than those who have not, and both being bullied and witnessing the bullying of a classmate have a negative impact on achievement levels (Roman & Murillo, 2011).

Student engagement is another factor which is defined as the level of participation, and intrinsic interest that a student shows in school. It includes behaviours such as persistence, effort, motivation, positive learning values, enthusiasm, and interest (Gibbs & Poskitt, 2010). It is expected that engaging students during the learning process leads to success and more learning, both inside and outside school. Studies showed that student engagement is fundamentally important in promoting achievement (Patrick, Ryan & Kaplan, 2007; Shernoff & Schmidt, 2008).

The relationship between school resources, (e.g., textbooks, computers, calculators, the number of pupils per teacher) and student achievement is one of the most debated issues in education which is of particular interest to policy-makers who are responsible for making decisions regarding the allocation of resources to schools. There are inconsistent results about the relationship of school resources and academic achievement. While there are studies which concluded that there is no strong and continuous link between school resources and the academic performance of students (Hanushek, 1997), some studies showed that expenditures per student had a relatively large degree of positive effect on the academic performance of students (Hedges, Laine & Greenwald, 1994).

Academic emphasis of school is another key variable in explaining student achievement. Setting achievable high academic goals for students leads to an orderly and serious learning environment; motivated students working hard; and higher academic achievement (Hoy, Tarter & Kottkamp, 1991). Literature related to the relationship of academic emphasis and achievement leads to consistent results that at all levels of education, i.e. elementary, middle and high school, academic emphasis and achievement were positively related, even controlling for socioeconomic factors (Hoy, 2012; Goddard, Sweetland & Hoy, 2000).

The school discipline and safety characteristics of a school also explain some of the variance in student achievement among schools. In schools where the disciplinary climate is strong, students perform better both behaviourally and academically (Kim, Namgung & Kang, 2004; OECD, 2004). There are studies addressing the influence of school safety conditions on student achievement. In these studies, violence has been found to hinder cognitive, social, and emotional development (Prothrow-Stith & Quaday, 1995). In more violent schools, students have less time to focus on academic activities as they are concerned about other factors and personal safety issues (Kimweli & Anderman, 1997; Prothrow-Stith & Quaday, 1995). So it can be argued that unsafe school conditions have a negative impact on the academic achievement of students.

Methods

This study is an exploratory study that utilized the TIMSS 2011 data. Different factors at student and school level were explored through HLM to predict mathematics achievement.

Data Source

This study used the data for eighth-grade students from the Trends in International Mathematics and Science Study (TIMSS) 2011 assessment, one of the largest international comparative studies of mathematics and science achievement to date. TIMSS is an international database that has been collected by the International Association for the Evaluation of Educational Achievement (IEA) every four years since 1995, and that is designed to reveal trends in the mathematics and science achievement of students. TIMSS 2011 is the fifth and most recent one in the series. In addition to measuring the mathematics and science achievement of fourth- and eighth-grade students, TIMSS 2011 collected information from students, teachers, and school principals about mathematics and science curricula, instruction, home contexts, and school characteristics and policies in more than 60 countries around the world.

In this study, the data was gathered through the student questionnaire, the school questionnaire and the mathematics test in the international database (http://timssandpirls.bc.edu/timss2011/international-database). The mathematics achievement test contains items on numbers, algebra, geometry, and data/chance. The student questionnaire, which was completed by each student who took the TIMSS assessment, was asking about the aspects of home and school lives of students including basic demographic information, their home environment, school climate for learning, and self-perception and attitudes toward mathematics and science. The school questionnaire was completed by the principal of each school participating in TIMSS, and it was asking about school characteristics, instructional time, resources and technology, parental involvement, school climate for learning, teaching staff, the role of the principal, and students' school readiness (Mullis, Martin, Ruddock, O'Sullivan & Preuschoff, 2009).

