Confirmatory Path Analysis of Relationships between Gender Differences and Teachers' Role with Math Achievement through Mediator Variables in Iranian 8th Grade Students at Timss 2007

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Abstract

The purpose of the present study was to determine a conceptual model for predicting science achievement at TIMSS 2007 based on gender. Mathematics achievement was the criterion variable and the variables of math attitude, math confidence, math learning process, school attachment, school climate as endogenous and socioeconomic status, as exogenous variables were considered. Teacher-related variables (teaching experience, education, attitude towards their students and themselves) by the multilevel model to predict academic achievements were investigated. Results showed that in both groups, socioeconomic status has a positive and significant direct effect on improving math, math strategies and the use of computer. Also school climate has a positive and significant direct effect on mathematics achievement, math attitude and math confidence. Analysis of multilevel model showed that school attachment, math self-confidence and computer use (between boys), math self-confidence, computer use (between girls) at the first step, teacher's attitude towards math (between boys), and teaching experience (between girls) at the second level could predict part of mathematics achievement.

Key word: Mathematics achievement, Gender, Math confidence, Teacher's role, SES

Introduction

Recognizing the effect of factors for the evaluation of academic achievement in the teaching and learning areas has been interesting for researchers. In this context, the main objective of TIMSS studies is measuring students' achievement in order to get more perspectives. Internal factors (such as self-concept, attitude and self-efficacy), environmental factors (e.g., SES, school climate, how to interact with the teacher and classmates) are factors that affect learning. In this regard, math is necessary for most courses. The mean performance of students in mathematics at grade 8 from 1995 to 2007 decreased by 15 points and from 2003 to 2007 were associated with scores lower than 8. Also, students' performance of Iranian grade 8 girls in mathematics from 1995 to 2007, with an increase by 2 points and boys ' performance in this period, with a decrease by 29 points.

One of the most remarkable findings of TIMSS (2007) regarding Iranian eighth grade students was the boys' math achievement scores had a significant decline and the girls' scores showed a significant improvement compared to the scores of (2003) and (1999). Considering the participation of 8th grade students from different countries in the TIMSS 2007, mean performance of 8th grade girls in mathematics was higher than boys' (7 points). In Iran, the gender difference in performance showed an increase by 30 points for girls than boys from

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1995 to 2007,which was an exception compared with international average scores.

One of the most important factors that influence learning is socio-economic status (SES). SES has the greatest impact on math achievement (Duncan; Brooks-Gunn & Colbanov, 1994; Fulartoon, 2004; Kiamanesh, 2010).

Students with low SES often have less success in school, graduation rates, and university entrance exams (Santrak, 2009). In fact, lower SES results in educational facilities differences. Socio - cultural structure of students has a profound influence on academic interest and achievement (Awang and Ismail 2008, Garden and Robitallin, 1989; Almor 2006; quoted Kyamanesh 2010, Pramiss 2001 Marcoulides, Heck and Papanastasiou, 2005). Duncan, Brooks - Gunn and Colbanov (1994) argue that this effect increases as the student's grade reduces. Lerner (1991), Coleman et al (1966), White (1982), Marjoribank (2002) Fulartoon (2004), quoted Kyamanesh 2010 and Kyamanesh (2005) also confirm this.

Based on data collected in earlier studies in Iran, there is a direct link between students' achievement in mathematics and variables such as parental education level (Awang and Ismail, 2008, Fulartoon, 2004, quoting Kyamanesh 2010, 1989; Almor, 2006; Kyamanesh, 2010). Studies conducted in the learning environment and academic achievement show significant correlation between them (Qualglia and Pery, 1996; Wilson and Wilson, 1992 quoted Abedi 2010; Papanastasiou, 2002; Marcoulides, Heck and Papanastasiou, 2005; Fulartoon, 2004, quoting Kyamanesh, 2010). Fraser and Fisher (1982) stated that classroom environment that is ideal for students increases outcomes and efficiency. In addition, the classroom atmosphere has the emotional impact on students and is related to their achievement (Larocque, 2008).The school environment and peer influence are important in developing a student's attitudes. It seems that behavior is formed with this relationship, an individual's attitude and his peer's attitudes to the subject (Papanastasiou and Papanastasiou, 2005).

Studies regarding the impact of attitude on achievements in general and especially on academic achievement, (Fnma, 1980; Leder, 1990, quoted Papanastasiou, 2002) have concluded that attitudes play an important role in learning (Laster, Garofalo, and Kroll, 1989; Shaughnessy, 1983 quoted Papanastasiou, 2002; Awang and Ismail 2008) and the mathematical achievement (McLean, 1995; Laster, Garofalo, and Kroll, 1989; quoted Papanastasiou, 2002).

