Interclass Comparisons of the Association between Some Contextual Variables and Mathematics Achievement: Results from TIMSS 2007

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ABSTRACT: The goals of this study was investigation of relationships between mathematics achievement and some contextual variables at the school level and student level and examination of the percentage of each of levels in explaining total student mathematics achievement variance. In order to conduct this international education study, the Trends in Mathematics and Science Study 2007 eighth-grade student and school dataset of Iran was used. Our analysis focused on the Iranian sample that included 3978 students from 208 schools. The variables used in this analysis exist in two levels: the student level (level 1): students' attitude, self-efficacy, gender and the school level (level 2): school climate, parental involvement, and grouping. Two-level hierarchical linear modeling (HLM) was used to explore the relationship between student mathematics achievement and the hypothesized predictors in this analysis. The results indicated that the relationship between mathematics achievement and self-efficacy is positive but relationship between mathematics achievements with attitude is negative at the individual level. The relationships between mathematics achievement with climate and grouping at the school level are positive too. The results showed that the school level accounts for a significant amount of variability of student mathematics achievement.

Key words: students' attitude, self-efficacy, gender, school climate, parental involvement, and grouping, TIMSS 2007, HLM.

INTRODUCTION

The role of the student's achievements in mathematics and science in an international educational field has not only a fundamental role in reducing social and economic disparities but also it is vital to economic and social development of a country .)Friedman [1], 2005 .(This fact leads to the globalization of many aspects of a country's competitiveness .The effectiveness of a country's education system is one of the fundamental aspects in the growth of competitive profit in the global economy; Science and education are of issues that many psychometric and educational researchers around the world have taken into consideration (Fvlartn , 2004 ; Slavin , Lake and Lrvf , 2009 ; O'Connor - Ptrsv and Miranda , 2003). The results of comparing the performance of Iranian students in mathematics of eighth grade in 2007 shows that Iranian students owns 34th rank among 49 countries participating in.(Mvlys , Martin and Fu , 2008). In addition, their performance in the Thames studies in 1995 and 2007 show that the average of student's scores in 2003 is 422, 411, 403 (Kiamanesh and Mohsenpour, 2010). As you can see, not only Iranian student's performance in Thames studies in 2007 was poor but also it has been dropped than in the previous two ones. So, it is so important to investigate that what factors lead to poor performance. Various educational and psychological researchers have identified several factors having role in the mathematic achievement of students. Most of the researches have been used conventional

regression methods or path analysis to examine the predictive variables and relationships between variables in a class (students levels) (for example Pelvan Sadiq , 2006; Kiamanesh and Mohsenpour , 2010) however there are researches studying exactly variables at different levels of student , class , school and country in Thames studies. (Eg Foulartin , 2004 , Liu , 2010 , we Papanastasyv , 2004). It seems that until now there is no research in Thames's ones to study the predictive variables in this level to determine the amount of variance explained by the predictive variable criteria to evaluate the share of different levels. Multi-level modeling techniques provide an accurate statistical picture because by using this method we can study students background (individual level) and social background (in school level). We can also use these techniques to explain familiarity of students in schools. so, The aim of this study is to develop a mathematical relationship between Iranian student's mathematical achievement in Thames's eighth grade in 2007,gender, self-efficacy ,attitudes at the first level (of student) and involvement , school climate , and grouping in the second level (school).