Sample

The international sample design for TIMSS is generally referred to as a two-stage random sample design with a sample of schools drawn as a first stage, and one or more intact classes of students selected from each of the sampled schools as a second stage (Martin & Mullis, 2012). Four countries, namely Turkey, Finland, Singapore and the USA, were compared in this study. Singapore and Finland were selected because they are the top scoring countries from different continents in all successive cycles of large-scale assessments, both in TIMSS and PISA. The USA was selected in this study both because it is located in a different continent and because it has reformed its education system in the last decade with the No Child Left Behind Act which is similar to the Turkish educational reform focusing on more student-centered learning environments. The numbers of schools and students that participated in the study were as follows:

Table 1.
Numbers of Schools and Students Having Participated in TIMSS in each Country

	Turkey	Finland	Singapore	The USA
Number of schools	239	145	165	501
Number of students	6928	4266	5927	10477

Variables

Dependent variable. The dependent variable in this study was the mathematics achievement scores of students. Due to the use of rotated booklet design, every student was not tested on the same items. Therefore, item response theory (IRT) was used to estimate proficiency scores for each individual student. A range or distribution of plausible values was estimated for each student's proficiency rather than an individual observed score. The TIMSS drew five plausible values (BSMMAT01-05) at random from the conditional distribution of proficiency scores for each student (Mullis et al., 2012). In multilevel modelling, the parameter estimates were based on the average parameter estimates from separate HLM analyses of the plausible values (Raudenbush & Bryk, 2002).

Independent variables. All variables that were included in the study were index variables provided by IEA in the TIMSS international database. The individual items to derive these variables from, and their names and coding in the international database are represented in the following table. Detailed information is available in the TIMSS 2011 international database.

Table 2.

Explanations for Independent Variables

Student level	
Home educational resources (BSDGHER)	This index is based on 8th-grade students' responses to the following variables: number of books in the home; educational aids in the home (computer, study desk/table for own use, dictionary); and parents' education (mother's and father's) [1=few resources, 2=some resources, 3=many resources].
Bullying (BSDGSBS)	TIMSS 2011 created the Students Bullied at School scale based on how often students experience six bullying behaviors: a) I was made fun of or called names; b) I was left out of games or activities by other students; c) Someone spread lies about me; d) Something was stolen from me; e) I was hit or hurt by other student(s); and f) I was made to do things I didn't want to do by other students [1=almost never, 2=about monthly, 3=about weekly].
Like learning maths (BSDGSLM)	Students like learning mathematics: The index was created by TIMSS and based on students' responses to the following five statements: a) I enjoy learning mathematics; b) I wish I did not have to study mathematics; c) Mathematics is boring; d) I learn many interesting things in mathematics; e) I like mathematics [1=don't like learning maths, 2=somewhat like learning maths, 3=like learning maths].
Self-confidence in maths (BSDGSCM)	Students' confidence in mathematics: The index was created by TIMSS and based on students' responses to the following seven statements: a) I usually do well in mathematics; b) Mathematics is harder for me than for many of my classmates; c) I am just not good at mathematics; d) I learn things quickly in mathematics; e) I am good at working out difficult mathematics problems; f) My teacher tells me I am good at mathematics; g) Mathematics is harder for me than any other subject [1=not confident, 2=somewhat confident, 3=confident].
Engaged maths learning (BSDGEML)	Engaged mathematics learning: The index was created by TIMSS and based on students' responses to the following five statements: a) I know what my teacher expects me to do; b) I think of things not related to the lesson (reverse coded); c) My teacher is easy to understand; d) I am interested in what my teacher says; and e) My teacher gives me interesting things to do [low=1, medium=2, high=3].
Parent education level (BSDGEDUP)	Parents' highest education level: The index was created by TIMSS and based on students' responses related to the highest education level of mother or father. [1=some primary or no school, 2=lower secondary, 3=upper secondary, 4=postsecondary but not university, 5=university or higher].
School level	
Emphasis (BCDGEAS)	School emphasis on academic success: The index was created by TIMSS and based on students' responses to the following five statements given by school principals: a) Teachers' understanding of the school's curricular goals; b) Teachers' degree of success in implementing the school's curriculum; c) Teachers' expectations for student achievement; d) Parental support for student achievement; and e) Students' desire to do well in school [1=medium, 2=high, 3=very high].
School resources (BCDGMRS)	School resources: The index was created by TIMSS and based on principals' responses related to how much capacity is available to provide instruction affected by a shortage or inadequacy of the following statements: Instructional materials (e.g., textbooks); Supplies (e.g., papers, pencils); School buildings and grounds; Heating/cooling and lighting systems; Instructional space (e.g., classrooms); Technologically competent staff; computers for instruction; Teachers with a specialization in mathematics; Computer software for mathematics instruction; Library materials relevant to mathematics instruction; Audio-visual resources for mathematics instruction; Calculators for mathematics instruction [1= affected a lot, 2=somewhat affected, 3=not affected].
Discipline and safety of school (BCDGDAS)	School discipline and safety: The index was created by TIMSS and based on students' responses to the following five statements: a) This school is located in a safe neighborhood; b) I feel safe at this school; c) This school's security policies and practices are sufficient; d) The students behave in an orderly manner; and e) The students are respectful of the teachers [1=moderate problems, 2=minor problems, 3=hardly any problems].
School composition (BCDG03)	School composition by students' economic background: The index was created by TIMSS and based on students' responses to the following two statements replied by school principals. Approximately what percentage of students in your school have the following backgrounds? a) Come from economically disadvantaged homes; b) Come from economically affluent homes [1= more disadvantaged, 2= neither more affluent nor more disadvantaged, 3= more affluent].