Also, the literature and research on the relation between self-concept and math achievement always show a direct and significant relationship (Petrous et al, 2003, quoted Larocque, 2008; Kyamanesh (2005) and Karimzadeh (2001). Students who have high self-concept are more confident and get a higher score (quoting Kyamanesh, 2005). According to studies, the self-concept can influence socioeconomic status and attitudes to school and affect learning process and academic performance.

Papanastasiou and Papanastasiou (2004) also showed that the quality of teaching is directly and strongly related to students' attitudes and academic performance. Education process is one of the variables that according to the literature is affected by socio-economic status and math self-confidence and the tool used for learning math.

Attachment to school includes a sense of dependency to school and relation with teachers and friends and work in school affairs (Douglas et al, 2006). School climate and socio-economic status have an effect on attachment to school (Crosen, Johnson and Elder, Thomas, 2004, quoted Paczak, 2005) and attachment to school directly affects the school's academic performance (Paczak, 2005; Blum, 2004). Attachment to school is one of the variables that was examined in this study.

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On the other hand, studies have shown the effectiveness of teachers and learning context considerably influence a student's attitude toward education (Fitz and Gibbson, 1996). Conceptual model of Hammond and Hudson (1988, quoted Papanastasiou, 2002) suggests that teacher, school and student quality influences the quality of teaching, which affects students' performance.

In this study, variables related to the teacher [his education, teaching experience and a teacher's perceptions (of themselves and their students)] as second-level variables have been studied.

Impact of gender and gender differences in mathematics performance is a controversial domain. Gender is a social construct which is influenced by the interpersonal interactions of individual and social contexts.

Several factors directly or indirectly affect both sexes in mathematics achievement. In his study, Kyamanesh (2008) showed significantly direct effects of SES and self-concept on attitudes toward mathematics and negatively direct effect of attachment to school and attitudes toward mathematics on achievement in mathematics. Further research on the relationship between gender and different variables indicate that gender is associated with self-concept and attitude toward courses (Kyamanesh, 2010). Research related to gender and students' perceptions of the classroom show girls' perception is more positive than boys'. In addition, students with poor scores find their classroom more competitive (Larocque, 2008). Therefore, the introduction of the factors affecting the failure of boys and girls in math is important.

The present study aimed to evaluate and assess factors affecting mathematics achievement due to the variables in the education area and TIMSS 2007 study.

Purpose of the Study

The purpose of the present study has been to determine a conceptually multilevel model for predicting math achievement by examining different factors (attitude toward math, math confidence, math learning process, attachment to school, school climate, teaching experience and education, teacher s' attitude toward students and themselves) on Iranian 8th graders (by gender) . Also, we wanted to determine the contribution of each factor to the explained variance in order to see whether different models would emerge for boys and girls.

Methods

Data Sources

The data for this study were obtained from 3981 (girls and boys) Iranian 8th graders who participated in TIMSS (2007). Using research evidence, a tentative list of items from the Student Questionnaire was selected for factor analysis. The data were subjected to principal component factor analysis with oblimin Rotation. Seven factors were accepted as the most interpretable for the models. The obtained factors were named on the basis of research carried out on the TIMSS data (Martin et al., 2008; Papanastasiou, 2004 & 2002; Koutsoulis & Campbell, 2001). These factors were identified as Attitudes towards math 'achievement, School Climate, School attachment, math learning, math learning strategies, math confidence, and computer use. Mathematics achievement of standard scores (Rash Score) was used as the student's math achievement, and seven different path coefficients analyses were estimated. Factors and items as well as the Cronbach's alpha for each factor are defined in table 1. Factor loadings and items under each factor as well as the amount of the cumulative effect of the variance in two different models indicated similar patterns for the two models. In order to determine the criterion variable for this study, seven different path analyses were used. In each analysis the exogenous and endogenous were the same but the criterion variables were different.

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Tables 1: Analysis of explorative factors and reliability coefficients

Variables	factors	Explained variance	Indicators number	Omitted questions
socioeconomic status		0.48	5	----
Math self concept	Matt self confidence	0.43	8	----
	Math attitude		4	
math learning process	math learning strategies	0.54	4	8
			3	
	math learning			
	computer use		2	
School attachment	School attachment	0.22	3	----
teacher school perception		0.55	8	
School Climate	School Climate	0.22	4	1

Statistical Analysis

To achieve results, descriptive and inferential statistical procedures were performed. To evaluate the reliability, internal consistency using Cronbach's alpha was used. Values greater than 0/7 represent optimum reliability, between 0/6 to 0/7 the average, between 0/5 to 0/6 poor and amounts smaller than 0/5 an unacceptable reliability (Tinsley and Brown 2000). To investigate the relationship between variables, the parametric and nonparametric tests were used appropriately. To classify the questions in the questionnaire, based on the logical structure, construct validity through Principal Axis Factoring (PAF) to extract the factors (constructs) and the oblimin method (with Delta Zero and Kaiser normalization) was used for the components (Tinsley and Brown 2000).

