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The connection between school and student characteristics with Mathematics achievement in Turkey*

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Abstract

This study aims to investigate the effects of school-level and student-level variables on Mathematics achievement of Turkish students. The study adopted quantitative research design. The participants were composed of 4498 students in 146 schools. Both schools and students were selected randomly, and they took part in the study on voluntary basis. The data were collected using a school questionnaire, student background questionnaire and Mathematics achievement test of "Trends in International Mathematics and Science Study". The data were analyzed via Hierarchical Linear Modeling. The results showed that 45% of variance between schools, 54.6% of the variance was in schools, 57.33% of school the variance in Mathematics achievement accounted by principals' report on percentages of students coming from economically disadvantaged homes, parents to volunteer for school programs, school resources for mathematics instruction and principals' perception of school climate.

Keywords: Trends in International Mathematics and Science Study (TIMSS 2007), mathematics achievement, hierarchical linear modeling (HLM), factors

1. Introduction

School has an important portion, far less than do factors at the class-level, either students' mathematics achievement (MA) or failure since students have completed their instruction in that environment (Howie, 2003; Sammons, 1999; Teddlie & Reynolds, 2000). Effectiveness of observable and quantifiable traits in and approaches of school principals enchain student achievement (Anderson, 2008). The school effectiveness refers to several factors that may be helpful to understand why some schools attain higher achievement levels than others, with the broader social and economic context in which the schools operate, the curriculum, teacher quality, and school resources (Reynolds &

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Teddlie, 2000, as cited in Ramirez, 2006). School characteristics may affect not only the average level of attendance or achievement (within-school slopes) (Bourke, 1986) but also the relationship between individual-level variables with school-related factor as school characteristics, the role of principal, parental involvement, school climate for learning, eight grade instruction, eight grade teachers, student behavior, resources and technology (Philips, 1997), environment, principals, duties of principals, school climate, socioeconomic status of school (Campbell and Abbot, 2006, Chernickovsky, 1985; Lee & Loab, 2000; Lee & Smith, 1995; Ramirez, 2006). Factors affecting MA examined in categories as home background, home-school interface, school size and location, school social climate, instructional activities in mathematics class and affective variables. Academic achievement at any point is a cumulative function of current and prior family, community, and school experiences. A vast array of characteristics and constructs that have been shown to influence achievement: attitude (Ma, 1997), beliefs (Kloaasterman, 1995; Schoenfeld, 1985; Garafalo, 1989), gender (Benbow & Stanley, 1980; Fennema & Carpenter, 1981), parent education (Ethington & Wolfe, 1984; Ma, 1997, Meece et al., 1982; Tasi & Walberg, 1983), employment (Greenberger & Steinberg, 1986), homework (Keith & Cool, 1992) and school size (Lee & Smith, 1997).

The World Bank (1995) listed libraries, time on task, homework, textbook provision, teacher knowledge, teacher experience, laboratories, teacher salaries, and class size as important for effective schooling in developing countries. Leadership, organization, management were identified as important factors by school effectiveness researchers, whilst school improvement concentrated on decision-making, within-school hierarchy, and communication (Gray et al., 1999). Other influential factors were teacher expertise and competence, strong leadership, clear organization of the school day and the learning program (time and opportunity) and community and parental involvement in school governance (Muller & Roberts, 2000). TIMSS 1999 indicated that teacher education, the frequency of assigning homework, and school autonomy improve MA which depends mainly on mathematics curriculum contents, school equipment, use of computer and calculator in teaching and learning, mathematics teachers' preparation and experience, students' motivation and their level of educational aspiration, parents' educational level, etc. Disruptive students had a statistically significant negative relationship to the students' test results (Jürges & Schneider, 2004 cited in Mikk, 2006). A strong relationship of teacher and parent education, the students' safety in schools were revealed with TIMSS data of Lithuania and the economically developed counties (Mikk, 2006). Mathematics instruction time had no correlation among countries with the higher TIMSS score but in Lithuania, the comparison revealed a positive relationship between these variables (Mikk, 2006).

1.1. School-Related Factors

1.1.1. School Characteristics

Structural characteristics of the schools have an important impact on the lives of the school members' principals, administrators, teachers, students. The characteristics of school have an influence on students' achievement. School characteristics are school location, school size (total school enrolment of all grades), type of students' background of economic influence, type of students' background of disadvantages. Firstly, school location influences MA of students who were living in rural areas possess high achievement levels than urban areas. Children in larger villages and of the freehold and Barolong farms are more likely to be enrolled in school than children in rural areas (Campbell and Abbot, 1976). Moreover, children living in large villages, both those in school and those out of school have higher average levels than children living in small villages after controlling variables (age, sex, etc.) (Chernickovsky, 1985).

School size, was the second of school characteristics, has an influence on achievement directly or indirectly through teacher attitudes (Lee & Smith, 1995). Lee and Loeb (2000) analyzed teachers and students were influenced by the size of the inner-city elementary school in which they belong. In small schools, teachers had a more positive attitude about their responsibility for students learning, and students learn more. Small schools were favored compared with medium-sized or larger schools. Thirdly, SES has long been offered as a primary factor that contributes to differences in achievement (Thomas, Sammons, Mortimore, & Smees, 1997 as cited in Ma, 2001). Ma and Klinger (2000) examined effect of student background, school context, and school climate effects on 6th-grade student achievement in mathematics, science, reading, and writing by using HLM in New Brunswick School Climate Study that were used to gender, socioeconomic status (SES), and native ethnicity were significant predictors of academic achievement. Schools showed the largest variation in mathematics. Schools mean SES and disciplinary climate, school size, and parental involvement was significant in mathematics.

1.1.2. Parental Involvement

Parental involvement can be in the areas of checking homework, volunteering for field trips, and fundraising. Parents also can get involved in the decision-making or administrative processes of the school (e.g., selecting school personnel, reviewing, or making decisions for school finances, etc.). When parents are actively involved in their child's education, student academic achievement is increased and improved student attitudes (Fiala & Sheridan, 2003; Jones & White, 2000; Zellman & Waterman, 1998). Goldring & Shapira (1996) explored the dynamics of purposeful leadership and parental involvement, two central components of effective schools. The results of four case studies were presented that consider the ways in which principals work with parents in schools that had a shared, consistent mission. The case studies revealed that principal-parent interactions were the result of unique processes in each school and were negotiated and institutionalized over time.

Ho and Willms (1996) identified four dimensions of parental involvement and assessed the relationship of each dimension with parental background and academic achievement for a large representative sample of US middle school students. Schools varied somewhat in parental involvement associated with volunteering and attendance at meetings of parent-teacher organizations, they did not vary substantially in levels of involvement associated with home supervision, discussion of school-related activities, or parent-teacher communication. School-related activities at home had the strongest relationship with academic achievement. Parents' participation at school had a negligible effect on MA.

Zhao and Akiba (2009) examined the level of school expectation for various types of parental involvement in the US and South Korea and the relationship among school characteristics, expectations for parental involvement of 8th-grade students' MA by using the TIMSS 1999. Teacher collaboration and school disorder problems were two school factors associated with the level of school expectations for parental involvement in both countries. Moreover, school expectations for parental involvement were significantly associated with higher MA in the US but not in South Korea.

1.1.3. School Climate for Learning

Investigations have revealed that the school climate influences educational achievement (Schmitt et al., 1999). Good classroom climate fosters teach (O'Dwyer, 2005). On the other hand, disruptive students had a statistically significant negative relationship with the students' test results (Jürges and Schneider, 2004, cited in the Mikk, 2006). Student misbehavior occurs at the beginning and end of the lesson, during downtime and transition (Muijs & Reynolds, 2003). To avoid or minimize students' misbehavior, teacher sets the rules at the beginning of the semester. Students should be helping to set rules and they obey the rules. The reasons why the classroom environment needs rules should be explained to students. Mullis et al. (2004) examined the Lithuanian students' safety condition by TIMSS. Safety in schools (have you been hurt by other students, have you been left out of activities, etc. which considered high if the students answered "no" to five questions) was an important correlate of TIMSS results. The Lithuanian students assessed the safety in schools higher than the international average (0.73δ) and this was the reason for high TIMSS results in Lithuania.

Philips (1997) concluded that the coefficient of teachers' caring for students is not only negative but reliably different from zero. Results suggested that students who attend schools in which teachers seem to care a lot about them tend to have higher MA by the end of 8th-grade than they would if they attended schools in which teachers apparently cared less. This may just mean that schools in which students have fewer personal problems teach more mathematics. Students are less likely to be absent when they attend schools where a larger proportion of eighth graders take algebra and where teachers expect them to graduate from high school and college.

TIMSS 1999 data of the USA, Chile, Hungary, Israel, Netherlands, and Taiwan which were chosen for geographical, cultural, and sociopolitical representation of various regions around the world, analyzed for school-related predictors as their varying levels of student fear of school violence, and their differences in education and school systems, which will provide rich and diverse knowledge as to what actions need to be taken to reduce student fear of school violence (Akiba, 2008). Examination of school characteristics associated with student fear in six countries. Indicators of school disorganization predicted greater fear of violence among students in the USA, Chile, Israel, Netherlands, and Taiwan. Disorderly classroom and school environments predicted a higher level of student fear of becoming victims of school violence in these countries.

1.1.4. Resources and Technology

Resources of a school are a part of materials available to school which allow it to capacity to provide instruction. Lee and Smith (1995) found positive effects of school restructuring on achievement by using the National Education Longitudinal Study. A broad range of resources were positively related to student outcomes, with effect sizes large enough to suggest that moderate increases in spending may be associated with a significant increase in achievement (Greenwald, Hedges, Laine, 1996). Relations of student performance with schools' resource grants and teacher characteristics was that resources seem to be positively related to student performance, once family-background and institutional effects were extensively controlled for in terms of the quality of instructional material and of the teaching force (Fuchs and Wößmann, 2007).

Textbooks determine the results of learning as much as teachers' qualifications (Gopinathan, 1989, cited in the Mikk, 2006). Textbooks, teacher quality, and time were identified as being key factors emerging from school instructional effectiveness research (Creemers, 1996; Riddell, 1997 as cited in Howie, 2003).

