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The Comparative Analysis on Mathematical Achievement, Self-efficacy, and Self-concept Based the Perceived Classroom Climate

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ABSTRACT: The current study is aimed at conducting a comparative analysis on mathematical achievement, self-efficacy, and self-concept based on the perceived classroom climate among female and male students. For this purpose, 400 students (222 male and 178female) as respondents from 3rd grade of high school by means of cluster sampling technique(educational regions, high schools, classrooms, and student) and they answered to the questions derived from WIHIC questionnaire, mathematical self- efficacy questionnaire, mathematical self- efficacy inventory, and mathematical Self- concept Description Questionnaire. The results of route analysis indicated that mathematical self-efficacy rate was interpreted as 7% among female's students and 8% among male students. The variance of mathematical self-concept based the perceived classroom climate was expressed at higher percent in female students than in male group of students (32% versus 26%), while based on the internal variables in this model, the score of mathematics was interpreted as higher among male students than in female group (27% versus 13%). The findings came from route analysis showed that this difference are adjustable by the some variables as mathematical self-efficacy.

Key words: Mathematics Achievement, Mathematical Self- efficacy, Mathematical Self- concept, Perceived Classroom Climate, Students

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INTRODUCTION

The importance of mathematics is adequately so high that UNESCO called year 2000 as year of mathematics. Mathematics is one of the essential and effective lessons that influence in students' educational performance and occupational future. Both due to its instinctive beauty and for the sake of its different applications, has drawn highly attention by others. The international Association for Evaluation of Educational Achievement (IEA) has explored into the students' mathematics performance from many countries of the world in a Trend in International Mathematics and Science Study (TIMSS) test. As one the member states of IEA association, Islamic Republic of Iran has participated in this test in several years (1995, 1999, 2003, 2007, 2011) and has achieved to some ranks respectively as 38th rank among forty one countries, 31st rank among thirty three nations, 31st rank among 46 countries, 29th rank among 49 countries, and 32nd rank among forty two countries (TIMSS national association and PIRLS, 2008). With respect to TIMSS findings, Kiamanesh and Noori (1997 & 1998) have emphasized on Iranian students' mathematical under- achievement. One of the important and significant issues in teaching and learning field is the poor performance of Iranian students during five EIA exams. In this regard, one can refer to the studies done by Pahlavan Sadegh (2005), Nasr Isfahani (2003), Sadegh Nasri (1999), Anjum (2006), Martin et al (2004), and Peterson et al (2000).

Mathematical self-efficacy may be expressed ad one of the important factors on mathematical performance. In their studies, Anjum (2006), Martin et al (2004), Pahlavan Sadegh (2005), Nasr Isfahani (2003), Peterson et al (2000), Kabiri (2003), Pajares and Miller (2003), Pirhosseinloo (2003) and Wilkins et al (2004) reported direct and indirect effect of mathematical self-efficacy on mathematical achievement. One could define mathematical self-efficacy as "Status evaluation for individuals' confidence on their abilities to successful performance or completion of duty or solving a certain mathematical problem" (Hacket and Betz, 1989; after Pajares et al, 2003: 216).

Mathematical self-concept is the other important variable in mathematical achievement. Within several separated investigations, Pahlavan Sadegh (2005), Nasr Isfahani (2003), Wilkins (2004), Pajares and Miller (2004), Martin et al (2004), Peterson et al (2000), Anjum (2006), and Pourasghar (2004) have confirmed the effective role of mathematical self-concept on mathematical achievement. ("Impressions and perceptions about individual abilities for learning and doing math assignments", Wilkins, 2004, quoted from Reiss, 1984: 559).

It may be implied that learning and educational achievement among individuals are affected by the complex conditions. These conditions have various elements and each of them specifically effect on them. The existing individual and gender- related differences are one of the elements that play role in learning mathematics and personal learning environment.

Learning climate, which is occasionally called also as "learning situation 1" and "learning context 2", is a general term and it refers to several aspects of

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training centers. Classroom learning climate refers to an area or situation in which learners and teacher may interact to each other and they could exploit from various information tools and sources in order to pursue their learning activities (Nijhuis, 2008). At present, there are many studies regarding perceived learning climate that show the positive perception toward learning context may positively effect on improving cognitive consequences (Wubbels, T., Brekelmaans, M., & Hooymayers, H.P, 1991), positive attitude to classroom (Henderson and Fisher, 1998; Nair, C . S & Fisher, 1999), and increasing learners' satisfaction (d, 1986). (Nijhuis, 2008)

For example, the recent studies that were conducted about context- focused on cognitive classroom environment (Aldridge, Taylor, Fraser and Chen, 2000; Li & Fraser, 2001), measurement of effective cultural factors on classroom learning (Fisher and Waldrip, 2002), study on learning context in the countries with enriched technology (Khein and Fisher, 2003); Zendolite, 2002) as well as studies done on different learning contexts in various countries (e.g. Khein and Fisher, 2002; Leukeim, 2002) are considered as such surveys (Nijhuis, 2008).

