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The Impact of Student and School Characteristics and their Interaction on Turkish Students' Mathematical Literacy Skills in the Programme for International Student Assessment (PISA) 2003

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Abstract: PISA is one of the most influential international assessment program for providing feedback to education policy makers in the participating countries. In the present study, HLM analysis was carried out for the Turkish database for deriving findings related to student and school related factors as PISA described. For the student related factors, it was found that more educational resources at home, lower student teacher relations, positive feelings about school, higher levels of mathematics self-efficacy, lower levels of mathematics anxiety, more positive self-concept, more preferences for control strategies, less preferences for elaboration and memorization strategies and more positive disciplinary climate in mathematics lessons reveal higher mathematical literacy measures. Similarly, for the school related factors, it was found that higher performing schools have higher self-efficacy of the students, larger school size, higher proportion of females enrolled, lower total student-teacher ratio and mathematics student-teacher ratio, higher academic selectivity, higher quality of physical infrastructure, more positive evaluations of student-related factors and the less positive evaluations of teacher-related factors affecting school climate. Moreover, the disciplinary climate in mathematics lessons has more of an influence on mathematical literacy in schools with larger school size and with larger mathematics student-teacher ratio. The results were discussed in terms of education policy impact in the Turkish educational system.

Keywords: Programme for International Student Assessment (PISA), Mathematical Literacy, Hierarchical Linear Modeling (HLM), Student-Level Factors, School-Level Factors.

Uluslararası Öğrenci Değerlendirme Programı'nda (PISA 2003) Türk Öğrencilerin Öğrenci ve Okula İlişkin Etkenlerin ve Etkileşimlerinin Matematik Okur Yazarlığına Etkisi

Öz: PISA, katılımcı ülkelerin eğitim politikalarının gözden geçirilmesi kapsamında geribildirim sağlayan en etkili uluslararası değerlendirme programlarından birisidir. Bu çalışmada, Türkiye verileri kullanılarak HLM analiz yöntemi ile PISA'da tanımlanan öğrenci ve okul faktörlerinin ve birbirleriyle olan etkileşimlerinin matematik okuryazarlığına etkilerinin incelenmesi amaçlanmıştır. Öğrenci faktörlerine ilişkin sonuçlara bakıldığında; evlerinde daha fazla eğitim kaynağı bulunan, öğretmenleriyle etkileşimleri daha az olan, okula yönelik olumlu tutumları bulunan, matematikte kendini yeterli görme yeterlikleri yüksek olan, matematikte kaygı ve sıkıntı düzeyleri düşük olan, matematikte özgüven düzeyleri yüksek olan, kontrol stratejilerini daha çok kullanan, diğer yandan ezberleme ve tekrar stratejilerini daha az tercih eden ve matematik derslerinde pozitif bir sınıf ortamı bulunan öğrencilerin matematik okuryazarlığında başarılı oldukları görülmektedir. Benzer şekilde matematik okuryazarlığında daha başarılı olan okulların öğrencilerinin matematikte kendini yeterli görme yeterliklerinin yüksek olduğu, okul mevcudunun ve bunun yanı sıra kız öğrenci oranlarının yüksek olduğu, öğrenci-öğretmen oranının ve özellikle de matematik öğrenci-öğretmen oranının düşük olduğu, okula öğrenci kabulünde akademik seçimin yüksek olduğu, fiziksel şartların daha iyi durumda olduğu, okul ortamını etkileyen öğrenci bazlı etkenlerin daha olumluyken öğretmen bazlı etkenlerin daha az pozitif olduğu okullar olduğu ortaya çıkmaktadır. Ayrıca, öğrenci ve okul faktörlerinin birbirleriyle etkileşimi kapsamında, okul mevcudunun yüksek olduğu ancak matematik öğrenci-öğretmen oranının düşük olduğu okullardaki matematik derslerindeki sınıf ortamının matematik okuryazarlığına etkisinin daha fazla olduğu elde edilmektedir. Tüm bu araştırma sonuçları Türk eğitim sistemindeki eğitim politikalarına etkileri açısından tartışılmaktadır.

Anahtar Sözcükler: Uluslararası Öğrenci Değerlendirme Programı (PISA), Matematik Okuryazarlığı, Hiyerarşik Lineer Modelleme (HLM), Öğrenciye İlişkin Etkenler, Okula İlişkin Etkenler.

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In the 21st century schools as an educational institution function to foster skills needed to cope with the daily life problems and challenges faced in the literate society rather than teaching subject matter content only. The need to understand and develop basic daily life skills of the youngsters initiated an extensive study to assess students literacy skills, since the full participation in society not only requires the ability to read and write, but also mathematically, scientifically and technologically literate people (OECD Publications, 2002). The Organization for Economic Cooperation and Development (OECD) aimed to assess the literacy skills of school children across member and non-member countries through the Programme for International Student Assessment (PISA). The literacy concept defined in PISA pertains “the capacity of students to apply knowledge and skills and to analyze, reason and communicate effectively as they pose, solve and interpret problems in a variety of situations” within reading literacy, mathematical literacy and scientific literacy domains (OECD Publications, 2004, p. 23). Among these three domains, the mathematical literacy has a special place for various reasons. First, PISA 2003 focuses on mathematics literacy in this particular year. Second, mathematics is a subject matter in which the majority of students generally fail. For instance, in Turkey almost 28% of the students could not even achieve the minimum proficiency level as defined by the PISA scale (National Education Publications, 2005). The national mean of the Turkish students is 423 which is almost one standard deviation below the OECD mean (OECD Publications, 2004). The low performance level of the Turkish students has drawn the attention of researchers to international comparative studies to understand the factors that are related to mathematics achievement (Akyüz, 2006; İş Güzel, 2006; İş Güzel & Berberoğlu, 2005; Yayan & Berberoğlu, 2004).

In the related literature, factors that are related to mathematics performance were extensively studied. When closely examined, the variables considered in these studies could be grouped under student and school related factors. In terms of student related factors, demographic variables as well as students’ affective variables were extensively studied (Abu-Hilal, 2000; Alwin & Thornton, 1984; Ames & Ames as cited in Al-Halal, 2001; Baker & Stevenson, 1986; Boocock, as cited in Dowson & McInerney, 1998; Bos & Kuiper, 1999; Cooper & Robinson, 1991; Eccles, 1994, as cited in OECD Publications, 2004, p. 123; Eccles, Meece & Wigfield, 1990; Ferry, Fouad & Smith, 2000; Hackett & Betz, 1989; Hall & Ponton, 2005; Hill & Rowe, 1998; Ma, 1997; Marsh, 1986; O’Brien, Martinez-Pons & Kopala, 1999; Okevukola & Ogunniyi, as cited in Al-Halal, 2001; Reynolds & Walberg, 1992). On the other hand, in some studies school related factors and their impact on mathematics achievement were also considered (Bidwell, & Kasarda, 1975; Bos & Kuiper, 1999; D’Agostino, 2000; Edington & Martellaro, 1989; Finn, 1989; Gallagher, 2004; Hallinan & Sørensen, 1987; Jenkins, 1995, as cited in OECD Publications, 2004; Lee, 2004; Lee & Bryk, 1989; Lee, Smith & Croninger, 1997; Lim, 1995; Ryoo, 2001).