Size of classroom affects the students' achievement. According to IEA, TIMSS participating countries with larger class sizes than international average class size has higher achievement levels than the international average. The significantly greater percentage of students in high achieving schools were in larger than average mathematics classes in Australia, Canada, Lithuania, Czech Republic, Korea, Belgium (Fr), Netherlands, Belgium (FI), Hong Kong. The academic press was both positively related to average MA and most strongly related to the MA of students who enter middle school with low scores (Philips, 1997).Reducing classroom size increased the students' achievement since teachers' deals with fewer students. Teachers can spend more time with individual students, so the class size promotes academic achievement. 7th-grade low achieving students in the small-sized classroom benefited more since teachers spend more time with individual students and teachers did not use the extra time for the new material (Betts and Shkolnik, 2000). Stasz and Stecher (2000) researched that teachers in reduced and non-reduced classes (with maximums of 20 and 33 students, respectively) covered the same general topics in mathematics and did so for similar amounts of time. Some differences appeared in teaching practices; particularly teachers in small classes spent less time disciplining students and taught to the whole class less often. Also, students in small classes carried out more activities that are consistent with curriculum reforms in reading and mathematics, such as writing narrative pieces in language arts and playing mathematics games and using patterns to find relationships in mathematics.

Class size affects research with the Tennessee' Project Star which was a longitudinal study between 1985 and 1989. Finn and Achilles (1999) were used in the developed version of that project. Small class size increases student math performance in the primary years of the education by one-third of a standard deviation while comparing students with their peers in regular classes with and without aids. The correlation between class size and achievement changed from insignificant to significant negatively when the student ability is directly controlled (Bourke, 1986). The class size has a minor effect on achievement (Greenwald, Hedges, and Laine, 1996). Moreover, smaller class size has a positive effect on students' achievement estimated by a reduction in primary-school class size by one-third, from about 23 to about 15 students per class led to an increase in student performance by about 22% of an SD in test scores with the Project Star in Tennessee (Krueger, 1999). Pong and Pallas (2001) examined the relationship between class size and eight grade MA in the USA and abroad. Class size tends to be greater and more homogenous in centralized education systems compared with those in decentralized systems. After controlling for possible confounding characteristics of the teacher, school, and classroom, in no other country than the USA did they found a beneficial effect of small classes.

Students' behavior may provide a framework for the effect of class size on student achievement. Teachers spend less time on classroom order and management in smaller classes (Betts & Shkolnik, 1999; Rice, 1999; Stasz & Stecher, 2000). Students in small classes were more engaged in learning behavior and display less disruptive behavior compared to students in large classes (Finn, Pannozzo, & Achilles, 2003). Moreover, there was no evidence of class-size effects on student achievement in either reading or mathematics and class size is equally insignificant for students from different race/ethnic, economic, and academic backgrounds (Milesi & Gamaron, 2006). No additional advantage of class size for low-achieving students (Nye, Hedges, & Konstantopoulos, 2002). Jürges and Schneider (2004) revealed no relationship between class size and the students' performance. Bigger classes are in bigger schools and the students of them have a higher achievement indicator. They concluded that "it is hard to find any systematic effect of interesting variables such as resources, decentralized decision-making or central exit examinations on average student performance." The availability of school resources for mathematics was not a strong predictor of the differences in achievement between schools (O'Dwyer, 2005).

1.2. Studies about the Student Related Factors

Socio-economic status (SES) of families has a positive relationship on the students' achievement. The correlation between SES and student academic achievement is around 0.3 at the individual level. When the school is the unit of analysis, then the correlation coefficient is around 0.7 (Yang, 2003 as cited in Mikk, 2006). Average socioeconomic status was significantly related to average MA for high school students in previous studies (Lee & Bryk, 1989; Raudenbush & Bryk, 1986). Lytton & Pyryt (1998) examined what factors beyond social class account for between-school variation in achievement by analyzing the school-by-school achievement test results in mathematics for 3rd and 6th-graders in all elementary schools of the Calgary Board of Education. Social-class variables (average family income of the catchment area of each school and a social adversity index) explained up to 45% of the variation in achievement, so in Canada between 35% and 50% of the variation in elementary students' academic achievement can be attributed to SES.

Hammouri (2004) scrutinized the effects of student-related variables on MA with the TIMSS data of 13-year-old 3736 Jordanian 8th-graders by a structural equation model. Affective variables were educational aspiration, attitude, success attribution, confidence in ability, and perception of the importance of mathematics. Four attitudinal and motivational variables had strong positive total and direct effects; and two variables had negative total and direct effects on MA.

Ramirez (2006) investigated the likely important causes for low MA of Chile in TIMSS 1999 by comparing to South Korea, Malaysia, the Slovak Republic, and Miami-Dade County Public These countries had large school systems that had similar economic conditions but superior mathematics performance. Chilean 8th-graders had parents with fewer years of schooling and with fewer educational resources at home. Chilean mathematics curriculum covered less content and fewer cognitive skills; and the insufficient official curriculum translated into a weaker curricular implementation. School assets were unequally distributed across social classes, with schools in socially advantaged areas more likely to have their own mathematics curriculum and better prepared teachers who emphasized more advanced mathematics content. Schools with their own mathematics curriculum and whose teachers covered more advanced content had significantly higher in students' MA.

Birenbaum, Tatsuoka and Xin (2005) compared MA of 8th-grader from the USA, Singapore, Israel by applying a diagnostic model for TIMSS. Comparisons were made on the mastery probabilities for content, skills, and cognitive processes underlying students' performance and the proportions of students from these samples in each of eight hierarchically ordered clusters of knowledge states by using TIMSS 1999. USA and Israel had relative strength in most content and special skills but with a considerable deficiency in mathematical thinking skills such as logical thinking pattern recognition, which involves inductive thinking, open-ended items, which involves divergent thinking, and data and procedure management. The average student in the USA and Israel was taught relatively well in content knowledge and special mathematics skills but not mathematical thinking skills. Singapore's students, conversely, were well taught in these skills as well as in content and special skills.

Antonijević (2004a) examined the Serbian 8th-grade students and the mathematics curriculum context of their MA by using TIMSS 2003. Serbian 8th-graders placed in the zone of intermediate international benchmarking level by 477 points. Statistically significant difference was found in the MA between girls and boys in the Serbian TIMSS 2003 sample, so the girls' average scale score was 480 and the same value for the boys was 473. The achieved results raised many questions about the contents of the mathematics curriculum in Serbia as its quality and basic characteristics of its implementation. Their results can be eligibly used to improve the mathematics curriculum and teaching in Serbian primary school. Moreover, Antonijević (2004b) studied connectedness between using computers and calculators and students' achievement is especially explored and presented in the frame of students' sample in USA, Netherlands, Bulgaria, and Serbia. Using computers and calculators in teaching and its implications to students' 8th grade MA examined by using TIMSS 2003. Using computers in teaching did not significantly contribute to better MA but showed some level of significant influence on science achievement. Moreover, using calculators in mathematics teaching may improve overall achievement.

Ramirez (2005) studied students like and value mathematics by using HLM to predict MA both at the student-within-class and class levels with TIMSS 1999. At both levels, students' perceived difficulty of doing mathematics, expectations for further education, and beliefs regarding the causes of their mathematics outcomes were significant predictors of MA. However, classes having more students liking mathematics had significantly lower mean scores. The socio-economic status of Chilean students' families was important factor in explaining academic achievement. Poorer students accomplish substantially lower achievement levels than their peers from more economically advantaged backgrounds. The result was interpreted as the consequence of the more demanding curriculum and tougher grading standards used in higher-performing classes.

1.2.1. Home Background

The effects of the student home background and the composition of the student body must be considered while studying the effects of school factors on achievement. Student home background covers socioeconomic factors with the parental emphasis on and support academic achievement and was an important predictor of academic achievement (Coleman, 1966; Jencks et.al, 1972; Blakey and Heath, 1992; O'Dwyer, 2005). The index included the educational level of mother and father and the books at home. Parents' education and the number of books at home were significant factors of TIMSS 2003 mathematics results in Lithuania. Jürges and Schneider (2004) have revealed the same factors and computer at home as the facilitators of school performance. The students who always spoke the test language at home scored 15 points higher than the students who never spoke the test language at home.

As an indication of the educational environment, number of books is a good predictor of the MA. The greater the number of books in the home increased the MA. The size of the home incentives as library is a good pointer of an educational environment that values literacy, the acquisition of knowledge, and academic achievement (Papanastasiou, 2008). The numbers of books at home were significant factors of TIMSS 2003 MA in Lithuania (Elijio, Dudaitė, 2005 as cited in Mikk, 2006). The same factors and computer at home as the facilitators of school performance (Jürges and Schneider, 2004).

1.2.2. Presence of Study Aids

Chernichovsky (1985) examined the household demographic of children's schooling on Botswana. Researcher defined household wealth as assets which enhance children's productivity and dominates the wealth effect at the low and intermediate level. The wealth effect appeared to dominate when households are relatively well endowed in the house. Researcher also concluded that when substitutes for child labor are available in the household, children appear to be freed for schooling.

Sukon and Jawahir (2005) examined the home-related factors which influence numeracy performance at the primary level in Mauritius by survey data of 1800 fourth graders among 60 primary schools which was carried out jointly by UNESCO and UNICEF with the collaboration of the Government of Education. They concluded that the level of education of parents, availability of reading materials at home, home possession, parental support in education, and familiarity with English at home are the major causing variation in the children's numeracy achievement. There was a positive relationship between MA and having aids at home (Sukon and Jawahir, 2005).

1.2.3. Level of Educational Attainment of Parents

The level of the parents is another factor that affects MA. The educational background of the family correlates positively and clearly with the MA. Parents with higher educational levels frequently marked greater confidence in their ability to support their school-going children at academic and levels (Chinapah, 1983; Harmon et al., 1997 Harmon et al., 1997).

Chernichovsky (1985) examined the socioeconomic characteristics of children's schooling on Botswana. Postulating a positive wealth effect and negative price effect on schooling were supported by the data. The wealth effect, was affecting the children's schooling, was supported by the level of the education of the head of the household. Educated parents send more children to school and keep them there longer than uneducated parents.

Sukon and Jawahir (2005) concluded the importance of parental support with the related education level of parents on the achievement. Less-educated parents cannot support their children enough. They can offer fewer opportunities to study. Educated parents maintain their children both academically and psychologically. They are aware of the books that they need to buy and help them with their homework. These types of behaviors motivate children to do well in their studies.

1.2.4. Calculators and Computers

Impact of the technology does not appear automatically; the influence of calculators and computers depends on how teachers use that technology in class. Showing positive relationship studies and negative relationship studies exist. Wenglinski (1998) used the 1996 National Assessment of Educational Progress (NAEP) in mathematics, consisting of national samples of 6227 fourth and 7146 8th-graders. Data on the frequency of computer use for mathematics in school, access to computers at home and in school, professional development of mathematics teachers in computer use, and the kinds of instructional uses of computers in the schools were used. They found a negative relationship between the frequency of use of school computers and school achievement. The greatest inequities in computer use were not in how often they were used, but in the ways in which they were used. Pelgrum and Plomp (2002) found a similar result by using international data. Researchers used TIMSS 95 data since the data unique for combining indicators of MA with indicators of the use of computers in school subjects. They found that students who used ICT frequently for mathematics learning had much lower mathematics scores than students who hardly used or did not use ICT. Kozma (2003) examined the findings from 174 case studies of innovative pedagogical practices using technology from 28 participating countries looking at how classrooms worldwide are using technology to change the practices of teachers and students. Other classroom practices were more likely to be associated with certain teacher and student outcomes, at least as they were reported in our case studies. Tool use and tutorials alone may not have as great an impact on student learning as technology-based research projects and technology used to manage information, at least according to self-reports. Wenglinski (1998) found certain uses of technology had a positive effect on achievement. In eighth grade, teachers' professional development in the use of technology and its use to teach higher-order thinking skills were positively related to MA.