To evaluate the adequacy of the models, the KMO index and the Bartlett's test were used. In this case, values showed greater than 0/7, which is a desirable index for the factor analysis model of data.

To determine the nature of the factors, a cut-off point of 4/0 was selected (Tinsley and Brown 2000). To assess the factors structure of the exploratory factor analysis, confirmatory factor analysis model was performed. In addition, the model (CFA) as a measurement model of structural equation model (SEM) in a four-step process was used for both questionnaires (Mulaik and Millsap 2000). Maximum likelihood method was used to fit the model. The adequacy of the model was then necessary to examine; then for the relationship between the coefficients in the paths analysis, fit indices were used.

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After confirming the theoretical model based on data, for significance assessment of path coefficients of the model, the T-value was used. In addition to evaluating the relationship between teacher variables with student variables, and the number of students for a teacher (i.e. there were many students per teacher), multilevel modeling was used. In this model, teacher's variables in level 2 and student's variables in level 1 of the model were included.

Results

Evaluating the adequacy of the model achieved a desirable level of fitness and its adequacy was confirmed. Results of path coefficients Significance for the path analysis with respect to gender were obtained in the analysis. According to gender, results showed in both groups that socioeconomic status has a positive and significant direct effect on improving math, math strategies, and the use of computer. It also has negative and significant direct effects on math attitude and math self-confidence. On the other hand, school climate has a positive and significant direct effect on mathematics achievement, math attitude, and math confidence.

In the homogeneity test in both male and female models, different structural models and significant differences were observed in some individual coefficients.

Analysis of multilevel model showed school attachment, math self-confidence and computer use (among boys), math self-confidence and computer use (among girls) at the first step could explain part of mathematics achievement. In the second level, teachers' math attitude (among boys) and teaching experience (among girls) could predict part of mathematics achievement.

The proposed model for the total sample was tested using LISREL 8.5. Diverse fit statistics were used to assess the goodness of fit for the two models (see Table 2).

Table 2: Goodness of fit for the models

Indices	boys	Girls
$\chi 2$	68.83	30.98
$\chi 2$/df	6.89	3.098
Df	10	10
GFI	0.99	0.99
AGFI	0.96	0.98
RMR	0.077	0.037
RMSEA	0.057	0.037
CFI	0.97	0.99
NFI	0.97	0.98
NNFI	0.9	0.95

The index values were obtained for boy and girl models; an index of less than 5 chi square to degrees of freedom was confirmed the model fitness. The fit indices of NFI, NNFI, CFI, IFI, CFI, GFI and AGFI were greater than 0/9; RMSEA less than 0/08 and SRMR index value smaller than 0/1, which confirmed the validity of these models. As a result, models achieve a desirable level of fitness and their adequacies were confirmed. In the final models, the estimated coefficients of the boys and girls samples are presented in Figures 1 and 2 respectively. Data from Table 3 and Figures 1 and 2 show the direct and indirect impacts.

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Table 3: Direct, indirect and total effects and paths coefficients in the model for boys and girls

paths	INDIRECT EFFECT			DIRECT EFFECT	TOTAL EFFECT	
	girls	boys	girls	boys	girls	Boys
To math confidence From Social-Economical statues From school climate From math attitude From school attachment From math strategies	-0.14** -o.o1 0.38** 0000 -0.17**	-o.15** -0.09** 0.39** 0000 -0.14**	-0.05* -0.01 0.04 -0.02 0000	-0.03* -0.01 0.03 0.03 0000	-0.19** -0.02 0.42** -0.02 -0.17**	-0.18** -0.10** 0.42** 0.03 -0.14**
To math attitude From Social-Economical statues From school climate	-0.07* -0.02	-0.01 -0.02	00000 00000	00000 00000	-0,07* -0.02	-0.01 -0.02
To math strategies From math attitude From school climate From school attachment From Social-Economical statues	-0.18** 0000 0.13** 0.13**	-0.18** 0000 0.19** 0.17**	0.03* 0.01 0000 0000	-0.05* 0.05* 0000 -0.01	-0.21** 0.01 0.13**** 0.13	-0.23** 0.05* 0.19** 0.16**
To computer use From Social-Economical statues	0.20**	0.21**	0000	0000	0.20**	0.21**
To school attachment From Social-Economical statues From school climate						