Data Analysis

Data files used in this study were downloaded from the IEA website (http://timssandpirls.bc.edu/timss2011/international-database). Multilevel modelling was employed because of the nested structure of the data where students (level 1) were nested within schools (level 2). HLM (Hierarchical Linear Modelling) 6.02, which is a multilevel analysis software program that has the capacity to perform integrated analyses for handling problems such as the aggregation bias in standard error estimates and erroneous probability values, was used in order to build a two-level HLM model (Raudenbush & Bryk, 2002). Listwise deletion was performed for the missing data before the HLM analysis. Model testing proceeded in two phases. In the first stage, oneway ANOVA with random effects model (unconditional model) with no predictors at either level 1 or level 2 was built in order to partition the variance within classes and between classes as recommended by Raudenbush and Bryk (2002). This model provided a measure of the variances within and between classrooms for mathematics achievement, and gave the opportunity to investigate the relationship of school factors with achievement. At the second stage (random coefficients model), student- and school-level variables were added to the unconditional model to determine whether their relationships with achievement varied significantly across classrooms (Raudenbush & Bryk, 2002). In order to determine whether there was a multicollinearity problem or not, the bivariate correlations were calculated by SPSS 17. Having all the bivariate correlations among the variables below 0.80 in all countries showed that there was not a risk of multicollinearity problem.

The level-1 and level-2 models in this study are as follows:

Level-1 Model

$Y_{ij} = \beta_{0j} + \beta_{1j}$*(Home Educational Resources) + β_{2j}*(Bullying) + β_{3j}*(Like Learning Maths) + β_{4j}*(Self-confidence in Maths) + β_{5j}*(Engaged Maths Learning) + β_{6j}*(Parent Education Level) + r_{ij}

(i represents the ith student; j represents the jth school; Yij represents the achievement score of ith student in jth school; B_{0j} represents the intercept in the jth school; B_{1j}, β_{2j}, …, β_{7j} represents the beta coefficient for corresponding level-1 variable in the jth school; r_{ij} is the random error in the jth school)

Level-2 Model

$\beta_{0j} = \gamma_{00} + \gamma_{01}$*(Emphasis) + γ_{02}*(School Resources) + γ_{03}*(Discipline and Safety of School) + γ_{04}*(School Composition) + u_{0j}

(B_{0j} represents the intercept in the jth school; γ_{00} is the average intercept across the level-2 schools; u_{0j} is level-2 random effects; γ_{01}, …, γ_{04} represents the coefficient for corresponding level-2 variable in the jth school)

In the analysis, all level-1 variables were group-centered in order to study the effects of the level-1 and level-2 variables independently and to yield more accurate estimates of the intercepts, and level-2 variables were grand-centered (Raudenbush & Bryk, 2002).

Using sampling weight in the estimation of population characteristics is essential due to the sample design of TIMSS. There were several weight variables reported in TIMSS 2011. Since the unit of analysis is student, Student House Weight (HOUWGT), which ensures that the weighted sample corresponds to the actual sample size in each country, was chosen as weight variable (Foy, Arora & Stanco, 2013).