Among the variables considered, in terms of student related factors, home educational resources, sense of belonging at school, self-efficacy, self-concept, anxiety, learning strategies and disciplinary climate were found to be all related and effective in developing higher achievement level of the students (Abu-Hilal, 2000; Alwin & Thornton, 1984; Baker & Stevenson, 1986; Boocock, as cited in Dowson & McInerney, 1998; Bos & Kuiper, 1999; Brookover, Beady, Flood, Schweitzer & Wisenbaker, 1979; Cooper & Robinson, 1991; Eccles, Meece & Wigfield, 1990; Ferry, Fouad & Smith, 2000; Finn, 1989; Hackett & Betz, 1989; Hall & Ponton, 2005; Jenkins, 1995, as cited in OECD Publications, 2004; Marsh, 1986; O’Brien, Martinez-Pons & Kopala, 1999; OECD Publications, 2001, 2004, 2005; Scheerens & Bosker, 1997; Willms, 1992). Similarly the school related factors such as indicators of school resources, instructional and school organizational characteristics, instructional resources and practices, class climate, student, school and education policy factors, teacher evaluation scores are all considered to explain students achievement in mathematics (Bidwell, & Kasarda, 1975; Bos & Kuiper, 1999; D’Agostino, 2000; Edington & Martellaro, 1989; Finn, 1989; Gallagher, 2004; Hallinan &

Sørensen, 1987; Jenkins, 1995, as cited in OECD Publications, 2004; Lee, 2004; Lee & Bryk, 1989; Lee, Smith & Croninger, 1997; Lim, 1995; OECD Publications, 2004; Ryoo, 2001).

These independent studies provide valuable information about the factors related to students' performance in mathematics, however, different scales and samples used among them limits the comparability of the results, as well as their generalizability to the whole population of interest. On the other hand, PISA provides student level and school level information in a valid way to consider for the education policy decisions. Moreover, PISA provides scores representing students' mathematical literacy skills rather than mere achievement, which is considered as an important variable, especially for the OECD countries (OECD Publications, 2001, 2002, 2004, 2005). Studies using PISA database were generally focused on reading and scientific literacy skills of the students (Halinen, Sinko & Laukkanen, 2005; Hvistendahl & Roe, 2004; Kjærnsli & Lie, 2004; Leino, Linnakylä & Malin, 2004; Linnakylä, Malin & Taube, 2004; Turmo, 2004). In terms of mathematical literacy, a linear structural model was studied to investigate the factors related to reading and mathematical literacy skills of the students in the PISA 2000 data across Brazil, Japan and Norway (İş Güzel & Berberoğlu, 2005), and National Center for Education Statistics published a report in which the PISA 2003 results were extensively examined from the U.S. perspective (Lemke, Sen, Pahlke, Partelow, Miller, Williams, Kastberg & Jocelyn, 2004).

As could be understood from the related literature, there are multifold variables considered to explain students' performance in mathematics. PISA database provides substantial information about the key variables which are related to students' performance in mathematics literacy measure which makes holistic analysis about the relative importance of these variables possible. It is expected that such an analysis will provide substantive results for education policy makers. Thus, in the present study, by the use of PISA 2003 data base within the framework of hierarchical linear modeling (HLM), it is aimed to examine how the school level factors are related to student level factors and in turn how the student level factors related to the students' mathematical literacy performance in Turkey. It is expected that the results of the present study will have education policy impact for improving the quality of educational practices in Turkey.

Method

Sample

PISA uses age based definition for the population to be tested (OECD Publications, 2004). The mean age of Turkish students was 15 years 9 months. A two-stage stratified sample design was used in the PISA (OECD Publications, 2005). The first stage consisted of the selection of the individual schools where 15-year-old students were enrolled and second consisted of the selection of the students within the sampled schools (OECD Publications, 2005).

Turkish sample consisted of 4855 students from 719702 students in national desired target population. 159 school principals filled out the school questionnaire. The data file from 4855 students was used as a level-1 file and 159 principals answers constituted level-2 file in the hierarchical linear modeling analyses.

The sample included 2090 (43%) female and 2765 (57%) male students. The distribution of the grade levels of the Turkish students in this study is presented in Table I. As it is seen from Table I, the grade levels of the students ranged from 7th to 12th grade in the Turkish sample.

Table I
The Distribution of the Grade Levels of the Turkish Students

Grades	Frequency	Percent
7th Grade	27	0.6
8th Grade	92	1.9
9th Grade	191	3.9
10th Grade	2 863	59.0
11th Grade	1 670	34.4
12th Grade	12	0.2
Total	4 855	100.0

Instruments

In the present study, PISA index values derived from Student Questionnaire and School Questionnaire were used. The index values were defined by the PISA consortium based on the structural equation modeling to confirm the theoretical constructs assessed by the questionnaires (OECD Publications, 2004). On the other hand, students' mathematical literacy measures were used based on the Mathematical Literacy Assessment test results. Five plausible values which are reported for this instrument in the PISA data files were used in the analyses. All the index values of Student and School Questionnaire used in the study are given and described in Table II at the Appendix.

Data Analyses

The PISA data files are hierarchical in nature since students are nested within schools. Thus, the HLM analysis was used to analyze the multistage and complex sampling in PISA. This particular analysis provides more accurate estimation of sampling error within a nested group design. In the present study, two-hierarchical linear models were tested to examine the relationship between student and school characteristics and mathematical literacy at the student and school levels simultaneously (Raudenbush, Bryk, Cheong & Congdon, 2001). School related measures were linked with the student level factors. Likewise, student related measures are matched with mathematical literacy and all aggregated in the analysis.