1.2.5. Homework

The students' homework was important as well (Dandy and Nettelbeck, 2002). Homework is a complex process by involving different actors (teacher, students, parents), serving various purposes (e.g., achievement improvement, self-regulation), involving tasks of different quality (e.g., routine vs. complex tasks), and impacting the organization of lessons (e.g., discussing, checking). The relationship between homework and student achievement was indicated that students learn more mathematics during middle school when they attend schools where students do more homework (Neuwahl & Van den Bogaart, 1984; Van der Sanden, 1989). The relationship between homework and achievement in the USA as 'checking and grading' of homework seems to be related to achievement (De Jong, Westerhof, & Creemers, 2000). Many studies showed positive relationships between homework (time) and achievement. Conversely, there were indications that homework time is not consistently related to achievement across grade levels (Cooper, 1994) and across nations (Burstein, 1993). Walberg (1984) stated that the effect sizes of key variables in education as homework which was compared to no homework had an effect size of .28. If homework is given frequently the effect size rises to .49. If teachers check and grade homework the effect size is highest (.80).

De Jong, Westerhof, and Creemers (2000) analyzed whether any significant homework characteristics were related to MA in the Netherlands. Teachers hardly check the results of homework individually. Researchers could not find the relation between achievement and checking homework because there was no variance in checking. Researchers found teachers in the Netherlands complain that this was impossible in a situation with large classes and a large workload of lessons each week. More frequent checking was negatively related to achievement (based on partial correlations), indicating that Dutch teachers check whether homework is done more frequently in classes with low ability and low achieving students.

Rodriguez (2004) studied was primarily cross-sectional, examining existing conditions of several student and classroom characteristics and their relationships to student achievement by HLM analyses were conducted to see relations between student and teacher variables with TIMSS data. Rodriguez found the amount of time spent was not always clearly related to achievement. Trautwein et al. (2002) collected data from 1976 German 7th-graders in 125 classes by repeated measurement for analyzing the role of homework in enhancing MA by controlled for prior achievement, intelligence, SES, motivation, and type of secondary school. They concluded monitoring of homework completion did not contribute significantly to MA.

Kiamanesh (2004) tried to identify the number of student factors (35 items) that represented relationships among sets of interrelated variables using Iranian TIMSS 1999 data. The researcher tried to examine the contribution of each factor on explaining the variance of students' MA and the total variance that could be explained by the determining factors. Mathematics self-concept, home background, teaching, and attitude explained 12.3, 5.1, 1.6, and 0.9% of the variance, respectively. The variance explained by press, attribution, and motivation factors, though significant, was negligible, the school climate did not enter in the equation.

Ismail and Awang (2008) studied differences of eighth-grade students MA by using TIMSS 99 of Malaysia. A series of school, home, demographic and socio-economic variables were used to investigate the differences in mean student mathematics scores. Gender, the language spoken at home, expected educational level, family background, and home educational resources and aids had a significant influence on the students' MA levels. Ismail and Awang (2008) examined the effects of students' characteristics and attitudes towards mathematics learning on their achievement of Malaysian 8th-grade students using TIMSS 2003. Background information including the gender of students, parents' education level and whether students speak the language of test at home were assessed in terms of their influence on MA. The number of books in the home, availability of study desks and computers in home were labeled as educational resources while students' attitude taken into account students' educational aspirations, their perception of being safe in school, time spent on mathematics homework, self-confidence in learning mathematics and the value students place on mathematics. Chi-squared tests and odds ratios were used to check the associations and strength of the relationships of these factors with MA. Results explained that except for gender, language spoken at home and time spent on mathematics homework, all the other variables have a significant positive influence in classifying students to low, medium, and high achievers.

In Turkey, some of research was carried using TIMSS data with a combination of variables. Yayan and Berberoğlu (2004) investigated a linear structural model to explain the relationships among a set of latent variables with 240 Turkish schools with 7841 students which were participated in TIMSS-R. Three factors, home family background characteristics, what teachers do in the classroom, and students' affective measures are very crucial variables to explain the achievement in mathematics. Akyüz (2006) investigated the effects of mathematics teacher characteristics on students' MA across Turkey, European Union countries by analyzing the data of student, teacher, and MA in TIMSS-R. Explanatory models were built by using HLM with controlling home educational resources of students. She found that there were some differences in the factors affecting MA significantly among the countries except mean of home educational resources which had positive significant effect on MA in all the countries. In Turkey, the classes of male teachers were more successful and teacher experience, time spent on tests and quizzes, use of textbooks, disciplined class climate and the class mean of home educational resources were found to have a positive significant effect on student achievement.

Alacacı and Erbaş (2009) investigated the effects of certain school characteristics on students' mathematics performances in Turkey in the PISA 2006 by controlling family background and demographic characteristics. Three models of HLM were explained 55%

of the variance is attributable to between-schools and the remaining 45% to individual student characteristics. About two-thirds of the 55% is explained by selectivity in admissions, time to study mathematics and students' SES, gender, and the geographical region.

TIMSS data were used for analyzing of MA because of importance of one of the biggest international survey which Turkey participated in. Some of the studies examine the effects of school characteristics on MA. Moreover, some of the studies analyze the student related factors and MA. None of the studies use the Turkish TIMSS 2007 data for analyzing two level all the school and student related factors together. There should be a need for the analysis of the variance in student achievement between schools and within schools on MA for Turkish of TIMSS 2007. Analysis of the study was also significant since HLM permits multiple covariates statistically controlled within the same analysis. In the analyses, school characteristics were used to predict MA. HLM was used to analyze multiple regressions. The results of the research would be helpful for students, teachers, schools, parents and policymakers for improving MA. The results can be used to support students' attitudes for mathematics and teachers and school for modifying school settings, and adapting teaching activities, policymakers for resource allocation.

This quantitative study aims to explore the school-level factors affecting student level factors and MA of Turkish 8th grade students using TIMSS 2007 data. The study attempts to get an understanding of the school-level factors and their interactions on Turkish MA controlling for student characteristics. Therefore, the following research questions were analyzed using hierarchical linear modeling (HLM) which was selected to investigate the relationships between all these nested variables. Furthermore, the design of the study, which is quantitative research, could also be stated as a correlational study. Each main research question was analyzed separately as follows:

- Which school factors have a significant effect on the mathematics achievement of the Turkish students?
- What proportion of variance in mathematics achievement is explained by school related factors?

Sub-research questions of the study were:

- Are there differences in the students' MA among schools?
- Which school characteristics are associated with the differences in MA in Turkey?
- Which student characteristics are associated with the differences in MA in Turkey?
- Which school characteristics influence, and student characteristics effect the MA in Turkey?

Based on the research questions, following null hypotheses were constructed:

The variability among school means MA is zero.

H_0: Var (B_0) = T=0, Alpha=0.001

The effect of each of the selected school-level variables on MA is zero.

H_0: $\gamma_{1j}= \gamma_{2j}= \gamma_{3j}=......= \gamma_{6j}=0$, alpha=0.001

The effect of each of the selected student-level variables on MA is zero.

H_0: $\beta_{1j}= \beta_{2j}= \beta_{3j}=......= \beta_{12j}=0$, alpha=0.001

2. Method

The study adopted quantitative research design, and the other details of the research method are as in the following:

2.1. Participants

TIMSS 2007 assessed students' mathematics and science achievement over 60 countries at the eight and fourth grade. In each country, nationally representative samples of approximately 3,500 eighth-grade students (13 and 14 years old) students were assessed in about approximately 150 schools. TIMSS used a school frame to correspond to define the target population. School-level exclusions consisted of very small schools (MOS<10), special education schools, and schools that were difficult to reach (traveling difficulties) and within-sample exclusions consisted of functionally or intellectually disabled students. TIMSS 2007 used a two-stage sampling procedure to ensure a nationally representative sample of students. Firstly, schools were randomly selected, explicit stratification by region, for a total of seven explicit strata. Secondly, implicit stratification by school type (public, private), for a total of 14 implicit strata, one classroom was randomly selected within schools. Small schools sampled with equal probabilities. 4498 students who were participated and 146 principals who answered the school questionnaire, teacher questionnaire, student questionnaire, and MA test in TIMSS 2007 were included as the Turkey sample.

2.2. Instruments

2.2.1. Mathematics Achievement Test

MA (TIMSS 2007, International Mathematics Report) was organized around two dimensions, a content dimension specifying the subject matter domains to be assessed within mathematics and a cognitive dimension specifying the thinking processes or domain to be assessed. The content domains at the 8th-grade are number, algebra, geometry, and data and chance. Mathematics framework describes each content domain in terms of specific topic areas covered and the objectives within each topic.

The cognitive domains are the same for both grades knowing, applying, and reasoning. Each cognitive domain is described according to the sets of processing behaviors expected of students as they engage with the mathematics. The emphasis across the cognitive domains is such that many of the items assess the applying or reasoning domains (TIMSS 2007, International Mathematics Report, p. 26). The test included 215 items totaling 238 score points approximately half the items are constructed response and half are multiple-choice. Target percentages of the TIMSS 2007 mathematics assessment devoted to content were as Number 30%, Algebra 30%, Geometry 20%, Data and Chance 20%, Cognitive domains were knowing 35%, Applying 40%, and reasoning 25%. TIMSS 2007 used scale anchoring to summarize and describe student achievement at four points on the mathematics and science scales: Advanced International Benchmark (625), High International Benchmark (550), Intermediate International Benchmark (475), and Low International Benchmark (400) (Olsan et al., 2008).

2.2.2. Student Questionnaire

Students were asked about their home environments and school experiences, and their attitudes toward mathematics by background questionnaires. Home background and attitudes of students as learners in mathematics examined. The number of books in the home, availability of a study desk, the presence of a computer, the educational level of the parents, and the extent to which students speak the language of instruction have been shown to be important home background variables, indicative of the family's socioeconomic status, that are related to academic achievement. Such factors are also indicative of the home support for learning and can influence students' overall educational aspirations. The extent to which employment, sports and recreational pastimes, and other activities occupy the student's time may also affect learning. Creating a positive attitude in students toward mathematics and science is an important goal of the curriculum in many countries. Students' motivation to learn can be affected by whether they find the subject enjoyable, place value on the subject, and think it is important in the present and for future career aspirations. Furthermore, students' motivation can be affected by their self-confidence to teach the subject (TIMSS 2007, Assessment Frameworks).