Effective schools are the ones that have earned strong educational outcomes. However, effects of schools and classrooms, students can be gained by the characteristics of students. Among the courses that are so important the educational system, it is math. Mathematical Achievement among students in

different levels of education is considered as one of the concerns of policy makers and educators. Mathematical Achievement is considered as a long-term economic potential of a country. Therefore, it is important to investigate the factors of this development .In this paper we will examine some of these factors. Psychology and motivation theory believe that student's positive attitudes toward learning and positive self-perception of their abilities have impact on motivation and and their achievements. Many empirical studies have examined this hypothesis and they have generally examined feedback loop between self - assessment, or self-efficacy, and intrinsic interest in the achievements. Academic self-concept of students has significant and causal effects on math achievement .Results of long study among high school students in Germany showed that students expressing more interest in mathematics were more likely to participate in advanced math courses. There is also evidence that self-efficacy has a significant correlation with next achievement in mathematics among high school students. The concept of self -efficacy was introduced by Bandura for the first time (1997). According to his sayings, self- efficacy recognizes compatibility, errors and resistance against the problems. Since then, many studies have examined the relationship between self-efficacy and academic achievements (Moulton, Brown and Lent, 1991). They showed in their infra-analysis that there is positive relationship between self-efficacy and academic performance (0.38) Efficacy expresses 14 % of the variance in student achievement in the subjects, designs, and sizes of the criteria. Studies showed self-efficacy has important role in academic performance by growing age. The results of Thames report showed that there are positive relations between the levels of self-efficacy in mathematics learning and mathematical achievement in every country. Attitudes toward academic subjects are an important factor in learning and development. When a student's view is positive toward mathematics, they will more likely show their stability and resistance and will have more involvement. Schreiber (2000) found that students who perform better on math tests, have positive attitude toward mathematics. Calvary's (2000) considers Students ' attitudes towards mathematics learning as the best predictor of academic achievement. Papanastasyv has reported direct relationship between attitude toward mathematics and academicals achievement on the Thames data. However, there is a positive relationship between attitude toward mathematics and achievement in those lessons in some studies. There are some Concern about female students and mathematics because mathematics is entrance key to science, technology,

engineering and math and related careers and females in this fields don't have enough competence. Although less social scientists proved that there is

Few hormonal and genetic differences, such as "lack of learning theory" While other researchers postulate a combination of nature and nurture. Age is a major modulator of the relationship between gender and math achievement. Girls have acted better than boys in elementary (d = - ./06)) and middle -./.07) =grades but boys are better in high school(= ./29 d)and university(= ./41 d). The results of Thames 2007 showed that average math scores of girls are significantly higher than boy's scores in international level. In particular, among participants of 49 countries, girls had higher math scores in 7 countries in statistical terms. Also Kiamanesh and Mohsenpour studies (2010) showed that boys in math test scores and in fields of geometry, measurement, and geometry of numbers in the study area of Thames 99, acted better than girls in 2003 and 2007. The girls generally acted well in total score of math and geometry within the Thames studies of 2003 and 2007. In addition to students, parents are of the factors that affect student outcomes. Since Coleman et al (1966), the relationship between family background and educational achievement is well known. Active involvement of parents in education has an important effect .However, unlike the influence of teachers and schools; the impact of parental involvement in education has not been well studied. Initial studies of parental involvement have provided conflicting results including the positive and negative effects and there is no relation. By review and meta- analyzes, they have concluded that parental involvement effect on student outcomes, but there is fluctuations (changes) in the form of conflict. In particular, parental behavior and activities indicating educational values and yearnings have a strong effect on the educational outcomes of students. However, parental involvement in school activities has a direct impact on student achievement. However, some factors affect the relationship between parental involvement and academic outcomes. Socio-economic position of parents and the race are main factors. In other words, the level of parental involvement changes in terms of socio-economic position and race. Differences in the involvement level and its effects reflect on the differences in human, social and cultural capitals. In addition, the relationship between parental involvement and academic achievement will be moderated by variables such as parents' socio-economic position and the race. For example, Lee and Bowen (2006) found that as discussions of parent - child has positive relationship with academic achievement among European Americans, In Hyspink/ Latin Americans it has a negative relationship. According to