Data files used in this study were downloaded from the PISA International Database in the PISA Web Site. All the PISA index values from student and school questionnaires and additional variables of interest were selected in line with the PISA framework of the context questionnaires. Then, each student and school level factor was evaluated on the basis of descriptive data analyses such as missing data analyses, data cleaning procedures. Two-level hierarchical linear modeling provides two options for handling missing data at level-1. These are pairwise and listwise deletion of cases (Raudenbush, Bryk, Cheong, & Congdon, 2001). In order not to lose any data, pairwise deletion of cases was preferred for the level-1 data file. On the other hand, two-level hierarchical linear modeling assumes complete data at level-2 (Raudenbush, Bryk, Cheong, & Congdon, 2001). For the level-2 data file, the missing values of the school level factors ranged from 0.6% to 3.8% with the exception of 20.1% missing on *Total Student-Teacher Ratio* and *Mathematics Student-Teacher Ratio* measures. In level-2 data file, the mean replacement was used in order to retain the whole data set.

In the preliminary analysis, it was observed that the *Mathematics Self-Efficacy* measure indicated a significant correlation ($r = 0.489$) with the *Mathematical Literacy* measure. Thus, *Average Mathematics Self-Efficacy* measure was calculated based on the index value and added to the level-2 file as a controlling variable.

PISA provides estimations of five plausible values for the mathematical literacy measure. Four hierarchical linear models were conducted using HLM 5.05 for five mathematical literacy plausible values separately, and then, the averages of parameter estimations were calculated and reported in the manuscript. Thus, the measurement error resulting from the multiple imputations of PISA mathematical literacy scores was also taken into account by averaging the parameter estimates obtained from the HLM analyses of five plausible values (Raudenbush, Bryk, Cheong, & Congdon, 2001).

Results

A two-level HLM model was fitted using student and school variables as predictors and mathematical literacy as an outcome measure with the data based on 4855 students and 159 school principals. In the analyses, the four models such as analysis of variance model, means as outcomes model, random coefficient model, and intercepts and slopes as outcomes model (final full model) were built in order to investigate the relations of student and school level variables with Turkish students' mathematical literacy measures.

The analysis of variance model provided information about differences in the students' mathematical literacy measures among schools. Based on the maximum likelihood estimate of the variance components ($\tau_{00} = 5998.42$ & $\sigma^2 = 4925.92$), 54.9 % of the variance in mathematical literacy is attributed to among school differences ($\tau_{00} / \tau_{00} + \sigma^2$). The test statistic ($\chi^2 = 5578.68$, df = 158) indicates a significant ($p < 0.001$) variation among schools with respect to mathematical literacy measures. This result also implies that the school level variables might account for the differences in the students' mathematical literacy measures which are investigated in the means as outcomes model.

Means as outcomes model provided information about which school variables are associated with the differences in the students' mathematical literacy measures. The model was first run with the inclusion of all the school level variables indicated in Table II. In this particular analysis, the non-significant variables were removed from the model for the final full model. Due to the inclusion of school level variables in this model, the residual variance between schools ($\tau_{00} = 1512.91$) is found substantially smaller than the original variance ($\tau_{00} = 5998.42$) obtained in the analysis of variance model. When the estimates across the two models are compared ($\left(\tau_{00\,(1st\ model)} - \tau_{00\,(2nd\ model)}\right) / \tau_{00\,(1st\ model)}$), it is found that 74.8 % of the true between school variance in mathematical literacy is accounted for by the significant school level variables. Finally, the χ^2 statistic is found as 1408.44 (df = 147, $p < 0.001$) in the analysis indicating that significant school level variables did not account for all the variation in the intercepts.

The random coefficient model provided information about which student variables explain the differences in the students' mathematical literacy measures. In this analysis, the building strategy recommended by Raudenbush and Bryk (2002) was utilized. In this strategy, each of the student level variables was introduced into the model one at a time in order to determine if each variable significantly contributed to the explanation of the variance on the mathematical literacy measures. Therefore, the final random coefficient model includes twelve student level variables, among which only two variables such as Grade Level and Disciplinary Climate in Mathematics Lessons were found to be randomly varying. Therefore, the other ten variables found as non-randomly varying and were fixed in the final analysis. The maximum likelihood estimate of the variance components ($\sigma^2 = 3758.66$) of this model is smaller than the one ($\sigma^2 = 4925.92$) resulting from the analysis of variance model. Therefore, within school variance is reduced by 23.7 % by including these student level variables as predictors of mathematical literacy measures ($\left(\sigma^2_{(1st\ model} - \sigma^2_{(3rd\ model)}\right) / \sigma^2_{(1st\ model)}$). The student level variables fixed in this step account for about 24 % of the student level variance in mathematical literacy measures. The results also indicate that the intercept is quite reliable (0.98). Indeed, the intercept reliability (0.98) has increased compared to the analysis of variance model (0.97) due to the inclusion of student level predictors. On the other hand, the slopes are far less reliable (Grade = 0.41, Climate = 0.30). However, it is stated that the reliabilities above 0.05 are acceptable and the primary reason for the lower reliability of slopes is a smaller true slope variance across schools than the variance of the true means (Raudenbush & Bryk, 2002).

Intercepts and slopes as outcomes model (final full model) provided information about which school variables are related to the student variables and through this way related to mathematical literacy measures. In this model, means as outcomes model is replicated by including the significant student and school related variables obtained in the random coefficient model. The equations and the results of HLM analyses of the final full model were presented in the Tables III and IV at the Appendix.

The results of the study indicated some positive and negative relationships with the mathematical literacy measures of the students. In the school level variables, Average Mathematics Self-Efficacy, School Size, Proportion of Females Enrolled at School, Academic Selectivity, Quality of School's Physical Infrastructure, and Student-Related Factors Affecting School Climate are significantly and positively related to mathematical literacy, whereas Total Student-Teacher Ratio, Mathematics Student-Teacher Ratio, and Teacher-Related Factors Affecting School Climate are significantly but negatively related to mathematical literacy.

In the student-level variables; Grade Level, Gender, Home Educational Resources, Sense of Belonging at School, Mathematics Self-Efficacy, Mathematics Self-Concept, Control Strategies, and Disciplinary Climate in Mathematics Lessons are significantly and positively related to mathematical literacy measures. On the other hand, Student-Teacher Relations at School, Mathematics Anxiety, Elaboration Strategies, and Memorization Strategies are significantly but negatively related to mathematical literacy measures.

Only two school level variables, School Size and Mathematics Student-Teacher Ratio, interact with the student level variable, Disciplinary Climate in Mathematics Lessons in the final full model. School Size is positively and Mathematics Student-Teacher Ratio is negatively related to Disciplinary Climate in Mathematics Lessons (B_{12} = 7.18 + 0.01*(SCHSIZE) – 0.04* (MRATIO) + u_{12}). When estimates of random coefficient model ($\tau_{qq} = 6083.74$) and final full model ($\tau_{qq} = 1642.61$) are compared, the proportion of variance explained is found as 73%. Moreover, the reduction of variance for Disciplinary Climate in Mathematics Lessons is found to be 12% when the variance component values of random coefficient model (72.96) and final full model (64.20) are compared. This 12% reduction in the variance of Disciplinary Climate in Mathematics Lessons is associated with these two significant school level variables, School Size and Mathematics Student-Teacher Ratio.