In the present study, student characteristic variables were such as the highest level of education of either parent, students speak the language of test at home, students' parents born in-country, books in home, computer and internet connection, computer use, index of time students spend doing mathematics homework in a normal school week (THM), index of students' positive affect toward mathematics (PATM), index of students valuing mathematics (SVM), index of students' self-confidence in learning mathematics (SCM), and index of students' perceptions of being safe in school (SPBSS) were used. Reliability and validity indicators for the attitudinal indices were given at the below Table 1.

Table 1. Reliability and validity of indices

		Grade 8		
Code	INDICES	Cronbach's Alpha Between Component Variables	Multiple R between Student Achievement and Component Variables	Percent of Variance in Student Achievement Accounted for by the Component Variables
PATM	Turkey	0.76	0.31	0.10
	International Median	0.81	0.28	0.08
SCM	Turkey	0.76	0.5	0.25
	International Median	0.73	0.46	0.21
SVM	Turkey	0.60	0.19	0.04
	International Median	0.70	0.19	0.04
THM	Turkey	0.09	0.17	0.03
	International Median	0.10	0.11	0.01
PBSS	Turkey	0.58	0.16	0.02
	International Median	0.62	0.16	0.03

2.2.3. School Questionnaire

School questionnaires completed by school principals provide essential information about the school context and the resources available for mathematics instruction. The school factors that were examined in TIMSS were selected on the basis of eighth strands of research: school characteristics', role of principal, parental involvement, school climate for learning, 8th-grade instruction in mathematics and science, teachers in school, student behavior, resources and technology. In the present study, school characteristic variables such as principals reports on the percentages of students in their schools coming from economically disadvantaged homes, principals report on the percentage of students having the language of test as their native language, index of good attendance, principals time spent on various school-related activities, schools encouragement of parental involvement, index of school resources for mathematics instruction, index of teachers' adequate working conditions, school's report on teachers mathematics professional development in the past 2 years, index of principals perception of school climate, Index of Good Attendance at School (GAS), The Index of Availability of School Resources for Mathematics Instruction (ASRMI), The Index of Principals' Perception of School Climate (PPSC). The Index of Good Attendance at School categorizes students according to their school principals' reports on the frequency of students' absenteeism and its severity as a disruptive influence on continuity in classroom and time for learning. Reliability and validity indicators for the attitudinal indices are given in Table 2.

Table 2. Reliability and Validity of Indices

		Grade 8		
INDICES		Cronbach's Alpha Between Component Variables	Multiple R between Student Achievement and Component Variables	Percent of Variance in Student Achievement Accounted for by the Component Variables
GAS	Turkey	0.81	0.17	0.03
	International Median	0.81	0.17	0.03
ASRMI	Turkey	0.82	0.27	0.08
	International Median	0.84	0.18	0.03
PPSC	Turkey	0.84	0.42	0.18
	International Median	0.81	0.23	0.05

2.3. Reliability

At the international level, the reliability of the TIMSS 2007 MA was obtained as 0.88. The reliability of the mathematics scale is 0.91. The reliability values for mathematics scale are quite high values representing high reliability (Olsan et. al., 2008). The reliability of underlying scales was assessed using Cronbach's alpha and the relationship with achievement was summarized by multiple correlations between component variables of the scales underlying indices and achievement (multiple R) and the percent of the variance in achievement accounted for by the component variables (R-square). Confirmatory factor analysis was used to examine the dimensionality of the scales underlying the indices and to present a latent trait measurement model of each scale and it is component variables (Olsan et. al., 2008).

2.4. Data Collection

All the variables in the TIMSS 2007 Student and School Background Questionnaire data files were examined. The variables of the interest were selected from these data files. All the variables are investigated based on descriptive statistical procedures. The descriptive data analyses were conducted to see the response pattern, to understand the results of the analyses, to make appropriate conclusions about the results we got from the analyses, and to discuss the analyses. All these interpretations could lead to conclude, discuss, and interpret the reasons for the study.

There is no need for conducting some of the inferential data analyses such as explanatory and confirmatory factor analyses since the variables are taken from TIMSS 2007. Factors were investigated to get an insight into the school level factors to affect the student-level factors and how the student-level factors influence MA in TIMSS 2007, HLM was selected as a modeling technique since HLM has a nested structure. All the relations between student-level factors, school-related factors and MA could be explored by HLM 5.05. Therefore, HLM for Turkey is performed using HLM to examine relations between student, school-related factors, and MA in study.

2.5. Handling Missing Data

There should not be any missing data codes or blanks in the level-2 files. The missing data analyses were conducted for the level-2 data files for Turkey to estimate the amounts of the missing data in the level-2 variables. The criterion of the missing value percentage is generally 10% for mean replacement. The missing values for the school-level factors range from 0 to 9.6%. There was an exception only in one school variable computer access to the internet had missing value percentage as 11.6. Although that percentage was exceeded the criterion mean replacement was conducted for the missing values of the school-level factors.

2.6. Student and School Level Factors

Twelve student-level factors were included as the level-1 variables in analysis, as: Students speak the language of test at home, Books in home, Computer at home, Internet connection, Highest level of education of either parent, Students' parents born in country, Computer use, Time students spend doing mathematics homework in a normal school week, Students positive affect toward mathematics, Students valuing mathematics, Students self-confidence in learning mathematics, Students' perception of being safe in school.

Sixteen school-level factors were included as the level-2 variables in the analysis. They were: Principals report on the percentages of students in their schools coming from economically disadvantaged homes, Principals report on the percentages of students in their schools coming from economically affluence, Principals' administrative duties, Principals' activity percentages of instructional leadership, Principals' activity percentages of supervise teachers, Principals' activity percentages of teaching, Principals' activity percentages of public relations activity percentages of other, Parents to attend special events, Parents to raise funds for school, Parents to volunteer for school programs, Parents to ensure complete homework, Parents to serve on school committee, Good attendance, School resources for mathematics instruction, Principals' perception of school climate.

2.7. Controlling Variable

It is critical to control for some student factors before attempting to assess the impact of various variables related to school to explore the school effect. In the present study, students' SES, attitudes, and resources were used as a control variable. The choice of the control variable depends on two reasons. Firstly, index variables were used. Secondly, the correlation analyses revealed that there was a strong relationship between these student variables and MA for the Turkey data. Indeed, the student level variable having the strongest relation with MA performance of the students was the mathematics self-efficacy levels of the students in Turkey.

2.8. Centering the Covariates

Covariates at the student level centered at the grand mean for that variable, all the mean overall students in the population. This is consistent with standard practice in the analysis of covariance and has implications for the interpretation of the regression coefficients in the model. This means that, for each school, the intercept of the level 1 model is adjusted for the linear regression of the test scores on that variable, as putting all school means on an equal footing with respect to that variable. In HLM, the adjusted intercepts can be described as "adjusted school means". The variation among adjusted means will almost always be less, and usually less than the variation among the adjusted means (Raudenbush & Bryk, 2002).

2.9. MA Outcome (Plausible) Variables

In TIMSS 2007, not all the students responded to all the mathematics items. Therefore, student proficiencies or measures were not observed for all the mathematics items. Since there were missing data that could be inferred from the observed item responses, several possible alternative approaches could be applied for making this inference. TIMSS used two approaches such as maximum likelihood using Warm's (1985) Weighted Likelihood Estimator (WLE) and maximum likelihood using plausible values (PV). PV is a selection of likely proficiencies for students that attained each score. The PV is not test scores and should not be treated as such. They are random numbers drawn from the distribution of scores that could be reasonably assigned to everyone (OECD Publications, 2002b). Therefore, five overall mathematical literacy PV from PV1MATH to PV2MATH were computed for all the participating students in the TIMSS 2007.

Four models were built to investigate the effects of school-level factors on MA in the HLM analyses for Turkey. Like Turkey HLM analyses in the present study, five overall MA plausible values from PV1MATH to PV5MATH were considered as MA. Student level variables were weighted according to the total weight of student variables. All the four HLM models were conducted for the five MA PV separately, and then the averages of the obtained values from the results of the HLM analyses were calculated. For instance, the first HLM model for Turkey were conducted five times in the consideration of the five MA plausible values and the average values of the obtained results from the five analyses of the first HLM model were calculated and presented as the results of the first HLM model for Turkey. This process was conducted separately for the four HLM models for Turkey. Correspondingly, the process of calculating the average values of the results of the five plausible values for each model was carried with the Turkey data set. Thus, all five MA plausible values were included as the outcome variables in the HLM of Turkey.

3. Results

The MA of Turkish students was analyzed by using four different models by using HLM. The models were given in four sections: one-way analyses of variance with random intercept model, means-as-outcome model, random coefficient model, and an intercept - and slopes- as outcomes model: the effects of school, teacher, and students.

3.1. One Way Analysis of Variance

ANOVA produces practical preliminary information about how much variation in the MA lies within and between schools and about the reliability of each school's sample mean estimate of its true population mean. The research question for ANOVA was whether there are differences in the MA among schools.

The level-1 level: $Y_{ij} = \beta_{0j} + r_{ij}$

The level-2 model: $\beta_{0j} = \gamma_{00} + \upsilon_{0j}$

β_{0j}= Intercept r_{ij} = Student level factor; γ_{00}=Grand Mean

υ_{0j}=Random effect associated with unit j (school)

The results of ANOVA with random intercept model for Turkey were indicated that there were significant differences among schools. The measurement of the variation among schools in their MA mean scores can be calculated. Under the normality assumption 95% of the school mean falls within the range. The grand mean of MA is 438.99 and SE= 6.63 indicating a 95% CI of $425.99 \leq X \leq 451.98$ (Final Estimation of Fixed Effects of MA for All TIMSS 2007 (ANOVA of Turkey) Average School Mean γ00 (df=145) = 438.99, SE= 6.63, t=66.186, p= 0.000). The maximum likelihood estimate of the final estimation of variance components obtained from fixed effects obtained by ANOVA and the intra-class correlation coefficient for students was as: at the student level effect, r_{ij}, σ^2= 7324.46 (SD=85.58) (At the student level sigma squared- within classes) and at the school level, γ_{00} is the variance of the true school means, β_{0j}, around the grand mean. The variance component for the school means, υ_{0j}, is τ_{00}= 6080.76 (SD= 77.97) (between classes) (df (145), X^2 =3450.8, p=0.000). This showed a substantial proportion of variation among schools as estimated by the interclass correlation:

p_ic=τ_00/(τ_00+σ^2/n_j)= 6080.76/(6080.76+7324.46)=0.4536

Hence, 45% of the variance in MA is among schools. The proportion of student-level or within school variance: p_ic=σ^2/(τ_00+σ^2)= 7324.46/(6080.76+7324.46))=0.5463

Hence, 54.63 % of the variance in mathematics achievement is within schools. HLM offers an estimate of the reliability of the sample mean in any school. The reliability is an estimate of the true school mean and is impacted by the sample size within each school. The overall estimate of reliability is the average of school reliabilities $\rho = 0.95$ indicating that the sample means tend to be a reliable indicator of true school means. The equation for determining the reliability of the mean MA within each school is: p=τ_00/(τ_00+σ^2/n_j) . The reliability is affected by the within school size (n_j) of the sample. Consequently, statistics indicated significant variation (X^2= 3450.80, df=145, p=0.000< 0.001) among schools in MA. Findings from ANOVA models showed that the achievements of the school were significantly different in their MA. This also implied that school-level variables might account for the differences in the students' MA.