Many studies have been carried out concerning to students' gender and its role in the studied variables among of them some suggest lack of relationship (Rein et al, 2008; Keramati & Shahraray, 2004; Pahlavan Sadegh 2005), while some other reflect the existing relationship (Seif Hashemi, 2003; Walsh et al, 2005; Noori 2002; Melbas et al 2000) among gender and other studied variables. The findings of Pintridge and De Grout (1990) signify that in primary schools, boys and girls possess the confidence at the same level but the male students from high school have shown more confidence than female high school students.

In his study, Razavieh (2005) had come to the results that mathematical educational performance is better among female students than in male students. In his survey, Keramati (2001) had reported that there was a positive significant relationship among mathematical self efficacy and performance in mathematics lesson but no significant difference was observed regarding gender. Hack and Betz (1981, quoted from Wolfolk Hoy and Spiro, 2005) indicated that mathematical self-efficacy expectations in male academic students are stronger than in female students and in another study which they conducted, male students acquired higher scores in self- efficacy. Compared to females, male students evaluated mathematics as more helpful and they took better attitude toward mathematics and they assured further on their capabilities in mathematics. According to Wolfolk Hoy and Spiro (2005), an investigation was carried out on role of gender in ideas about mathematical and computer self-efficacy and the results suggest that the rate of beliefs in the mathematical and computer perceived self-efficacy is higher among male teens than in female teenagers (Shank and Pajares, 2002).

On the other hand, Pajares (1999) stated that a difference could be seen generally among sense of self efficacy and field of mathematics and natural sciences especially in both genders between racial minorities while blacks compared to Caucasians and also girls in comparison to boys feel lower sense of self efficacy.

Gholati (2001) in his study on the relationship among social support and self-efficacy and research habits in lesson of natural sciences and their comparison among female and male students found that educational self-efficacy in lesson of natural sciences plus subscale of social support (family and others) have a positive and significant relationship with elements of research habits (cohesiveness, control, and memorizing contents).

The studies conducted on self-concept and genders have been followed by different results. Several investigations (Pajares and Miller 1994Y Skalovic and Rankling 1994; Teddman and Faber 1995Y after Apapchich, 1998, Yeung and Clark 1999; Marsh 1998, quoted from Pajares and Shank, 2001) showed that male academic and school students in primary schools and high schools had reported higher level of mathematical self-concept than female academic and school students. Similarly, the studies done by Mull and Scott and Martin (1997), Khalili (1996), and Elizi et al (1998) indicated that girls acquire higher scores in mathematics self-concept than boys and this because of this fact that girls are affected further by those people who play role in their life; female students are more encouraged by teachers. Additionally, girls are more sociable than boys and they are further influenced by others than boys. Consequently, their self-concept is more highly affected by classroom climate than boys. The results of surveys done by Yam et al (1964), Rohani (1980), and Hassanzadeh et al (2004) showed that self-concept in girls is higher than in boys.

Likewise, other studies suggest the lack of difference among both genders in mathematical self-concept. Of these studies one could refer to investigation that was conducted by Pajares and Graham (1999). The findings reflected that there is no different in mathematical self-concept among girls and boys at the end of academic year.

During two previous decades, gender related differences have been the major subject of these studies. Mainly the studies indicate that boys'

mathematical achievement is higher than in girls. One reason has been present for this difference and that is the self-efficacy among boys is higher than in girls students (Maccoby & Jacqueline, 1974Y after Walsh et al, 2005). Despite of these findings that show the boys' superiority in variable of mathematical performance, some studies (Noori, 2002) indicate that among both genders, the score of mathematical achievement in girls was significantly toward their superiority.