Discussion

PISA provides substantial database with school and student levels variables that make a comprehensive analysis possible to understand the factors related to mathematical literacy skills of the students for drawing elucidative results to make education policy decisions. This study attempts to analyze the contribution of these variables on explaining the variation on the mathematical literacy measures of Turkish students. In the model tested seventy-three percent of the total variance explained on mathematical literacy measure by the variables considered. This is rather a remarkable variance component which could be considered seriously for education policy decisions to initiate improvement in the students' performance within the framework of PISA literacy measures throughout the years.

When the student level variables are considered, as expected, students with higher mathematical literacy measures have more educational resources at home, have positive feelings about their schools with higher level of mathematics self-efficacy, lower level of mathematics anxiety, but higher level of mathematics self-concept, prefer more control strategies and less memorization strategies in learning, and have more disciplinary climate in mathematics lessons. Moreover, males seem to have higher mathematical literacy measures from higher grade levels. These findings are expected when the related literature is considered. For instance, positive impact of educational environment at home on academic performance was extensively reported (Alwin & Thornton, 1984; Baker & Stevenson, 1986; Boocock, as cited in Dowson & McInerney, 1998; Bos & Kuiper, 1999; OECD Publications, 2004). As indicated in the literature, as students feel themselves as a part of the school, they perform better in the mathematics assessments (Finn, 1989; Jenkins, 1995, as cited in OECD Publications, 2004). It is also reported that Turkey is the one of the countries which students reported the lowest sense of belonging at school, indeed, the proportion of students reporting that school has done little to prepare them for life is quite high (OECD Publications, 2004). The strong relation of self-efficacy (Berberoğlu, 2011; Cooper & Robinson, 1991; Eccles, Meece & Wigfield, 1990; Ferry, Fouad, & Smith, 2000; Hackett & Betz, 1989; Hall & Ponton, 2005; O'Brien, Martinez-Pons & Kopala, 1999; OECD Publications, 2004, 2005), negative relation of mathematics anxiety (Berberoğlu, 2011; Eccles, Meece & Wigfield, 1990; OECD Publications, 2004, 2005), and positive relation of self-concept (Abu-Hilal, 2000; Marsh, 1986; OECD Publications, 2004) with mathematics performance are consistent with the results of previous studies. In fact, students in Turkey tend to have average self-efficacy and self-concept in mathematics based on OECD average, however, there is a considerable variation with the top and bottom quarters of students (OECD Publications, 2004). Similarly, it is mentioned in the PISA reports that there is considerably cross-country variation in Turkey in the degree to which feel anxiety when dealing with mathematics (OECD Publications, 2004). The positive relation of control strategies and negative relation of memorization strategies with the mathematical literacy measure are expected outcomes (Berberoğlu, 2011; OECD Publications, 2004). However, the learning strategies cannot be thought as separate, they should be taken into account with the variables about self-related cognitions such as self-efficacy, self-concept and anxiety since there are strong interrelationships among all (OECD Publications, 2004). Similarly, gender difference in mathematics performance was extensively reported in the related literature (Fan, Chen & Matsumoto, 1997; Olszewski-Kubilius & Turner, 2002; Tate, 1997; Tiedemann, 2000; Voyer, 1998; Watt, 2000). The grade level is another factor that is obviously related to the extent of the literacy measures since the age is an important factor in developing certain skills assessed by the PISA literacy tests (OECD Publications, 2004). What is hard to explain in this analysis is the negative relation of student-teacher relations with the mathematical literacy measure. The items used in this particular dimension are about to what extent teachers are interested in students' well-being, teachers treat students fairly, and teachers really listen to students. These are all related to positive climate between students and teachers in schools rather than academic support teachers provide for the students. However, as students think that their relationships with teachers are positive with respect to these aspects, they likely to fail on mathematical literacy measures. The average of this index for Turkish data set was found as 0.16 which indicates higher than average student perceptions that teachers are supportive in their mathematics lessons. However, it is reported in PISA reports that males report particularly low levels of teacher support in mathematics lessons in Turkey (OECD Publications, 2004). Indeed, this relationship is defined as mixed and generally weak due to variation across countries and it is stated that the correlation between support and performance would be expected to be negative to the extent that teachers typically use more supportive practices for weaker students of for classes attended by a majority of less able students (OECD Publications, 2004). Thus, based on this negative relation, it seems that less able Turkish students get more support from teachers in Turkey. Similarly, as an unexpected relation, a negative relation was found between elaboration strategies and mathematics performance. This finding requires an elaborative discussion about the appropriate learning strategies to use in developing skills assessed by the PISA mathematical literacy test. The discussion is given in OECD Publications (2004) as:

> Memorization strategies are important in many tasks, but they commonly only lead to verbatim representations of knowledge, with the new information being stored in the memory with little further processing. But such learning by rote rarely leads to deep learning. In order to achieve understanding, new information must be integrated into learner's prior knowledge base where elaboration strategies can be used to reach this goal (p. 145).

However, due to the cultural and educational contexts, it is mentioned that it remains difficult to compare the results across countries and the relations with performance tends to be weak (OECD Publications, 2004). Indeed, the averages of this memorization and elaboration strategies indices for Turkish data set were found as 0.10 and 0.45 respectively. It seems that the students reported that they use more elaboration strategies than memorization strategies. Moreover, the reliabilities for the memorization and elaboration strategies were found as 0.76 and 0.47 in the data set which are little lower reliabilities. Thus, the responses on these learning strategies may not be so valid since the results are not much consistent with the learning environments where mostly the memorization strategies are preferred and used due to the examination based education system in Turkey.

The positive relation of disciplinary climate in mathematics lessons with the mathematical literacy measure is also supported by the findings of the previous studies (Bos & Kuiper, 1999; Brookover, Beady, Flood, Schweitzer & Wisenbaker, 1979; OECD Publications, 2001, 2004; Scheerens & Bosker, 1997; Willms, 1992). Disciplinary climate index reflects a mathematics classroom where students are more orderly, quiet, listen to their teacher, work well in the classroom, etc. These are the behaviours of interested students rather than having authoritarian teachers in the mathematics classrooms. Moreover, grade level and disciplinary climate in mathematics lessons are more related to mathematical literacy measures of the students in some schools than the others since these two variables were found to be randomly varying across the schools in the analysis. Thus, it could be said that the disciplinary climate in the mathematics lessons has positive but different effects in magnitude from school to school.