3.2. Means as Outcomes Model

The second research question of HLM about which school characteristics were associated with the differences in MA in Turkey. In the means-as-outcome model, the level 1 model equation remained unchanged. MA were observed as varying around their school means. The equations to answer this question are:

The level-1 model: MA (Y_{ij}) = $\beta_{0j} + r_{ij}$ the level-2 model:

$\beta_{0j} = \gamma_{00} + \beta_{01}$*(GSB-1) + γ_{02}*(GSB-2) + γ_{03}*(GAP-1) + γ_{04}*(GAP-2) + γ_{05}*(GAP-3) + γ06*(GAP-4) + γ_{07}*(GAP-5) + γ_{08}*(GAP-6) + γ_{09}*(GAP-7) + γ_{010}*(GAP-8) + γ_{011}*(GAP-9) + γ_{012}*(GAP-10) + γ_{013}*(GAP-11) + γ_{014}*(GAS) + γ015*(SRM) + γ_{016}*(PPSC) + υ_{0j}

Y_{ij} = MA

γ_{0j}= The school mean on the MA, rij = Student level factor

γ_{00}= The grand mean for MA. The average of school means on mathematics score across population of schools

γ_{01}=The differentiating effect (DE) of principals' report on the percentages of students in their schools coming from economically disadvantaged homes on school mean on MA

γ_{02}=The DE of principals' report on the percentages of students in their schools coming from economically affluence on school mean on MA

γ_{03}=The DE of principals' administrative duties on school mean on MA

γ_{04}=The DE of activity percentages of instructional leadership on school mean on MA

γ_{05}=The DE of activity percentages of supervise teachers on school mean on MA

γ_{06}=The DE of activity percentages of teaching on school mean on MA

γ_{07}=The DE of activity percentages of public relations on school mean on MA

γ_{08}=The DE of activity percentages of other on school mean on MA

γ_{09}=The DE of ask parents to attend special events on school mean on MA

γ_{10}=The DE of ask parents to raise funds for school on school mean on MA

γ_{11}=The DE of ask parents to volunteer for school programs on school mean on MA

γ_{12}=The DE of ask parents to ensure complete homework on school mean on MA

γ_{13}=The DE of ask parents to serve on school committee on school mean on MA

γ_{14}=The DE of good attendance on school mean on MA

γ_{15}=The DE of school resources for mathematics instruction on school mean on MA

γ_{16}=The DE of on school mean on mathematics achievement principals' perception of school climate on school mean on MA

υ_{0j}=Random effect associated with unit j (school)

The model was first run with all 16 factors, but 3 factors (GAS, GSB-2, GAP-8) were not significant were removed. At the second run with remaining 13 variables (GSB-1, GAP-1, GAP-2, GAP-3, GAP-4, GAP-5, GAP-6, GAP-7, GAP-9, GAP-10, GAP-11, SRM, PPSC) 6 of these variables (GAP-1, GAP-5, GAP-6, GAP-7, GAP-9, GAP-10,) were not significant. Thirdly, running with the remaining seven variables (GSB-1, GAP-2, GAP-3, GAP-4, GAP-11, SRM, PPSC) four of them (GAP-2, GAP-3, GAP-4, GAP-11) were not significant. Finally, Analysis were run with the remaining 3 variables (GSB-1, SRM, and PPSC) and GAP-8. The reason for adding GAP-8 was that all factors were run one by one and these 4 factors were significant with MA. The final estimation of fixed effects obtained from means as outcomes model of Turkey is given in Table 3. All factors will be reexamined during the development of the final full Intercepts and Slopes as Outcomes Model.

Table 3. Final estimation of Fixed Effects Fixed Effect Model for School Means1

	Coeff.	SE	t-ratio	p
INTRCPT2, γ00	439.14	4.82	91.08	0.000
GSB-1, γ01	-36.07	6.61	-5.456	0.000
GAP-9, γ02	-20.15	10.68	-1.88	0.059
SRM, γ03	-18.00	8.13	-2.21	0.027
PPSC, γ04	-28.21	10.05	-2.80	0.005

[1]The school level variables were Grand Mean Centered before analysis

The results indicated a significant association between of principals' report on the percentages of students in their schools coming from economically disadvantaged homes, parents to volunteer for school programs, school resources for mathematics instruction, and principals' perception of school climate on MA. According to the final estimation of variance components obtained from means as outcomes model of Turkey, the residual difference between schools (School mean, υ0j, τ00=3125.42, SD= 55.9) was substantially smaller than the original variance (Level-1 effect, rij, τ00=7324.76, SD=7324.76) resulting from the analysis of variance model (X2=1846.68, p= 0.000). This reduction is due to the inclusion of school related factors. By comparing the τ00 estimates across the two school means (analysis of variance model and means as outcomes model) an index of proportion, the reduction can be developed, or simply, the variance accounted for the school-level factors can be examined.

Proportion of variance explained in $\beta\_0j=\tau\_00/(\tau\_00+\sigma^2)$

Proportion of variance explained in $\beta\_0j=(7324.76-3125.42)/7324.76=0.5733$

This indicates that 57.33% of this between school variance in MA is accounted for by (GSB-1, GAP-9, SRM, and PPSC). Finally, these four school level variables account for all the variation in the intercepts (X^2 =1846.68, df =141, p<0.001).

MA of the Turkish students were predicted by the school variables of GSB-1, GAP-9, SRM, and PPSC in the means-as-outcome model. The proportion of variance explained by the means-as-outcome model of Turkish students' MA was 57.33%. Figure 1 illustrates the model results.

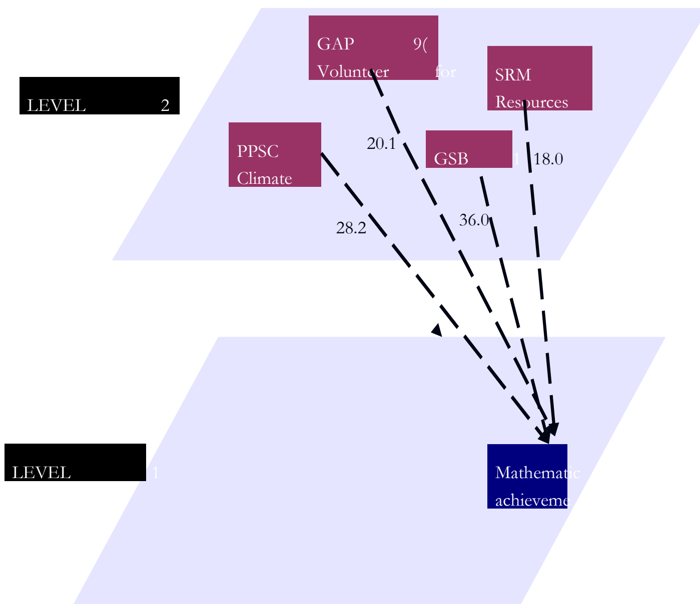

Figure 1. Model 1

3.3. Random Coefficient Model

The fourth research question of HLM analyze, which is called random coefficient model, about which student characteristics that explain the differences in MA in Turkey. Equations to answer this question are:

Level-1 Model

$MA = \beta 0 + \beta 1*(GOL) + \beta 2*(GBO) + \beta 3*(GTH\text{-}2) + \beta 4*(GTH\text{-}5) + \beta 5*(GED) + \beta 6*(GBO) + \beta 7*(GCA) + \beta 8*(MTM) + \beta 9*(MPA) + \beta 10*(MSV) + \beta 11*(MSC) + \beta 12*(GPB) + rij$

The variance of rij, $\sigma 2$, represents the residual variance at level-1 that remains unexplained after considering students' level predictors.

The school level models are:

$\beta_0 = \gamma_{00} + \upsilon_0$, $\beta_1 = \gamma_{10} + \upsilon_1$, $\beta_2 = \gamma_{20} + \upsilon_2$, $\beta_3 = \gamma_{30} + \upsilon_3$, $\beta_4 = \gamma 4_0 + \upsilon_4$, $\beta_5 = \gamma_{50} + \upsilon_5$,

$\beta_6 = \gamma_{60} + \upsilon_6$, $\beta_7 = \gamma_{70} + \upsilon_7$, $\beta_8 = \gamma_{80} + \upsilon_8$, $\beta_9 = \gamma_{90} + \upsilon_9$, $\beta_{10} = \gamma_{100} + \upsilon_{10}$, $\beta_{11} = \gamma_{110} + \upsilon_{11}$,

$\beta_{12} = \gamma_{120} + \upsilon_{12}$ where;

β_{0j}=The mean of MA

β_{1j}=The DE of students speak the language of test at home

β_{2j}=The DE of books in home

β_{3j}=The DE of computer at home

β_{4j}=The DE of internet connection

β_{5j}=The DE of highest level of education of either parent

β_{6j}=The DE students' parents born in country

β_{7j}=The DE of computer use

β_{8j}=The DE of time students spend doing mathematics homework in a normal school week

β_{9j}=The DE of students' positive affect toward mathematics

β_{10j}=The DE of students valuing mathematics

β_{11j}=The DE of students' self-confidence in learning mathematics

β_{12j}=The DE of students' perception of being safe in school

γ_{00} is the average of school mean on MA across the population of schools; $\gamma_{010} - \gamma_{120}$ are the average predictors- MA regression slope across these schools; υ0 is the unique increment to the intercept associated with school j; $\upsilon_1 - \upsilon_{12}$ are the unique increment to the slope associated with school j.

MA was regressed on the student level predictors that were grand-mean centered. The random coefficient model with a significant student-level variable was constructed for MA. The random coefficient regression models were constructed for all Turkish TIMSS 2007 sample.