Lee and Bowen (2006), it is due to this reason that discussions of parents - children in school is necessary only when the child is not doing well in school. Thus, the relationship between parental involvement and academic achievement is complex and depends on the type of conflict and social and cultural factors. Parental involvement is a multi-dimensional concept. Based on Summarization on Fan and Chen (2001) Parental involvement in education research has basically 5 dimensions: Dimensions of parental involvement , desire / expectations for student learning , relation with students at school-related events , parental control / structure related to school education, parental involvement and participation of parents in school activities. Fan and Chen in their infra-analysis article concluded that parental aspirations and expectations for student achievement have the highest correlation.= ./40) .work environment such as Support and involvement of parents in school activities are of factors that are positively correlated with job satisfaction of teachers. Satisfaction with teaching as a career is a prerequisite for teacher effectiveness, which in turn will lead to effective teaching and student achievement. Teachers, who do not have support in their work environment, may have less incentive to teach and perform well in the classroom. Ability grouping is used

To describe a group of students having homogeneous ability in a class. Grouping allows teachers to teach students with low and high academic achievement. Opposition opinions on Ability grouping are those reduce confidence in those students with low achievement. In many educators' opinion, the Group's ability is to respond to a reasonable degree of diversity among the students in a way that allows teachers to provide students with teaching suitable to their ability. Students with higher ability are being challenged motivated and Students with low ability are being supported. Therefore, all students will benefit from this grouping. Salween (1990) in meta-analysis of 29 articles about the relationship between educational achievement and grouping concluded that Grouping and academic achievement of all students at the all levels are almost zero. Moreover, it was shown that there is no difference between almost all subjects except social studies where students have higher achievement in heterogeneous groupings. Zoozoosky (2004) showed in his study that the grouping has a positive impact on the overall achievement and has differential positive effect on student outcomes with low and middle Scio-economical position whereas Ability grouping in mathematics having no effect on total or differential achievement. The school progress is an organizational process in school and is in connection with its external environment. School

Climate and culture (Foulan , 2001) and relationship or school (Bloom , Libya , 2004), are two key factors for success in school and high school students. Freiberg (1998) showed that a positive school climate can improve morale and can lead to academic achievement. Boulach and Kastlman Malone (1995) also showed that there is a meaningful relationship between academic achievement and school climate.

MATERIAL AND METHODS

Data of Thames's Eighth -grade students are used in this study from the 2007.Their number is 3978 out of 208 schools. The dependent variable in this study is a mathematical function, which is obtained from student mathematical achievement of Thames in 2007 and includes five scores that average of these five scores is used in this analysis. Two independent variables were used in this study: Student level (level 1) and school level (level 2). Three variables in the student level (student attitudes toward self-efficacy and gender) Three variables in the school level were selected by (school climate, parental involvement and grouping) and were used in the HLM analysis. These variables were selected by the Review of previous literature on the relationship of the variables with student math achievement.

RESULTS

On accordance with the hierarchical data structure, (in here student and school level) two -level hierarchical linear modeling (HLM) was used to assess students' achievement in math. HLM variance separates Student -level and school -level and breaks (Radnbush and brick 2002) total variance into within and internal variance and the correlation coefficient within classes can obtain

School relative Variance to the total variance. ICC importance is in determining the amount of variance in math achievement at the school level. In this study, an unconditional HLM analysis (One -way ANOVA model with random effects) is executed. This paper aims at separating variance of math scores of students at different levels (here the student and school) and studying whether or not there is difference between student math achievements in schools. This model provides estimation about the proportion of variance among schools in math achievement that is called correlation coefficients (ICC). A one-way ANOVA with random effects mode was used to answer the question that how much of math achievement variance is in student level and how much is in school level. In One -way ANOVA model with random effects, according to the following formula, correlation coefficient among classes was 48.58:

$$\rho = \tau_{00} / (\tau_{00} + \sigma^2)$$

3594.48913 / (3803.65726+3594.48913) = 48.58%. Therefore, schools explain 48% of mathematics achievement variance. 3594.48913, χ^2 = 3860.32925, *DF* = 198, *p* < 0.001). The results show that the average math performance of school is meaningfully different. The acquired amount of credit 0/94 indicates that the sample average is valid and can be used as the actual indicator of school.