When school level factors are considered, analyses indicated that schools with higher average mathematics self-efficacy, larger school size, higher proportion of females enrollment, lower total student-teacher ratio and lower mathematics student-teacher ratio, higher academic selectivity, higher quality of physical infrastructure, more positive student-related factors and less positive teacher-related factors affecting school climate were all found to be related to mathematical literacy measures.

There is a positive relation between the average mathematics self-efficacy and mathematical literacy measure of the schools which is an expected finding with reference to the previous studies (Cooper & Robinson, 1991; Eccles, Meece & Wigfield, 1990; Ferry, Fouad, & Smith, 2000; Hackett & Betz, 1989; Hall & Ponton, 2005; O'Brien, Martinez-Pons & Kopala, 1999; OECD Publications, 2004, 2005). As mentioned, this variable was also found to be significant in the student level analysis and therefore added as a controlling variable in the school level analysis. This particular variable might have mutual relations with the mathematics performance. As students get more successful, they feel more efficient in mathematics related concepts. Similarly, as they have higher efficacy level, they might be more successful in mathematics. This relation develops in time through the interaction of students with mathematics concepts. Turkish students have rather low efficacy level in mathematics; the mean value was found as -0.17 in the Turkish data set which is below average across OECD countries. This might be due to the exquisite exposure to mathematics concepts in the school curricula and general failure of the students in achieving the curriculum objectives. This might have negatively affected Turkish students' efficacy in time. Similarly, school size and proportion of females enrolled at school were found as significantly related to mathematical literacy. The larger the school size, the higher the mean school mathematical literacy performance. This result is consistent with PISA findings where there is a tendency of positive relationship with the school size and literacy performance across the countries (OECD Publications, 2004). The larger the school, the more likely to have heterogeneity in the student population in line with academic and non-academic characteristics. This diversity brings interaction among the students and motivates the average students to succeed more compared to the academic climate of a smaller school where students are more alike to each other in terms of academic performance. As discussed in the PISA reports, ability grouping seems to lead less success in the whole student population, thus, the larger schools likely to have no academic selectivity for students' enrollment thus have more variety in terms of student characteristics and achievement (OECD Publications, 2004). This is supported by the positive relation of the variable named as proportion of females enrolled with mathematical literacy measure. Even the females perform less than the males in mathematical literacy measure, having more females in a school is likely to occur in larger school, where female population in the school leads more diversity in terms of academic achievement in the school level. Thus, larger schools, with more female student enrollment likely to have no academic selectivity, might be improving academic achievement of students in average (OECD Publications, 2004). Besides this, in the school level factors, total student-teacher ratio and mathematics student teacher ratio are the two variables which are significantly related to mathematical literacy measures of the students. These two variables used as indicators of school resources in the analysis. This finding clearly indicate that as the number of students a teacher deals with becomes less, the students are likely to be more successful in the mathematical literacy measure (Bidwell, & Kasarda, 1975; OECD Publications, 2004). In a larger school with small student-teacher ratio seems to be the two important conditions to enhance student performance in PISA mathematical literacy measure. In terms of admittance policies and instructional context, only academic selectivity was found as significantly and positively related to student performance in mathematics. Schools having higher academic selectivity performed higher on the mathematical literacy assessment. This is an expected outcome and consistent with the finding related to academic background of students and its' relation to mathematics achievement (Lee, & Bryk, 1989; OECD Publications, 2004). However, academic selectivity is one of the basic problems in the Turkish educational system. Even though the academic selectivity increases the performance of the students in the school level, across the whole population, it may negatively affect students achievement, as was discussed in line with the school size variable above since selectivity might be reducing the heterogeneity of the students in schools. It is also inevitable to increase the among school differences by academic selectivity. Turkey is one of the two-countries with the greatest variation in performance between schools which is the result of extensive use of academic selectivity in the educational system (OECD Publications, 2004). Having greater performance on PISA measures in the schools using academic selectivity might not be the result of education quality the school provides rather it is the result of innate ability of the students selected for the privileged schools. Thus, it could be misleading result when other factors are not considered. As the school resources variable, only quality of school's physical infrastructure was significantly and positively related to mathematical literacy as expected (OECD Publications, 2004). Buildings in good condition and adequate amount of teaching space all contribute to a physical environment that is conducive to learning. Seventy to 80% of the school principals reported the lack of physical resources as the potential problem of hindering quality of the instruction in their schools. School principals also reported that student-related factors such as disruption of classes by students, students skipping classes, students lacking respect for teachers, students' use of alcohol or illegal drugs, students intimidating or bullying other students are factors that are affecting school climate and consequently the mathematical literacy performance as evidenced by the positive relation of student-related factors affecting school climate variable with the mathematical literacy measure. The percentages of responses given by the school principals on the related questionnaire items ranged in between 23% to 45% pointing out the seriousness of the problems covered in this particular dimension. Similarly, a negative influence of teacher-related factors affecting school climate, was found as significant in the analysis. This dimension includes teachers with low expectations of student performance, poor student-teacher relations, teachers not meeting individual students' needs, teacher absenteeism, teachers resisting to change, teachers too strict with their students, and not encouraging students to achieve their full academic potential. This particular finding might be the consequence of academic selectivity extensively used in the Turkish educational system. Teachers might be thinking that students who are not selected by some privileged schools are hard to teach and change, since as was discussed before, homogenous student distribution in a school in terms of academic performance does not create a challenged learning environment for the students because of the lack of a role model peers in the classrooms.

In the HLM analysis, the significant interaction between disciplinary climate in mathematics lessons and two school level factors, school size and mathematics student-teacher ratio was found. The positive interaction with school size and negative interaction with mathematics students-teacher ratio clearly indicate that disciplinary climate in mathematics lessons has more of an impact on mathematical literacy measures of the students in the schools with larger school size and with a smaller mathematics student-teacher ratio than in the schools with smaller school size and a larger mathematics student-teacher ratio. As was discussed above, the positive impact of school size can be considered as a facilitating effect on performance by creating socially and academically differentiated environment for the students to learn (Lee & Bryk, 1989).