Many studies (Melbas et al, 1999) considered boys' superiority over girls in their confidence to learn mathematics and this difference might be still seen even when girls presented better reason for feeling of confidence based on their performance. Walsh et al (2005) examined gender related differences in documents, self-efficacy, and mathematical achievement in sample with 62 fourth graders. The findings came from this investigation show that there is a significant difference in variable o mathematical achievement among both genders in favor of boys while no significant difference exits in variable of self-efficacy among boys and girls. In a similar study that was carried out by Rein et al (2008) under title of gender differences in language/ math self-concept and achievement among adults by means of route analysis method, it was shown that no significant difference was observed among two variables of mathematical self-concept and mathematical achievement between two genders. In another investigation (Keramati and Shahraray, 2004), they showed that no significant difference was seen among girls and boys in terms of mathematical self-efficacy and achievement.

The interwoven nature and inevitable complexity of researches in the field of behavioral sciences doubles the necessity for paying attention to multiple effects of variables. Thus, the present study tends to discuss about the existing differences among both genders regarding variables of mathematical performance, mathematical self-concept, mathematical self-efficacy based on perceived classroom climate.

MATERIAL AND METHODS

The current study was carried out by non-experimental (descriptive) method. Design of the present research is of correlation type by means of route analysis technique. The research statistical population includes female and male high school third graders in the field of math- physics, who study in public high schools at Tehran city during academic year 2012-13. Kukran formula was also adapted to determine sample size in selection of sample and calculation of its size where 400 participants were chosen as sample group proportionally to this size through randomized classification sampling technique.

Tools for data collection

Mathematical self-efficacy measurement tool: The mathematical self-efficacy questionnaire is the inventory that has been prepared by Shirali Pouraghdam Yamchi (2009). This questionnaire has been designed based on Bandura's guidelines (1986, quoted from Kamali Zaj, 2005) about similarity of self-efficacy questionnaire to the field of performance measurement. Apparently, this inventory has been prepared based on scale of Pajares (1995) so that the respondents mark the rate of their ability for any question according to a 11- degree scale ranged from zero (I can't do it at all) to 10 (I perfectly can do it). This questionnaire consists of 13 questions. With respect to questions of math exam at last year, respondent give answers to the questions. Due to benefitting from the acceptable content, the questions of last year exam have been selected from distinguishing rate at high level with item difficulty at average level.

The construct validity of this questionnaire has been examined by Ali Pouraghdam Yamchi (2009). He has extracted factorial structure of this scale at two steps by means of two methods i.e. exploratory factor analysis and confirmatory factor analysis. Analysis on main elements has shown single factor structure. Factorial analysis, which derived by means of confirmatory factor analysis, also was studied (Ali Pouraghdam Yamchi, 2009), that had appropriate validity. Based on report of Ali Pouraghdam Yamchi (2009), the rate of internal consistency for mathematical self-efficacy questionnaire i.e. Cronbach Alpha coefficient was acquired as 0.91. The rate Cronbach Alpha coefficient was also obtained in this study as 0.86.

- Mathematical self-concept measurement tool: To measure mathematical self-concept, the revised self-description questionnaire (Marsh, 1990) was utilized. This scale is according to Marsh's model in fact that has been extracted by means of mathematical related factor analyses and it was constructed based on multiple and hierarchical self-concept model of Marsh and Shavelson (Ali Pouraghdam Yamchi, 2009). It is assumed in this model that self-concept has seven separated and independent dimensions that are combined together and create the more general structure. The seven dimensions of self-concept which are examined and measured by this questionnaire are: physical ability and potential, physical characteristics and features, relationship with parents, verbal self-concept, mathematical self-concept, and self-concept for other lessons in school (Pourasghar, 2004). This questionnaire includes 12 questions in LIKERT scale

and comprising of five choices i.e. completely agreed, agreed, often agreed- often disagreed, disagreed, completely disagreed. These choices have been scored as follows: completely agreed (5), agreed (4), often agreed- often disagreed (3), disagreed (2), completely disagreed (1). Pourasghar (2004) and Ali Pouraghdam Yamchi (2009) have used this scale in Iran and reported the appropriate psychometric features for it.

The antecedent researchers in Iranian community have reported some evidences for construct validity of this scale. Ali Pouraghdam Yamchi (2009) examined structure of this inventory by means of exploratory factor analysis. According to his analysis, this questionnaire has subscales of mathematical interest and perceived mathematical capability. He also verified the acquired structure via confirmatory factor analysis (Table 5-3). Karimzadeh (2001) and Nasr Isfahani (2003) have also examined structure of this inventory and confirmed its construct validity.

Pourasghar (2004) reported reliability of this questionnaire as scale of Cronbach Alpha coefficient (0.89). Others also reported Cronbach Alpha coefficient at higher levels for this questionnaire (Ali Pouraghdam Yamchi, 2009). In our analyses, Cronbach Alpha coefficient for total scale was obtained as 0.81. Reliability coefficient for subscales of mathematical interest (0.70) and perceived math capability (0.76) was also reasonable.