The building strategy which was recommended by Raudenbush and Bryk (2002) was utilized. The student characteristics were first examined individually (GOL, GBO, GTH-2, GTH-5, GED, GBO, GCA, MTM, MPA, MSV, MSC, GPB) to determine whether they were significantly related to MA and whether or not they were randomly varying. One of these variables individually (MTM) was found to be non-significant and non-randomly varying so they were removed from the model. Eleven of these variables (GOL, GBO, GTH-2, GTH-5, GED, GBO, GCA, MTM, MPA, MSV, MSC, GPB) were found to be significantly and randomly varying. These eleven variables were examined and three (GTH-2, GTH-5, MSV) of these were significantly related to MA and the variables observed to be both significantly related MA and randomly varying. The final estimation of fixed effects obtained from the random coefficient model of Turkey is given in Table 4.

Table 4. Final Estimation of Fixed Effects (Random Coefficient Model of Turkey (Overall mean MA (The student level variables were Grand Mean Centered before analysis)

Fixed Effect	Coefficient	SE	T	p	Approx. df
У00	435.66	4.87	89.29	0.000	145
GOL, B1	-17.19	2.95	-5.81	0.000	20
GBK, B2	7.55	1.41	5.32	0.000	132
GED, B3	-10.56	1.54	-6.81	0.000	145
GBO, B4	-25.80	5.19	-4.96	0.000	18
GCA, B5	-4.46	1.49	-2.97	0.003	62
MPA, B6	-9.54	1.98	-4.81	0.000	145
MSC, B7	-44.30	1.88	-23.44	0.000	145
GPB, B8	-4.94	1.82	-2.71	0.007	145

The student who speak the language of test at home and MA slope coefficient (У10=-17.19, SE=2.95) indicates that students who speak the language of test at home performed significantly differently on MA. The student whose parents born in the country and MA slope coefficient (У20=7.55, SE=1.41) indicates that students whose parents born in the country performed significantly differently on MA. The student whose parents have the highest level of education and MA slope coefficient (У30=-10.56, SE=1.54) indicates that students whose parents have higher level of education performed significantly differently on MA. The student who have books in home and MA slope coefficient (У40=-25.80, SE=5.19) indicates that students who have books in home significantly differently on MA. The student who use computer and MA slope coefficient (У50=-4.46, SE=1.49) indicates that students who use computer performed significantly differently on MA. Students positive affect toward mathematics and MA slope coefficient (У60=-9.54, SE=1.98) indicates that students who have positive affect toward mathematics performed significantly differently on MA. Students' self-confidence in learning mathematics and MA slope coefficient (У70=-44.30, SE= 1.88) indicates students who have self-confidence in mathematics performed significantly differently on MA. Students' perception being safe in school and MA slope coefficient (У80= -4.94, SE= 1.82) indicates students who percept being safe in school performed significantly differently on MA.

The final estimation of variance components obtained from the random coefficient model of Turkey is displayed in Table 5. The df for random effect for Random Coefficient Model is based on the number of schools that had sufficient data to compute a separate OLS regression. Six schools did not have sufficient data; data sets did not give knowledge about these six schools. The intercept and coefficients from the fixed effect portion of the table are based on empirical Bayer estimates which utilize all data. Estimates of variance components for the random effects, and tests of the hypothesis that these variance components are null are also provided. All the factors that were not varied significantly were given in Table 5 (each has a p-value > 0.005).

Table 5. Final Estimation of Variance Components (Random coefficient Model of Turkey) (df=81)

Random Effect	SD	Variance Component	X2	p
School Mean, U0	54.93	3017.81	459.42	0.000
GOL, U1	10.72	115.07	102.60	0.053
GBK, U2	6.40	41.01	91.83	0.193
GED, U3	7.38	54.54	101.16	0.064
GBO, U4	14.10	198.87	86.51	0.317
GCA, U5	7.03	49.44	105.96	0.033
MPA, U6	6.58	43.42	76.53	>.500
MSC, U7	10.75	115.61	110.88	0.015
GPB, U8	7.29	53.23	70.00	>.500
Level-1 R	71.89	5169.56		

The variance explained at the student level can be examined by comparing the variances in the ANOVA and the Random Coefficient Model. The comparison is completed by creating an index of the proportion of reduction in variance at the student level by comparing σ2 estimates from these models. Proportion of variance explained Level-1= =(σ^2 (ANOVA)- σ^2 (RandomCoef.))/(σ^2 (ANOVA))

Proportion of variance explained Level-1= (7324.76-5169.56)/7324.76=0.2942

By including these student-level factors GOL, GBK, GED, GBO, GCA, MPA, MSC, GPB as predictors of MA, within school variance, was changed to 29.42%. Therefore, these factors account for about 29.42% of the student level variances in MA.

For the Random Coefficient Model, it is important to examine the variance of errors, τqq correlations. Tau as correlations obtained from the random coefficient model of Turkey was given in Table 6. A high correlation indicates that essentially the same variation across the school level units is being carried and reduction in the model may be warranted by fixing one of the variables to be non-randomly varying. High τqq correlation was observed between the variables.

Table 6. Tau as Correlations (Random Coefficient Model of Turkey)

	INTRCPT1,B0	GOL,B1	GBK,B2	GED,B3	GBO,B4	GCA,B5	MPA,B6	MSC,B7	GPB,B8
INTRCPT1, B0	1.000								
GOL,B1	0.010	1.000							
GBK,B2	0.178	0.222	1.000						
GED,B3	-0.223	0.423	0.336	1.000					
GBO,B4	0.455	-0.446	0.345	-0.448	1.000				
GCA,B5	-0.034	0.023	-0.142	-0.417	-0.116	1.000			
MPA,B6	0.118	-0.300	-0.009	-0.429	0.510	0.151	1.000		
MSC,B7	-0.786	-0.020	-0.151	0.142	-0.333	0.209	-0.279	1.000	
GPB,B8	0.272	0.210	0.244	0.095	0.186	0.220	0.036	0.152	1.000

The reliability of the intercept and the randomly varying slopes can be estimated. HLM indicated that the intercept is quite reliable (0.725) and the slopes are far less reliable GOL=0.145, GBK=0.143, GED=0.148, GBO=0.085, GCA=0.184, MPA= 0.065, MSC= 0.190, GPB=0.094. Bryk and Raudenbush (2002) defined primary reasons for the lower reliability of the slopes are that the true slope variance of the true means and many schools may be relatively homogeneous on the randomly varying variables. Coefficient reliabilities above .05 are acceptable (Raudenbush and Bryk, 2002). There is a significant difference between schools, even after the student-level predictors held constant these schools varied significantly in their MA. The proportions of variances explained by random coefficient models of MA 29.42%. Figure 2 illustrates the model 2.

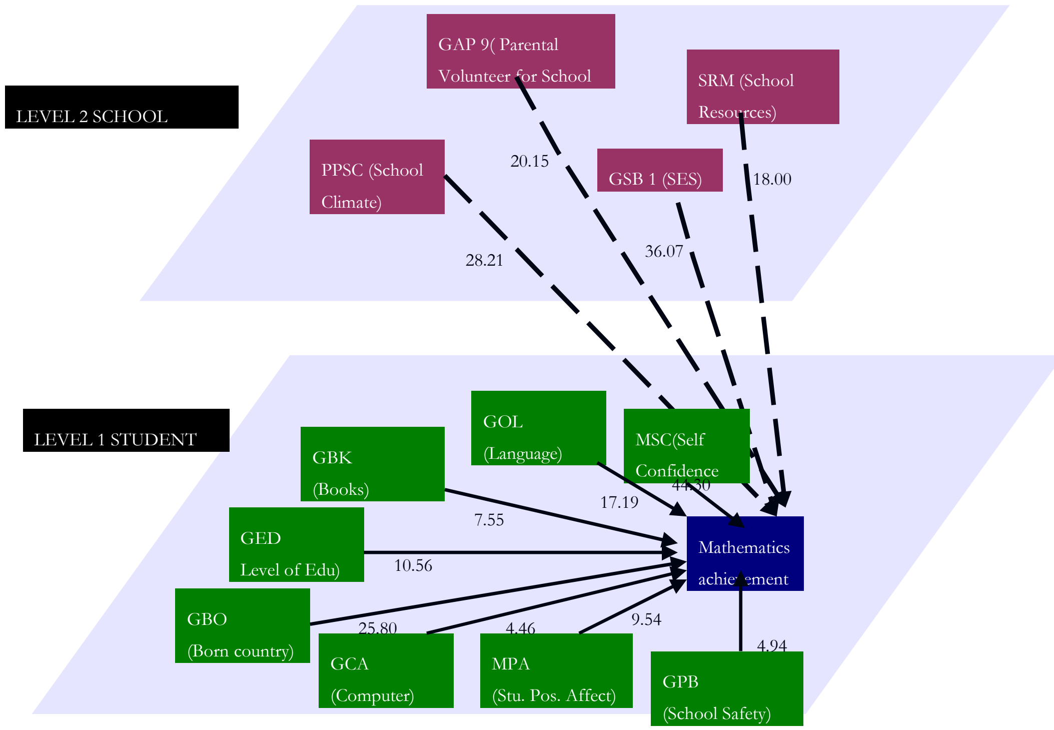

Figure 2. Model 2

3.4. Intercepts and Outcomes Model

The fifth question of HLM is termed as Intercepts and Slopes as Outcomes Model, provided information about which school characteristics influence the effect of student characteristics on MA in Turkey. For this research question, the coefficients (slopes) of the variables were modeled. Simply, the variability in level-1 coefficients from students was examined to ascertain if level-2 (school level) factors explain the variability. The coefficient is an indication of the amount of influence a variable has on the endogenous variable. The level-2 variables that are significantly associated with Level-1 factors are termed as cross-level interactions. Traditionally, there is only one Level-2 equation for each Level-1 Beta value.

This research question incorporates the first three questions and specifically examines randomly varying student-level coefficients, slopes as outcomes that can be examined with school-level variables. The first model was the MA as determined by the ANOVA (Research Question 1). The variability of MA was modeled with school-level variables in the Means as Outcomes Model (Research Question 2). The model is an explanatory model to clarify how differences among schools' characteristics might influence the outcome distribution of the MA of Turkish students within schools.

Student level variables or coefficients were observed to be randomly varying in the Random Coefficient Model (Research Question 4). Due to this variability, these two coefficients become a modeled with school-level variables, i.e., randomly varying coefficients becomes as model. The school-level variables that are observed to be significantly related to the random coefficients are termed as cross-level interactions. This simply means that a school-level variable influences a student-level slope.

The process of determining the final Intercept and Slopes as Outcomes Model begins with the results from the Random Coefficient Model (Research Question 3). The first step was to replicate the Means as Outcomes Model (Research Question 2) and include the significant student-level variables from the Random Coefficient Model (Research Question 3). The full model Intercepts and Slopes as Outcomes Model was analyzed according to group-centered and grand centered means at school-level variables and student-level variables was group mean-centered.