In the present study the following points could be considered for education policy decisions in Turkey based on the results obtained in the HLM analysis:

Students' lower sense of belonging at school might have an indirect influence on student-related factors affecting school climate as well as feelings of school not preparing them for life. Thus, this is an important finding that should be considered by education policy makers. As discussed, students in Turkey tend to have average levels of self-efficacy and self-concept in mathematics, but higher levels of mathematics anxiety which education policy makers should consider to increase students' levels of self-efficacy and self-concept in mathematics, but to decrease the level of mathematics anxiety of students. Similarly, raising students using more control but less memorization strategies is of importance for policy as well. It should be kept in mind that examination based education system in Turkey is one of the major sources of lower self-efficacy and self-concept, higher anxiety and higher preferences for memorization strategies. Proportion of females enrolled at school should be considered as an important variable for schools' mathematics performance which might actually support coeducation where girls and boys enrolled at schools together forming a heterogeneous learning environment. Moreover, usually school sizes are large in Turkey, however, the major problem is the student-teacher ratio, in fact the mathematics student-teacher ratio, thus, education policy makers should seriously consider to reduce the ratio of students that teachers deal with in classes for improving the quality of educational practices. As teachers have to handle more students during a class session, the opportunities in line with students' learning needs and demands provided might be limited. It is not this particular ratio to consider only, the teachers attitude towards their students learning seems to be one of the most important variables to consider. They need to expect more of their students to learn, motivate them to have positive attitudes towards mathematics, and support them to be able to use appropriate learning strategies in their own learning. As was discussed above, academic selectivity might have an indirect effect on this particular variable, teachers' attitude towards their students since it is important for teachers to be able to engage constructively with heterogeneity not only in student abilities but also in their approaches to learning. Thus, academic selectivity should be abandoned in the Turkish educational system. Lastly, disciplinary climate in mathematics lessons has more of an influence on mathematical literacy in schools with larger school size and smaller mathematics student-teacher ratio. This finding is of importance for policy as well since the social and academic differentiation might be created in larger size schools and more individualized learning could be generated by the smaller ratio of students that the teachers deal with.

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Appendix

Table II
The Index Values of Student and School Questionnaire and Their Descriptions

Indices of Student Questionnaire	
Student Characteristics Variables	
Grade Level	Grade level in which students are enrolled.
Gender	Gender of the students.
Student Background Variables	
Highest Parental Occupational Status	The index was derived from students' responses on parental occupation. It corresponds to the highest ISEI of either the father or the mother. Higher scores indicate higher levels of occupational status.
Highest Educational Level of Parents	The index was constructed using information on the educational level of the father, the educational level of the mother, and the highest level of education between the two parents. Parental education is classified using ISCED as i) ISCED 1, ii) ISCED 2, iii) ISCED 3B, 3C, iv) ISCED 3A, 4, v) ISCED 5B, vi) ISCED 5A, 6.
Socio-Economic and Cultural Status	The index was created to capture wider aspects of a student's family and home background in addition to occupational status. The rationale for the choice of these variables was that socio-economic status is usually seen as being determined by occupational status, education and wealth. It was standardized to have an OECD mean of zero and a standard deviation of one.
Computer Facilities at Home	The index was derived from students' reports on the availability of the items in their home as: i) a computer to be used for school work; ii) educational software; iii) a link to the internet. Positive values indicate higher levels of computer facilities at home.
Cultural Possessions of the Family	The index was derived from students' reports on the availability of the items in their home as: classic literature, books of poetry and works of art. Positive values indicate higher levels of cultural possessions.
Home Educational Resources	The index was derived from students' reports on the availability of the items in their home as: i) a dictionary; ii) a quiet place to study; iii) a desk for study; iv) a calculator; and v) books to help with school work. Positive values indicate higher levels of home educational resources.
School Climate Variables	
Attitudes towards School	The index was derived from students' reported agreement with: i) school has done little to prepare me for adult life when I leave school; ii) school has been a waste of time; iii) school helped give me confidence to make decisions; and iv) school has taught me things which could be useful in a job. Positive values indicate positive attitudes towards school.
Student-Teacher Relations at School	The index was derived from students' reported agreement with: i) most teachers are interested in students' well-being; ii) students who need extra help, will receive it from their teacher; iii) most teachers treat students fairly; iv) students get along well with most teachers; and v) most teachers really listen to what students have to say. Positive scores indicate good student-teacher relations at school.
Sense of Belonging at School	The index was derived from students' reported agreement that school is a place where: i) I feel like an outsider (or left out of things); ii) I make friends easily; iii) I feel like I belong; iv) I feel awkward and out of place; v) other students seem to like me; and vi) I feel lonely. Positive values indicate positive feelings about the students' school.
Variables about Self-Related Cognitions	
Interest in Mathematics	The index was derived from students' reported agreement with: i) I enjoy reading about mathematics; ii) I look forward to my mathematics lessons; iii) I do mathematics because I enjoy it; and iv) I am interested in the things I learn in mathematics. Positive values indicate higher levels of interest in and enjoyment of mathematics.

Table II (Continued)
The Index Values of Student and School Questionnaire and Their Descriptions