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From math attitude	-0.05*	-0.06*	0.02	0.01	-0.07*	-0.05*
	0.06	0.21**	0000	0.01	0.06	0.22
	-0.26**	-0.28**	0000	0000	-0.26**	-0.28**
To school climate From Social-Economical statues	0.03	0.01	0000	0000	0.03	0.01
To math achievement From Social-Economical statues	0.31**	0.37**	0.08**	0.06**	0.39**	0.43**
From school climate	0.07**	0.07**	0000	0.07**	0.14**	0.07**
From math confidence	-0.30	-0.28**	-0.01	-0.01	-0.31**	-0.29**
From math attitude	0.03	0000	-0.11**	-0.1**	0.08**	-0.1**
From math learning process	0000	0000	0000	0000	0000	0000
From computer use	-0.03	-0.08**	0000	0.01	0.03	-0.07**
From school attachment	-0.16**	-0.14**	0.02	0.02	-0.14**	-0.12**
From math strategies	0.06**	0.06**	0.06**	0.05**	0.12**	0.12**
to math learning process From Social-Economical statues	0.07*	0.06*	0.07**	0.08*	0.14**	0.14**
From school climate	0000	0000	0.01	0.02	0.01	0000
From math confidence	-0.15**	-0.17**	0000	0000	-0.15**	-0.17**
From math attitude	0000	0000	-0.10**	0.11**	-0.10**	0.11**
From computer use	0.12**	0.13**	0000	0000	0.12**	0.13**
From school attachment						
From math strategies						

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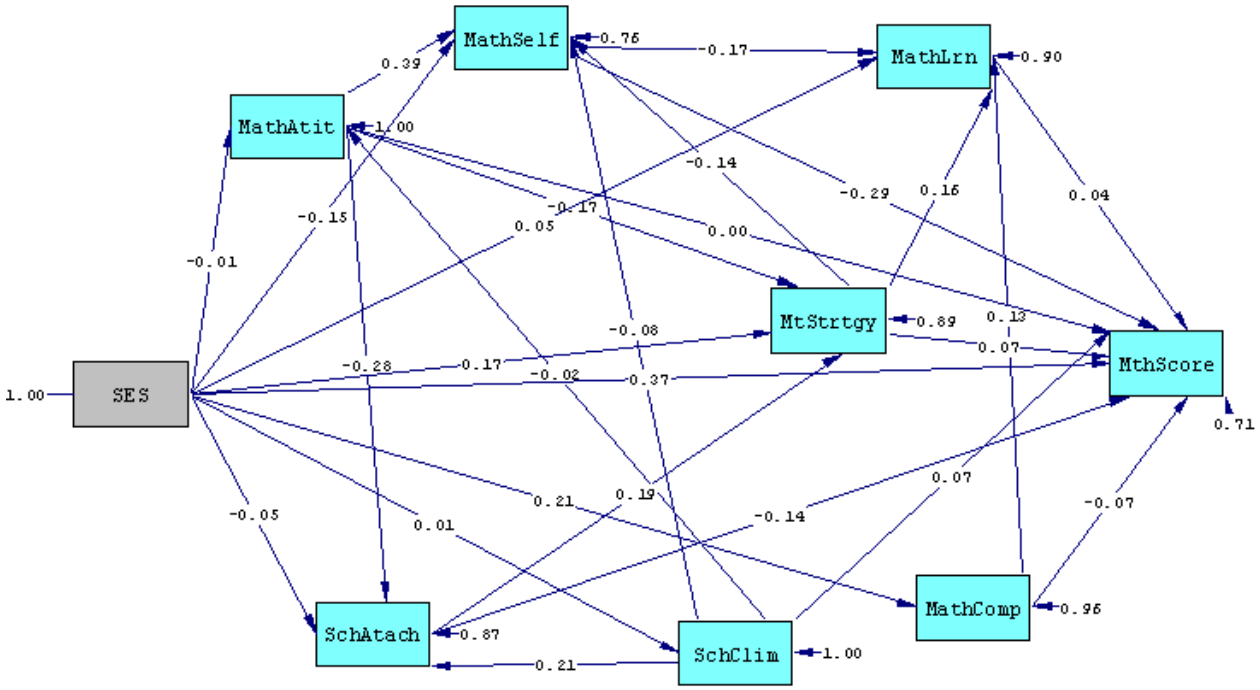
	0000 0.17**	0000 0.16**	0.03 0.02	0.04* 0.02	0.03 0.19**	0.04* 0.18**