Level-1 Model: MA= $\beta_0 + \beta_1$*(GOL) + β_2*(GBK) + β_3*(GED) + β_4*(GBO) + β_5*(GCA) + β_6*(MPA) + β_7*(MSC) + β_8*(GPB) + r_{ij}

Level-2 Model: $\beta_0 = \gamma_{00} + \gamma_{01}$*(GSB-1) + γ_{02}*(GAP-9) + γ_{03}*(SRM) + γ_{04}*(PPSC) + υ_0 $\beta_1 = \gamma_{10} + \gamma_{11}$*(PPSC) + υ1 $\beta_2 = \gamma_{20} + \gamma_{21}$*(GSB-1) + υ_2 $\beta_3 = \gamma_{30} + \gamma_{31}$*(GSB-1) + υ_3 $\beta_4 = \gamma_{40} + \gamma_{41}$*(SRM) + υ_4 $\beta_5 = \gamma_{50} + \gamma_{51}$*(SRM) + υ5 $\beta_6 = \gamma_{60} + \gamma_{61}$*(GAP-9) + υ_6 $\beta_7 = \gamma_{70}$ + υ7 β8 = γ80 + υ8

Table 7. Tau Correlations

	INTRCPT1,B0	GOL,β1	GBK, β2	GED, β3	GBO, β4	GCA, β5	MPA, β6	MSC, β7	GPB, β8
INTRCPT1,B0	1.000								
GOL,β1	0.255	1.000							
GBK, β2	0.082	0.235	1.000						
GED, β3	0.021	0.338	0.394						
GBO, β4	0.171	-0.139	0.576	-0.134	1.000				
GCA, β5	0.056	0.017	-0.085	-0.498	-0.154	1.000			
MPA, β6	0.219	-0.318	0.013	-0.367	0.417	0.126	1.000		
MSC, β7	-0.702	-0.029	-0.100	0.003	-0.214	0.163	-0.391	1.000	
GPB, β8	0.091	0.341	0.256	0.142	0.085	0.161	-0.008	0.342	1.000

Table 7 are displayed the Tau correlations between the Level-1 variables. The negative correlations between some intercepts and slopes of the Level-1 predictors indicated that if MA high, the effects of negative correlations in those schools are smaller. A high correlation indicates that essentially the same variation across the student level units is being carried and reduction in the model may be warranted by fixing one of the variables to be non-randomly varying. High τ_{qq} correlation was observed between the variables.

Table 8. Reliability Estimates

Random Level-1 coefficient	Reliability Estimate	Random Level-1 coefficient	Reliability Estimate
INTRCPT1, β0	0.643	GCA, β5	0.188
GOL, β1	0.120	MPA, β6	0.067
GBK, β2	0.149	MSC, β7	0.178
GED, β3	0.134	GPB, β8	0.084
GBO, β4	0.045		

Table 8 shows the reliability estimates of the Level-1 variables. The reliability of the intercept and the randomly varying slopes can be estimated. The results provided from HLM indicate that the intercept is quite reliable (0.643) and the slopes are far less reliable GOL=0.120, GBK=0.149, GED=0.134, GBO=0.045, GCA=0.188, MPA= 0.067, MSC= 0.178, GPB=0.084. The primary reasons for the lower reliability of the slopes are that the true slope variance of the true means and many schools may be relatively homogeneous on the randomly varying variables and coefficient reliabilities above .05 are acceptable (Raudenbush & Byrk, 2002).

The results of the final estimation of fixed effects obtained from the full final Intercepts and Slopes as Outcomes Model of Turkey are presented in Table 9 with variables as students speak the language of test (GOL), books in home (GBK), highest level of education (GED), students' parents born in country (GBO), computer use (GCA), students positive affect (MPA), self-confidence (MSC), school safety. PPSC is significantly related to mean of school MA. GSB-1 (γ_{01}= -18.78, SE=4.94), the parent volunteer for school progress (GAP-9) (γ_{02}= -20.51, SE=8.43). the school resources (SRM) (γ_{03}= -12.52, SE=6.65) and the school climate (PPSC) (γ_{04}= -18.91, SE=7.56) was related to school MA. The results from the Random Coefficient Model are reported in the final full intercepts and Slopes as Outcomes Model as well. Students speak the language of test (GOL), books in home (GBK), highest level of education (GED), students' parents born in country (GBO), computer use (GCA), students positive affect (MPA), self-confidence (MSC), school safety (PPSC) are significantly related to MA.

GOL slope coefficient (γ_{10}= 17.04, SE=3.05) is related to MA. Students' speak the language of test is related to the school's PPSC (γ_{11}=6.99, SE= 4.03). Books in home slope coefficient (γ_{10}= 7.48, SE=1.40) is related to MA. Students' books in home is related to school's socio-economic status (γ_{21}=-1.44, SE=1.41). Highest level of education of either parent slope coefficient (γ_{30}=-10.31, SE= 1.56) is related to MA. Students' highest level of education of either parent is related to school's socio-economic status (γ_{31}=2.20, se=1.43). Students' parents born in country slope coefficient (γ_{40}=27.60, se=4.80) is related to MA. Students' parents born in country is related to school's school resources (γ_{41}=-16.32, se=7.06). Computers use slope coefficient (γ_{50}=-4.17, SE=1.49) is related to MA. Students' computer use is related with school resources (γ_{51}=3.8, SE=2.11). Students' positive affect slope coefficient is (γ_{60}=-9.84, SE=1.98) related to MA. Students positive affect is related to parent volunteer for school progress (ɣ61=4.05, SE=3.77). Self-confidence slope coefficient is (ɣ60=-44.12, se=1.90) related to MA. School climate slope coefficient is (ɣ80= -4.83, se=1.79= related to MA.

Table 9. The Final Estimation of the Fixed Effects of Final Full Model

Fixed Effect	Standard Coefficient	Approx. Error	t	df	p
		For INTRCPT1, β0			
INTRCPT2, ɣ00	435.07	4.03	107.95	141	0.000
GSB-1, ɣ01	-18.78	4.94	-3.80	141	0.000
GAP-9, ɣ02	-20.51	8.43	-2.43	141	0.015
SRM, ɣ0	-12.52	6.65	-1.88	141	0.059
PPSC, ɣ04	-18.91	7.56	-2.50	141	0.013
		For GOL slope, β1			
INTRCPT2, ɣ10	-17.04	3.05	-5.58	20	0.000
PPSC, ɣ11	6.99	4.03	1.73	68	0.083
		For GBK slope, β2			
INTRCPT2, ɣ20	7.48	1.40	5.33	141	0.000
GSB-1, ɣ21	-1.44	1.41	-1.02	135	0.307
		For GED-1 slope, β			
INTRCPT2, ɣ30	-10.31	1.56	-6.58	144	0.000
GSB-1, ɣ31	2.20	1.43	1.54	144	0.122
		For GBO slope, β4			
INTRCPT2, ɣ40	-27.60	4.80	-5.74	25	0.000
SRM, ɣ41	-16.32	7.06	-2.31	38	0.026
		For GCA slope, β5			
INTRCPT2, ɣ50	-4.17	1.49	-2.80	66	0.006
SRM, ɣ51	3.8	2.11	1.81	144	0.069
		For MPA slope, β6			
INTRCPT2, ɣ60	-9.84	1.98	-4.96	130	0.000
GAP-9, ɣ61	-4.05	3.77	-1.07	144	0.283
		For MSC slope, β7			
INTRCPT2, ɣ70	-44.12	1.90	-23.16	145	0.000
		For PPSC slope, β8			
INTRCPT2, ɣ80	-4.83	1.79	-2.69	145	0.007

The results of the final estimation of variance components obtained from the full final Intercepts and Slopes as Outcomes Model of Turkey were presented in Table 10. The df for this model is based on the number of schools so 64 of the schools did not have sufficient data to be included. They were not used in this analysis. The proportion of variance explained for each achievement slope model with significant school level variables could be examined. The equation is:

The Proportion of Variance Explained in ßqj =(τ_qq (Random Coef.)-τ_qq (FullModel))/(τ_qq (Random Coef.))

ßqj=MA or the slope of the coefficient for a given variable

The Proportion of Variance Explained in ß0j =(3017.81-1786.25)/3017.81= 0.4081

Table 10. Final Estimation of Variance Components (Final Full Model of Turkey)

Random Effect	SD	Variance	df	X^2	p
INTRCPT1,U0	42.26	1786.26	77	282.02	0.000
GOL, U1	9.45	89.41	80	97.74	0.087
GBK, U2	6.49	42.19	80	90.73	0.193
GED, U3	6.91	47.81	80	97.24	0.092
GBO, U4	9.56	91.41	80	84.11	0.354
GCA, U5	7.11	50.55	80	102.53	0.045
MPA, U6	6.55	42.95	80	76.01	>.500
MSC, U7	10.35	107.13	81	110.75	0.016
PBSC, U8	6.62	43.90	81	70.76	>.500
Level-1, R	71.91	172.40			

The value (0.4081) lower than the one observed in the results Means and Outcomes Model and it was a result of the differences in the samples between two models. Furthermore, 10% reduction in the variance was accounted for other variables. Both proportions showed that amount of variation had been accounted for. Figure 3 illustrates the Model 3.

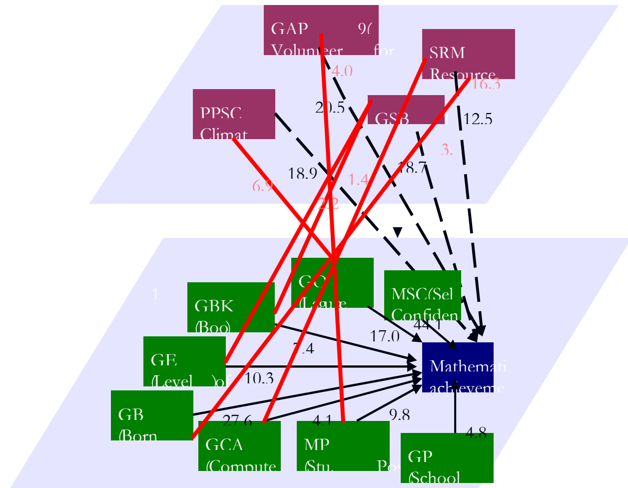

Figure 3. Model 3

3.5. Summary of Results

- 45 % of the variance in MA is among schools.
- 54.63 % of the variance in MA is within schools.
- MA score of the Turkish students were predicted by the school variables of SES, parent volunteer for school progress, school recourses, and school climate in the means-as-outcome model. The proportion of variance explained by means-as-outcome model of Turkish MA was 57.33%.
- Student level factors students speak the language of test, books in home, highest level of education level of either parent, students' parents born in country, computer use, students positive affect, self-confidence, school safety as predictors of MA, within the school variance was changed to 29.42%.
- 40.81% of the variance of MA depends on the school variables of SES, parent volunteer for school progress, school resources, and school climate when student-level variables students speak the language of test, books in home, highest level of education level of either parent, students' parents born in country, computer use, students positive affect, self-confidence, school safety were controlled.