	Variables about Self-Related Cognitions (Continued)
Instrumental Motivation in Mathematics	The index was derived from students' reported agreement with: i) making an effort in mathematics is worth it because it will help me in the work that I want to do later on; ii) learning mathematics is important because it will help me with the subjects that I want to study further on in school; iii) mathematics is an important subject for me because I need it for what I want to study later on; and iv) I will learn many things in mathematics that will help me get a job. Positive values indicate higher levels of instrumental motivation to learn mathematics.
Mathematics Self-Efficacy	The index was derived from students' reported level of confidence with the calculations as: i) using a train timetable, how long it would take to get from Zedville to Zedtown; ii) calculating how much cheaper a TV would be after a 30 per cent discount; iii) calculating how many square meters of tiles you need to cover a floor; iv) understanding graphs presented in newspapers; solving an equation like 3x + 5 = 17; v) finding the actual distance between two places on a map with a 1:10,000 scale; vi) solving an equation like 2(x+3) = (x + 3)(x - 3); and vii) calculating the petrol consumption rate of a car. Positive values indicate higher levels of self-efficacy in mathematics.
Mathematics Anxiety	The index was derived from students' reported agreement with: i) I often worry that it will be difficult for me in mathematics classes; ii) I get very tense when I have to do mathematics homework; iii) I get very nervous doing mathematics problems; iv) I feel helpless when doing a mathematics problem; and v) I worry that I will get poor <marks> in mathematics. Positive values indicate higher levels of mathematics anxiety.
Mathematics Self-Concept	The index was derived from students' level of agreement with: i) I am just not good at mathematics; ii) I get good marks in mathematics; iii) I learn mathematics quickly; iv) I have always believed that mathematics is one of my best subjects; and v) in my mathematics class, I understand even the most difficult work. Positive values indicate a positive self-concept in mathematics.
	Learning and Instruction Variables
Control Strategies	The index was derived from students' reported agreement with: i) when I study for a mathematics test, I try to work out what are the most important parts to learn; ii) when I study mathematics, I make myself check to see if I remember the work I have already done; iii) when I study mathematics, I try to figure out which concepts I still have not understood properly; iv) when I cannot understand something in mathematics, I always search for more information to clarify the problem; and v) when I study mathematics, I start by working out exactly what I need to learn. Positive values indicate preferences for this learning strategy.
Elaboration Strategies	The index was derived from students' reported agreement with: i) when I am solving mathematics problems, I often think of new ways to get the answer; ii) I think how the mathematics I have learnt can be used in everyday life; iii) I try to understand new concepts in mathematics by relating them to things I already know; iv) when I am solving a mathematics problem, I often think about how the solution might be applied to other interesting questions; and v) when learning mathematics, I try to relate the work to things I have learnt in other subjects. Positive values indicate preferences for this learning strategy.
Memorization Strategies	The index was derived from students' level of agreement with: i) I go over some problems in mathematics so often that I feel as if I could solve them in my sleep; ii) when I study for mathematics, I try to learn the answers to problems off by heart; iii) in order to remember the method for solving a mathematics problem, I go through examples again and again; and iv) to learn mathematics, I try to remember every step in a procedure. Positive values indicate preferences for this learning strategy.
Competitive Learning	The index was derived from students' reported agreement with: i) I would like to be the best in my class in mathematics; ii) I try very hard in mathematics because I want to do better in the exams than the others; iii) I make a real effort in mathematics because I want to be one of the best; iv) in mathematics I always try to do better than the other students in my class; and v) I do my best work in mathematics when I try to do better than others. Positive values indicate preferences for competitive learning situations.
Cooperative Learning	The index was derived from students' reported agreement with: i) in mathematics I enjoy working with other students in groups; ii) when we work on a project in mathematics, I think that it is a good idea to combine the ideas of all the students in a group; iii) I do my best work in mathematics when I work with other students; iv) in mathematics, I enjoy helping others to work well in a group; and v) in mathematics I learn most when I work with other students in my class. Positive values indicate preferences for cooperative learning situations.

Table II (Continued)
The Index Values of Student and School Questionnaire and Their Descriptions

	Classroom Climate Variables
Teacher Support in Mathematics Lessons	The index was derived from students' reports on the frequency with which: i) the teacher shows an interest in every student's learning; ii) the teacher gives extra help when students need it; iii) the teacher helps students with their learning; iv) the teacher continues teaching until the students understand; and v) the teacher gives students an opportunity to express opinions. Positive values indicate perceptions of higher levels of teacher support.
Disciplinary Climate in Mathematics Lessons	The index was derived from students' reports on the frequency with which, in their mathematics lessons: i) students don't listen to what the teacher says; ii) there is noise and disorder; iii) the teacher has to wait a long time for students to quieten down; iv) students cannot work well; and v) students don't start working for a long time after the lesson begins. Positive values indicate perceptions of a more positive disciplinary climate whereas low values indicate a more negative disciplinary climate.
	Indices of School Questionnaire
	School Characteristics Variables
School Type	Schools were classified as: i) "government-independent" private schools; ii) "government-dependent" private schools; iii) public schools.
School Size	The index contained the total enrollment at school based on the enrollment data provided by the school principal, summing the number of males and females at a school.
Proportion of Females Enrolled at School	This index provided the proportion of females at the school based on the enrolment data provided by the school principal, dividing the number of females by the total of males and females at a school.
	Variables about Indicators of School Resources
Total Student-Teacher Ratio	The index was obtained by dividing the school size by the total number of teachers.
Mathematics Student-Teacher Ratio	The index was obtained by dividing the school size by the total number of mathematics teachers.
	Variables about Admittance Policies and Instructional Context
Academic Selectivity	School principals were asked about admittance policies at their school. A school was considered to have selective admittance policies if students' academic records or recommendations from a feeder school was a high priority or a pre-requisite for admittance. It was considered a school with non-selective admittance if both factors were not considered for admittance.
Use of Assessments	School principals were asked to rate the frequency of the assessments at school: i) standardized tests; ii) teacher-developed tests; iii) teachers' judgmental ratings; iv) student portfolios; and v) student assignments, projects, homework. The index is given into three categories: i) less than 20 times a year; ii) 20-39 times a year; and iii) more than 40 times a year.
Ability Grouping between Math Classes	The index was derived from assigning schools to one of three categories: i) schools with no ability grouping between any classes; ii) schools with one of these forms of ability grouping between classes for some classes; and iii) schools with one of these forms of ability grouping for all classes.
Mathematics Extension Courses	The index is simply the number of types of extension courses offered such as enrichment or remedial mathematics courses.
Mathematics Activities	The index is simply the number of different types of activities offered at the school such as competitions, clubs or computer clubs.
Resource Autonomy	The index is the number of decisions that relate to school resources that are a school responsibility as: i) selecting teachers for hire; ii) dismissing teachers; iii) establishing teachers' starting salaries; iv) determining teachers' salary increases; v) formulating school budgets; and vi) deciding on budget allocations within the school.

Table II (Continued)