The random intercept model) with student -level variables were used to investigate how much self-efficacy and attitude is related to student's math achievements.

Two variables (attitudes and self -efficacy) were entered into the student level in HLM. Since there were no previous, assumptions about the different schools of the predictor, variables in the present study, slopes were constant and the intercept between different schools were considered. The results of this model (Model B) are presented in Table 3.

As it can be seen, self-efficacy has positive meaningful relationship with student's math achievements. (*b* ,2.044=*p*)(0.01>(

After the addition of these two variables in first level of variance, student level was acquired as 3654.92413 that in comparison with one -way ANOVA meaning the first model is reduced 3803.65726. ((3803.65726 - 3654.92413/ 3803.65726 =0/0391)

Therefore, it can be said that these two variables (self-efficacy and attitude) express 91.3 % of the variance in student mathematics achievement.

In random coefficients model with student -level variables and school level, three variables of student's level (gender, self-efficacy and attitude) as well as three school -level variables (school climate , and grouping and parents' involvement) were entered into HLM model . Because there are no hypotheses about differences between schools in the predictor, variables in this study, the slope among schools were not different and it was considered constant.

In addition, the interactive effects among variables have not been studied. The results of the random coefficient model are presented with student and school -level variables in Table 3. The above model (Model C) shows the results of two students -level variables that are significantly associated with students' math achievement, self-efficacy (*b* ,008/2= *p*0.01 >) has meaningful positive relation math progress. While the attitude (b = - 5.329, p \u003c0.01) has negative meaningful relation with progress. In the school level, climate variable (b = 7.279, p \u003c0.01) and grouping (b = 28.922, p \u003c0.01) had a significant positive relationship with math achievement. However, the involvement in school did not have meaningful relation with academic achievements. Variances in student level and

in the school level were in order 41688/3654 and16173.2294 that indicates the amount of variance explained by the three variables of student's level and the three variables at the school level. Therefore, the correlation coefficient among classes (ICC) is equal to 38.56% =2294.16173) +2294.16173 / (3654.41688.

Correlation coefficient among classes has reduced from 48.96 % to 38.56 % after variables are increased. This indicates that the three predictors at the school level express greater variability than student -level predictors 2 = 2544.058, DF = 195, p \u003c0.01) and the chi-square indicates that significant differences among schools in math achievement remains.

DISCUSSION

According to the findings of the present study for Iranian students, between self-concept and academic achievement, there is a meaningful relationship. However, the relationship between attitudes toward mathematics with mathematics achievement is not meaningful. Kiamanesh finding (2004) show that attitudes toward mathematics and mathematics self-concept are among the factors that affect student's mathematics achievement in Iran. Based on the mathematical concept of variables, the results of the survey findings is consistent with Kiamanesh ones (2004) but in the present research there is no meaningful relation between attitudes toward mathematics with math achievement for Iranian students. However, the research done by using path analysis (pahlavan sadegh. 2005 and Kabiri, 2003) attitudes toward mathematics for the Iranian students as a mediator variable, relation between gender and math achievement can be adjusted. Many researchers have studied relation between mathematical self-concept and mathematic achievement that the results of these researches are consistent with current research. for the variable called attitude towards mathematics, finding of Daniel (1995) , Dameh , Apdnaker and Brooke (2003) , Peter and Miranda (2003) and Papanastasyv (2000) demonstrated a meaningful relationship between attitude toward mathematics and mathematics achievement which it is not found in current research.

Total of 91/3 % changes in the depend variables of mathematics achievement is predictable by a first-level predictor variables (self-concept and attitude). Many researches have studied the relationship between student achievement levels and student level variables However; little researches have studied the impact of school -related variables on math achievement. The results of this study showed that school -level variables (school climate and parental involvement and grouping) have not only meaningful

relation with math progress but also expresses more share of   math achievement than student -level variables (gender, self-concept , and attitudes).

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