Chi-Square=68.83, df=10, P-value=0.00000, RMSEA=0.057

Figure1: Complete Model with Parameter Standardized Solution (Girls)

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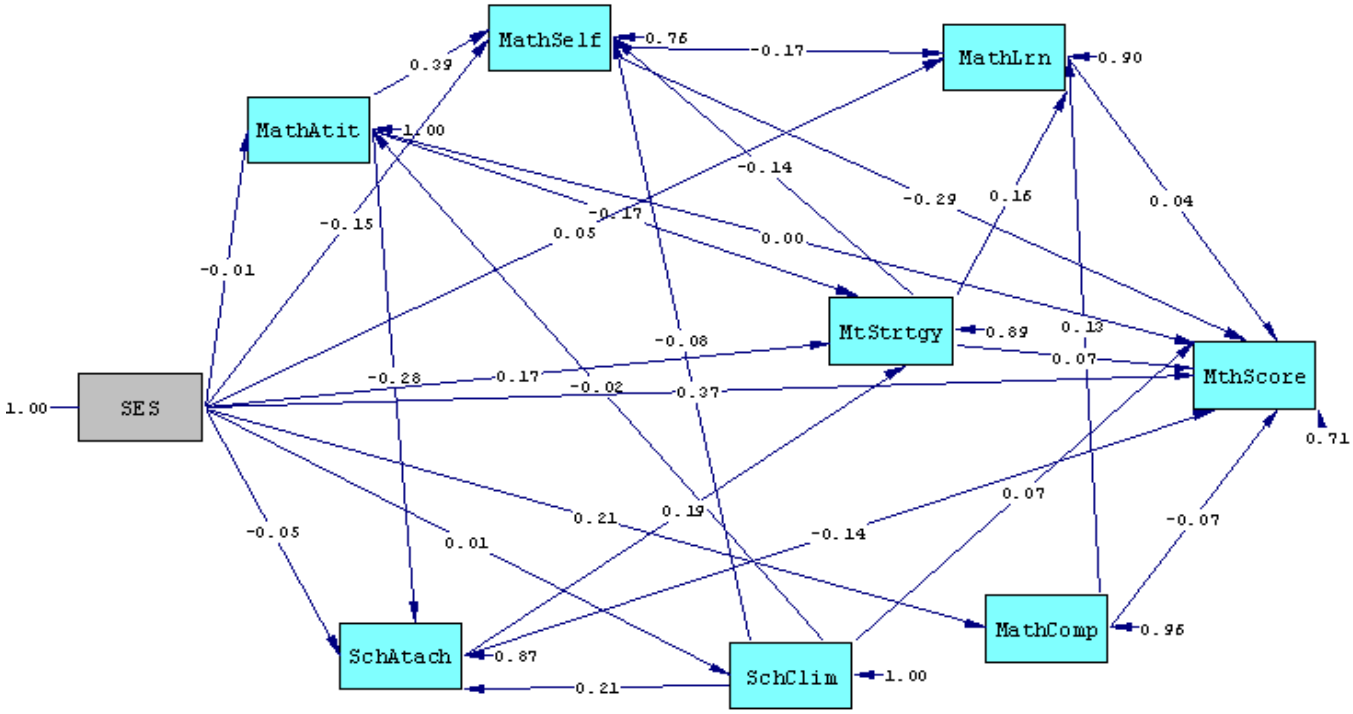

Figure2: Complete Model with Parameter Standardized Solution (Boys)

Testing the Equality of Paths

The equality of the structural paths between the girls' and boys' models has been tested using multiple group analysis. Some of the paths in the models were significant.

Table 4: Testing equality of paths (girls' and boys' model)

Chi	Df	p-value
59.87	26	0.001

Conclusions

This study showed that boys' and girls' models have nearly similar patterns. Better socioeconomic status provide better learning tools for students .The effect of Math self-concept on Math achievement was significant in both groups. On the other hand, in reviewing the relationship between teacher and student variables associated with student achievement, multilevel analysis showed that a student's achievement is directly linked to teacher characteristics. Math teachers' attitudes and teaching experience are important factors in using learning strategies such as cooperative learning, problem solving techniques, and engaging with math problems.

In this study, only some of the teachers' characteristics and their relationship with the math achievement of students were reviewed. In order to determine the causes of the students' math failure, variables related to teacher, variables related to principal and school environment require to be more thoroughly studied.

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