The Index Values of Student and School Questionnaire and Their Descriptions

	Variables about Admittance Policies and Instructional Context (Continued)
Curricular Autonomy	The index is the number of decisions that relate to curriculum which are a school responsibility as: i) establishing student disciplinary policies; ii) establishing student assessment policies; iii) approving students for admittance to school; iv) choosing which textbooks to use; v) determining course content; and vi) deciding which courses are offered.
	School Resources Variables
Quality of School's Physical Infrastructure	The index was derived from three items measuring the potential factors hindering instruction at school: i) school buildings and grounds; ii) heating/cooling and lighting systems; and iii) instructional space (e.g., classrooms). Positive values indicate positive evaluations of this aspect.
Quality of School's Educational Resources	The index was derived from seven items measuring the potential factors hindering instruction at school: i) instructional materials (e.g., textbooks); ii) computers for instruction; iii) computer software for instruction; iv) calculators for instruction; v) library materials; vi) audio-visual resources; and vii) science laboratory equipment and materials. Positive values indicate positive evaluations of this aspect.
Teacher Shortage	The index was derived from items measuring the potential factors hindering instruction at school. These factors are a shortage or inadequacy of: i) qualified mathematics teachers; ii) qualified science teachers; iii) qualified test language teachers; iv) qualified foreign language teachers; and v) experienced teachers. Positive values indicate teacher shortage at a school.
	School Climate Variables
Student Morale and Commitment	The index was derived from items measuring the school principals' perceptions of students at a school with: i) students enjoy being in school; ii) students work with enthusiasm; iii) students take pride in this school; iv) students value academic achievement; v) students are co-operative and respectful; vi) students value the education they can receive in this school; and vii) students do their best to learn as much as possible. Positive values indicate higher levels of student morale and commitment.
Teacher Morale and Commitment	The index was derived from items measuring the school principals' perceptions of teachers with: i) the morale of teachers in this school is high; ii) teachers work with enthusiasm; iii) teachers take pride in this school; and iv) teachers value academic achievement. Positive values indicate higher levels of teacher morale and commitment.
Student-Related Factors Affecting School Climate	The index was derived from items measuring the school principals' perceptions of potential factors hindering the learning of students at school with: i) student absenteeism; ii) disruption of classes by students; iii) students skipping classes; iv) students lacking respect for teachers; v) students' use of alcohol or illegal drugs; and vi) students intimidating or bullying other students. Positive values indicate positive evaluations of this aspect.
Teacher-Related Factors Affecting School Climate	The index was derived from items measuring the school principals' reports of potential factors hindering the learning of students at school with the following statements: i) teachers' low expectations of students; ii) poor student-teacher relations; iii) teachers not meeting individual students' needs; iv) teacher absenteeism; v) staff resisting change; vi) teachers being too strict with students; and vii) students not being encouraged to achieve their full potential. Positive values indicate positive evaluations of this aspect.

(OECD Publications, 2004, 2005)

Table III

Equations for Intercepts and Slopes as Outcomes Model (Final Full Model) in Turkey HLM Analyses

Intercepts and Slopes as Outcomes Model (Final Full Model) for Turkey
Student Level
Mathematical Literacy (Y_{ij}) = B_{0j} + B_{1j}*(GRADE) + B_{2j}*(GENDER) + B_{3j}*(HOMEDUC) + B_{4j}*(RELATION) + B_{5j}*(BELONG) + B_{6j}*(SELFEFFI) + B_{7j}*(ANXIETY) +B_{8j}*(SELFCON) + B_{9j}*(CONTROL) + B_{10j}*(ELAB) + B_{11j}*(MEMOR) + B_{12j}*(CLIMATE) + r_{ij}
School Level
$B_{0j} = \gamma_{00} + \gamma_{01}$*(MEANEFFI) + γ_{02}*(SCHSIZE) + γ_{03}*(PFEMALE) + γ_{04}*(RATIO) + γ_{05}*(MRATIO) + γ_{06}*(ASELECT) + γ_{07}*(PHYST) + u_{0j}
$B_{1j} = \gamma_{10} + u_{1j}$
$B_{2j} = \gamma_{20}$
$B_{3j} = \gamma_{30}$
$B_{4j} = \gamma_{40}$
$B_{5j} = \gamma_{50}$
$B_{6j} = \gamma_{60}$
$B_{7j} = \gamma_{70}$
$B_{8j} = \gamma_{80}$
$B_{9j} = \gamma_{90}$
$B_{10j} = \gamma_{100}$
$B_{11j} = \gamma_{110}$
$B_{12j} = \gamma_{120} + \gamma_{121}$*(SCHSIZE) + γ_{122}*(MRATIO) + u_{12j}

Table IV
Results for Final Full Model in Turkey HLM Analyses

Fixed Effect	Estimated Effects[1] Coefficient	Standard Error	T-Ratio	p-value
Overall Mean Mathematical Literacy, γ_{00}	418.72	3.36	124.84	0.000
*Mean of Mathematics Self-Efficacy, γ_{01}	113.00	7.50	15.08	0.000
*School Size, γ_{02}	0.02	0.01	3.53	0.001
*Prop. of Females Enrolled at School, γ_{03}	75.97	18.27	4.16	0.000
*Total Student-Teacher Ratio, γ_{04}	-1.24	0.36	-3.41	0.001
*Mathematics Student-Teacher Ratio, γ_{05}	-0.10	0.04	-2.44	0.018
*Academic Selectivity, γ_{06}	8.64	3.83	2.26	0.025
*Quality of School's Physical Infrast., γ_{07}	8.77	3.48	2.52	0.013
*Student-Rel. Fac. Affecting Sch. Cli., γ_{08}	6.80	3.38	2.01	0.047
*Teacher-Rel. Fac. Affecting Sch. Cli., γ_{09}	-10.35	3.85	-2.69	0.009
Grade, γ_{10}	21.31	2.81	7.58	0.000
Gender, γ_{20}	18.64	2.05	9.10	0.000
Home Educational Resources, γ_{30}	6.58	0.86	7.68	0.000
Student-Teacher Relations at School, γ_{40}	-6.93	0.89	-7.75	0.000
Sense of Belonging at School, γ_{50}	2.71	1.13	2.41	0.023
Mathematics Self-Efficacy, γ_{60}	16.71	1.16	14.45	0.000
Mathematics Anxiety, γ_{70}	-8.10	1.07	-7.59	0.000
Mathematics Self-Concept, γ_{80}	7.10	1.31	5.44	0.000
Control Strategies, γ_{90}	5.75	1.26	4.56	0.000
Elaboration Strategies, γ_{100}	-5.19	1.24	-4.17	0.000
Memorization Strategies, γ_{110}	-4.04	1.22	-3.30	0.002
Disciplinary Climate in Math Lessons, γ_{120}	7.18	1.24	5.79	0.000
*School Size, γ_{121}	0.01	0.00	2.96	0.005
*Mathematics Student-Teacher Ratio, γ_{122}	-0.04	0.02	-2.50	0.021

The Chi-Square Table

Random Effect	Variance Component	df	χ^2	p-Value
School mean, u_{0j}	1642.61	122	1495.45	0.000
Grade, u_{1j}	442.94	131	242.81	0.000
Disciplinary Climate in Math Lessons, u_{12j}	64.20	129	164.85	0.023
Level-1 Effect, r_{ij}	3757.57			

Reliability of Random Effects

The Intercept, B_{0j} = 0.924 & GRADE, B_{1j} = 0.403 & CLIMATE, B_{12j} = 0.274

Statistics for Current Covariance Components Model

	Deviance	Number of Estimated Parameters
1st Model (Two variables-random)	54226.49	7
2nd Model (Two variables-fixed)	54255.62	4

Variance-Covariance Components Test Results

	χ^2	df	p-value
Variance-Covariance Components Test	29.13	3	0.000

[1] *The school level variables were grand mean centered and the student level variables were group mean centered.*