4. Discussion

The study aimed to analyze the student and school-level factors, the interactions of these two levels and their impact on MA. Schools are an important part of the teaching since students and teachers spend most of their time at school. Apart from students and teachers, school administrations and parents and the environment of the school are affecting students' learning environment. Within the education system, these schools and student factors affect achievement.

4.1. Student Level Factors

Eight slopes (students speak the language of test, books in home, highest level of education level of either parent, students' parents born in country, computer use, students positive affect, self-confidence, school safety) were significantly related to MA speak the language of test was significantly related to MA. That is, students who speak the language of test at home were shown more MA than students who do not speak the language of test at home. This expected result is consistent with the results of the previous studies since if student speak the language of test at home, they can learn issues, they can analyze the meanings of words so mathematics in deep, so they show more MA. Ismail and Awang (2008) found no significant difference in the odds ratio when comparing students who are medium achievers and low achievers between students who always speak the language of the test at home and those who do not while the difference was significant when comparing between the medium and high achievers with the low achievers. The magnitude of the relationship between speaks the language of test at home and MA significantly varies from school to school. The reasons for that difference among schools are unknown since there are a lot of factors affecting that difference among schools. This research does not attempt to explain why the impacts of the student level factors are bigger among some schools than others. Further studies are needed to investigate the differences among schools with respect to significant student factors.

Secondly, books in home were found as a significant factor having positive effect on MA. That is, students who have more books in her home were shown more MA than students who have fewer books in their home. This result is consistent with previous studies. This was the expected result since if student has more books, their family's socio-economic status was higher than others. So, their families can reach books and other materials easily. They can learn issues, search these books so they show more MA. More books mean more exercises for practice, and one can only get better at calculations with lots of practice. Ismail and Awang (2008) verified with the Malaysian data from TIMSS 99 that students obtained higher mathematics scores when they have more books at home. The magnitude of the relationship between having more books in home and MA significantly varies from school to school. The reasons for that difference among schools are unknown since there are a lot of factors affecting that difference among schools. The students speak the language of test; this research does not attempt to explain why the impacts of the student level factors are bigger among some schools than others. Further studies are needed to investigate the differences among schools with respect to significant student factors.

Thirdly, highest level of education of either parent was found as a significant factor in having a positive effect on MA. Students whose parents have higher education level have higher MA than students whose parents' education level do not higher. Students from well-educated parents are associated with higher probability of high mathematics performance (Ismail and Awang, 2008). Better educated parents can guide their children in appreciating what they learn, how to learn it, and they can constantly monitor their progress. The magnitude of the relationship between higher level of education of parents and MA significantly varies among schools. Highest education level of parents was affected by MA more in same schools than other schools. As the stated number of books, students speak the language of test at home, the present study, did not attempt to explain why the effect of number of books and students speak the language of test at home, higher level of education of parents are greater than in same schools.

Fourthly, students' parents born in country; it was found a significant factor having effect on the MA. Students whose parents born in the country have higher achievement levels than student whose parents were not born in the country. In fact, students' parents born in the country is closely interrelated to MA. Therefore, that supplies a potential effect on MA.

Fifthly, use of computer was found significant factor affecting MA. Usages of computers affect MA. Students who use computers themselves showed a higher level of MA than students who do not use computers themselves or less usage of computers at school. Computer usage has the highest impact on students' mathematics score (Ismail & Awang, 2008). Computer usage is related to their MA levels. Learning using computers makes it easier for students to visualize and understand mathematics concepts in a much shorter time. Therefore, this influences MA.

Sixthly, students' positive affect toward mathematics was found significant factor affecting MA. It has a positive effect. Students who have positive affect toward mathematics have got higher achievement levels than students who do not have a positive effect toward mathematics. The biggest influence comes from self-confidence in learning mathematics (Ismail & Awang, 2008). In the point of fact, students' positive affect on mathematics is related to mathematics. Briefly, that positive effect on mathematics influences students' MA.

Seventhly, students' self-confidence in learning mathematics was found a significant factor affecting MA. This factor affects students' MA positively. Higher self-confidence in learning mathematics was related to the MA. There was a positive relationship between attitudes towards mathematics and MA (Papanastasiou, 2002). Self-confidence affected positively Iranian students' MA (Kiamanesh, 2004). Students' self-confidence levels affect their MA in developing or developed countries. Moreover, students with higher self-concepts and students, who valued the importance of mathematics, were more likely than their peers with low self-concepts to attain higher mathematics performance (Howie, 2002).

Eighthly, students' perception of being safe in school, was found a significant factor affecting MA. This factor affects positively the MA. Higher achievement levels related with lower levels of students' perception of being safe in school. School climate was influenced by the educational background of students and school climate in turn influences teaching (Papanastasiou, 2002). School climate was not related to the MA for Iranian students (Kiamanesh, 2004).

The reasons of why these slopes varied randomly among schools are difficult to provide. The analysis technology of HLM has the chance of an answer to whether effects of variables vary from school to school or not. To answer the causes of varying slopes among schools, more complete data and more sensitive analyses are needed.

4.2. School Level Factors

School related predictors were significantly related to a student-level slope. Therefore, there was cross-level interaction in HLM of Turkey. When the school level predictors were significantly related to MA in Turkey, four school-level factors were obtained: principals report on the percentage of students in their schools coming from economically disadvantaged homes, parents volunteer for school programs, school resources for mathematics instruction, principals' perception of being safe in school.

Principals' reports on the percentage of students in their schools coming from economically disadvantaged homes contacted with the MA. This negative contact is robustly linked with MA which was supported Lytton and Pyryt (1998). They showed that in Canada between 35% and 50% of the variation in elementary students' academic achievement can be attributed to SES.

While predictor about school characteristics was considered, parents volunteer for school programs was found significantly related to MA. Positive linkage between parents' volunteer for school programs and MA was monitored. Students learn more and perform better in schools that have strong parental involvement (Goldring & Shapira, 1996; Ho & Willms, 1996).

When school resources for mathematics instruction were considered, school resources for mathematics instruction were found significantly related to MA. This positive linkage between parents' support and MA was observed at the study of Kiamanesh (2008). Kiamanesh found a significant effect of teaching aids on MA. Ownership of study aids provides students with the necessary tools for learning mathematics especially when it involves a lot of calculations.

When principals' perception of being safe in school on students' achievement was considered, principals' perception of being safe in school was found significantly related to MA. This positive linkage between, principals' perception of being safe in school and MA was observed at the study was consistent with the previous findings. Conversely, Akiba (2008) found no consistent finding regarding socioeconomic status and academic achievement of students; these factors were not significantly associated with students' fear. Socioeconomic status and academic achievement level are not perceived by students as vulnerable characteristics for violence victimization in many countries examined at study. Overall, principals' reports on the percentage of students in their schools coming from economically disadvantaged homes, parents volunteer for school programs, school resources for mathematics instruction, principals' perception of being safe in the school were significantly related to MA.

4.3. Conclusions

At the student level, students speak the language of test at home, number of books in home, highest level of education of parents, students' parents born in country, computer usage, students' positive affect toward mathematics, students valuing mathematics, students' perception of being safe in school was significantly related to MA. At the school level, principals' reports on the percentage of students in their schools coming from economically disadvantaged homes, parents volunteer for school programs, school resources for mathematics instruction, principals' perception of being safe in school were significantly related to mathematics. HLM separates variation in school variables into between-student and school and then analyzes each component in relation to the other. Hence, HLM can offer better statistical adjustments and more accurate estimations and promote better policies and practices.

4.4. Implications

Identifying the characteristics of the under-achiever students, schools might help to educators, planners, to determine the priorities. Conversely, determining the characteristics of the high achiever students gives a clue for what to do for low achiever students. The results of the study give suggestions for improving mathematics education in Turkey. The contribution of this study is significant in that it was conducted in a country where all 8th grade students follow the same mathematics curriculum.

Parental involvement is important for students' MA, but school administrators do not include parents effectively or parents were less likely to involve schools' activities. Parents' socio-economic status has a negative factor in parental involvement at schools. Parents with higher socio-economic status neither give feedback to schools' administration, but their working conditions usually nor allowed them to participate regularly in school activities. Parental involvement should be satisfied with social activities, not the instructional activities.

School safety and safety learning environments is a major responsibility of the educators. Students should go to school without fear. Ensuring safety learning environments is a major responsibility of school administrators and educators. Educators should know that disorderly climate is affecting not only those who are directly involved but many others who are exposed to a chaotic environment by increasing their level of panic.

Policy makers should support parent involvement at school. Parents should be a part of the school community. Policymakers should give importance to school climate since a positive environment affects students' attitudes toward mathematics and indirectly MA. The results of this analysis on school effectiveness can contribute to the fuller understanding of the complicated issue of school improvement. However, educational effectiveness still demands further theoretical and empirical research. Important issues that require further research are the outcomes, inputs, learning process, and how to promote an active learning environment, both in the classroom and in schools.

4.5. Limitations of the Study

Present study is an associational nature of the HLM, so study does not give much information about the causes and effects of the relationships get. The measurement of the student and school-level variables which were used at the study might be limitation of the study. Since the validity and reliability of the measurement of school and student variables might be unreliable. The reason is that the study is a part of international study and some of the variables might not reflect the exact ones. One of the incorrectly measured variables gives incorrect relationships between variables and MA. One imprecise variable affects other variables coefficients, SD.

One more limitation can be affirmed as a lack of school and student variables. The results of the study showed a great deal of variance by adding or reducing variables from the study. Some of the variables could be added and give much more information about the school. To illustrate school social activities, give valuable information about the school social climate. Teaching patterns and teaching activities gives also valuable information about the students' achievement. By considering these two aspects for school variables, how much-unaccounted variance would have been absorbed by the school level is unknown.

Reduced df can also be a limitation of the study. The reduction of df reduces validity the study. Since the research questions were analyzed with different samples.

Application of the HLM is used in educational research. There is not much information about the assumptions and effects of these assumptions on the results. One more limitation is the model specification. HLM does not examine the bi-directional relationship as structural equation modeling. Because of that bidirectional relationships were not examined in the study. Student variables were not randomly varying with the school and teacher variables.

4.6. Recommendations for Further Researchers

Profundity research is needed to examine the reasons for the relationships obtained in the study. Further research should be conducted to explore the underlying reasons of the relationships between MA and selected student and school-related factors. The study was used the student and school variables and MA as an outcome variable obtained from TIMSS 2007.The same research could be conducted with the upcoming TIMSS data. So, all the results could be tested again on different samples selected from participating countries.

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