Results

One-way ANOVA with random effects model, which is stated as a first step for the HLM analysis by Raudenbush and Bryk (2002), is used to partition the variance in maths achievement, into within- and between-class components. Since one classroom was selected from each school in TIMSS sampling, it can be interpreted as within- and between-school variances. The results were as follows:

Table 3.
Within- and between-school Variances

Country	Within-school variance	Between-school variance
Turkey	69%	31%
Singapore	59%	41%
Finland	87%	13%
The USA	43%	57%

According to the unconditional HLM results, within-school variance in Finland, Singapore and Turkey was larger than between-school variance. Especially in Finland, most of the variance was within classrooms (87%), among the students in the same school. In the USA, between-school variance was higher indicating that the difference among schools is higher.

Coefficients and their standard errors obtained in the multilevel analysis are presented in Table 4. The explained amount of variances at level 1 and level 2 were also calculated after all student- and school-level factors were included in the full model using the formulas in Willms and Smith (2005).

Table 4 shows that at student level, self-confidence in mathematics and home educational resources positively affected the TIMSS 2011 eighth-grade mathematics scores in all countries. On average, the increases in the mathematics scores, which were associated with one point increase in mathematics self-confidence, were 61 points in Turkey, 27 points in Singapore, 29 points in the USA, 51 points in Finland, controlling for the other variables. The increases in the mathematics scores, which were associated with one point increase in home educational resources, were 17, 10, 10 and 17 points for Turkey, Singapore, the USA and Finland, respectively. Parent education level was also a significant positive factor associated with mathematics achievement except the USA. Like learning mathematics and engaged mathematics learning activities showed different results in each country. Like learning mathematics was a positive factor affecting mathematics achievement in Singapore and the USA. Engaged mathematics learning was a positively associated factor in Turkey but a negative factor in Finland, the USA and Singapore when all the other factors were controlled.

Table 4.
Coefficients and Amount of Explained Variances in HLM Models

	TURKEY		SINGAPORE		THE USA		FINLAND	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Intercept	454.52**	3.56	611.15**	3.98	511.19	2.77	519.44**	2.48
Student level								
Home educational resources	17.48**	3.61	10.23**	2.62	9.68**	1.91	17.39**	3.41
Bullying	-2.05	0.92	-3.63*	1.67	0.65	1.10	-6.72*	2.32
Like learning maths	3.61	2.02	11.91**	1.89	2.49*	1.16	1.44	2.54
Self-confidence in maths	61.36**	2.39	26.68**	1.93	28.87**	1.17	50.56**	2.32
Engaged maths learning	4.74*	2.43	-7.47*	2.32	6.18**	1.22	-6.33*	2.63
Parent education level	4.68*	1.70	3.16*	1.47	-0.41	0.75	4.59*	1.49
SCHOOL LEVEL								
Emphasis	34.91**	6.87	14.52*	5.25	4.11	4.94	10.87*	4.85
School resources	3.91	11.60	-0.93	5.18	5.19	5.30	0.32	4.90
Discipline and safety of school	13.07*	4.96	13.53	7.69	0.73	5.86	10.09*	4.20
School composition	26.42**	5.50	25.88*	5.84	23.59**	3.72	6.88	4.77
Explained variance at Level 1	34 %		25 %		25 %		47 %	
Explained variance at Level 2	36 %		20 %		11 %		6 %	

*Significant at level 0.05 **Significant at level 0.001

At school level, school composition was found to be an effective predictor of the average mathematics score at each school in all countries. In the full model, the intercept of variables at school level can be explained as for every unit of increase in school composition. The mathematics scores of students increased by 26, 26, 24, 7 points for Turkey, Singapore, the USA and Finland, respectively, when all the other variables were controlled. School resources factor was a nonsignificant predictor of mathematics achievement in all models. Every unit of increase in discipline and safety of school factor leads to 13 point and 10 point increase in maths scores of Turkish and Finnish students but a nonsignificant change in scores of students in the USA and Singapore. School emphasis on academic achievement was found to be a significant factor in Turkey, Singapore and Finland.

In the multilevel models of countries, explained variance at level 1 ranged between 25% and 47% of the between-school variance, and explained variance at level 2 ranged between 5% and 36 % as it is seen in Table 4.

Discussion and Conclusion

The major objectives of the study were to examine the effects of home educational resources, like learning mathematics, self-confidence in mathematics, parent education level and student engagement in learning activities which may have nested influences under school emphasis on achievement, school resources, disciplinary climate and safety of school, and school composition by students' economic background, and to compare the tested model in different countries.

Similar to the previous studies on TIMSS and PISA data, it was found that there were some similarities and differences in the factors effecting student achievement from one country to another (Papanastasiou & Zembylas, 2004; Shen & Pedulla, 2000). The reason might be the difference between social and cultural backgrounds, and the development levels of the countries.

The results showed that home educational resources at student level and school composition by students' socioeconomic background at school level positively contribute to the mathematics achievement of students similar to the previous studies in the literature in all countries (Olatunde, 2010). Parent education level was also an effective factor in Turkey, Singapore and Finland. Students from families with more resources, namely home educational resources and higher parental education level, had higher mathematics scores, attended more previleged schools with superior schoolmates, better physical resources, better teachers, and higher academic expectations (Chiu, 2010). Affluent people live in more affluent neighborhoods, send their children to more affluent schools, and support their children more at home, for example by home resources or their education level. As this is the case, there are differences among the schools in the achievement levels based on the socioeconomic level of students.

Self-confidence was another factor which has a great influence on mathematics achievement in all countries. Kadijevich (2006) concluded with the same results in his study including the TIMSS 2003 data of 33 countries. Since self-confidence in learning mathematics was mostly related to mathematics achievement, mathematics teachers may help their students develop and maintain positive beliefs about their mathematical competency. Engaging students in the learning process through learning tasks helps students build their self-confidence in learning mathematics. These activities can be easy enough to be solved by students so that they feel the pleasure of success, and can require them to use knowledge and skills from arithmetic, geometry, or algebra, or a combination of these two or three domains. Designed in this way, these tasks can respect students' knowledge and skills more, and give an opportunity for the further development of students. Although teachers were not included in this study, they have the responsibility to design the activities that increase self-confidence in mathematics (Eisenberg, 1991). Therefore, the pedagogical knowledge of teachers is important to improve the affective characteristics related to mathematics in positive direction.

It was revealed in the study that bullying at student level, and school disciplinary climate and safety at school level were significant predictors of mathematics achievement in Turkey and Finland. Students in schools with high levels of violence will be more apprehensive about their safety, distracted by violent or distracting events within classrooms and the school, and place a lower level of importance on components of learning than students in "safe" middle-level schools (Kimweli & Anderman, 1997). Because students within disciplined schools are not worried about victimization, they probably have more time to focus on academic activities. Educators in these schools would also be able to have more time for teaching, and would need less time for managing with problems among students. Having specific rules and academic traditions in schools is more likely to result in fewer behavioural problems and a greater emphasis on the importance of academic effort and achievement among teachers, students and parents (Newhouse & Beegle, 2006; Opdenakker & van Damme, 2006). This might partly explain the fact that schools which had a stricter disciplinary climate and which were safer had higher mathematics achievements (Shin, Lee & Kim, 2009) in the present study. School principals should have the ability to perform better leadership for their schools through in-service trainings.

School emphasis on academic achievement also found to be having a great effect on student achievement. Studies concluded that elementary schools with strong academic emphases positively affect achievement for poor and minority students (Hoy, 2012). Schools should emphasize the academic success of students. The role of the school principal and his/her instructional leadership, engaging in professional development activities to improve learning for all students; creating a school climate that encourages every child to succeed; holding all students to high educational standards and communicate the belief that all students can succeed; providing all students with opportunities for academic success; providing assistance as needed for students to achieve success are very important in increasing student achievement level (NCREL, 2011).

The variable of school resources had no significant effect in any of the countries. There were also incosistent conclusions in the literature related to this variable (Hanushek, 1997; Hedges, Laine & Greenwald, 1994). Controlling for other variables in the model, namely home educational resources, parent education level and school composition, may lead to this conclusion. More studies should be conducted to investigate the effect of school resources on achievement.

In conclusion, identifying the factors lying under low academic achievement is important for all stakeholders of the educational system. The study revealed that home educational resources and student self-confidence were the most influential at student level, and school emphasis on success and school composition by students' economic background were more effective at school level. So the results of the study are consistent with the literature. The study explains some of the factors that are expected to have practical implications. However, the variables included in this study were not enough to explain all the variance. Further studies should also be carried out with different student- and school-level variables to reveal the causal relationships among them.

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