- Perceived classroom climate measurement tool: To measure perceived classroom climate, the What Is Happening In this Classroom (WIHIC) questionnaire (Fraser, Fisher, and Mac Robbie, 1996) was utilized. This questionnaire was designed at high school level and many number of high school classrooms it has been examined by factor analysis and validation (Aldridge & Fraser, 2000; Fraser & Choin, 2000; Raflab & Fraser 2002; quoted from Aldridge, Derman & Fraser, 2004). This scale includes 56 questions and in 7 subscales consisting of students' cohesiveness 2, Teacher's support 3, students' involvement 4, investigation 5, task- orientation 6, cooperation 7, and equity 8 (Fraser, Fisher, and Mac Robbie, 1996). This tool has been adjusted within five scales LIKERT spectrum ranged from "almost never" (1) to "always" (5). Each of subscales may be counted separately. Also in Iran, Nikdel (1989) translated and used it.

In a study, Nikdel (1989) has validated this questionnaire. By means of exploratory factor analysis, he showed that factorial structure of this questionnaire has seven elements based on main form. Fraser, Fisher, and Mac Robbie (1996) reported appropriate Cronbach Alpha coefficient rate for each and every subscales of this questionnaire. In analysis conducted by Nikdel (1989), coefficients values were acquired among 0.89 to 0.95 for these subscales that reflects very high reliability of this inventory. In this research, Cronbach Alpha coefficient was acquired totally for this questionnaire as 0.89 that it confirms the reliability of this inventory.

- Mathematical educational achievement: Student's score in written final term exam in mathematics lesson was considered as his/ her mathematical educational achievement. Meanwhile, these marks were received from school head office.

Method Administration

A series of adjusted questionnaires were preliminarily administered in several math- physics classrooms (Grade III). Then the questionnaires were delivered by cooperation with Tehran City Training and Educational Organization (area no. 5) and for receiving recommendation letter from these areas and the administrator has referred to the given high school and selected one or two classrooms out of these schools with respect to classified sampling done in these areas and questionnaire forms were distributed among students. Furthermore, the required explanations were presented to them regarding goal of research and by focus on considering mathematics classroom in giving responses to the questions and some recommendations including carefulness and selection only one option among multiple choices before administration of the questionnaire and finally since research goal was prediction of students' educational performance in mathematics so list of mathematical scores of students at the last year final exam (year 2012-13) was taken from the schools.

RESULTS

In order to examine this question in the assumed model, the variables were tested separately by means of data from female and male students. Fitting parameters of route model for girl and boy groups that may be seen in Table 1-1 (girls and boys). All the fitting parameters of this model were at appropriate level (girls and boys) including Chi-2 square to degree of freedom (d.f), Comparative Fit Index (CFI), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), and Root Mean Square of Errors Approximation (RNSEA).

One could observe coefficients of direct, indirect, and total values along with the interpreted coefficient s for any endogenous variable in the Table 1- 3. The grey background for girls' group and white background for group of boys are indicated d here.

Based on reported findings in above table, mathematical self efficacy was interpreted as 7% in group of girls and 8% among group of boys. The

higher percentage of variance for mathematical self-efficacy was interpreted in girl's group than in boy's group (32% vs. 26%).while score of mathematical achievement was interpreted as higher in boys group than in girl group (27% vs. 13%). Coefficients of direct and indirect and total effect for both groups are statistically significant. Further, the direction of effect is positive for both groups throughout all routes.

In contrast to the acquired direct effects in both models (girls' model compared to boys'), it can be noticed that total model of coefficients is identical. Nevertheless, one could see a few differences in this regard: The rate of effect of variable perceived classroom climate on mathematical self-efficacy in group of girls (0.46) is stronger than in boys' group (0.28). The effective rate of mathematical self-efficacy on mathematical self-concept variable is greater in group of boys (0.35) than in group of girls (0.22). The rate of effect in mathematical self-efficacy on educational achievement is approximately the same but effect of self-concept on mathematical achievement in group of boys (0.40) is obviously stronger than in girls' group (0.23). It can be noted that the direct effect of variable of perceived classroom climate on educational achievement did not become significant in both groups.

Also indirect effects of model are almost the same in both groups with model. The indirect effect of perceived classroom climate on mathematical self-concept in group of girls is slightly lower (0.06) than in group of boys (0.10). As such, this effect in girls' effect is only significant alt level 0.05. The indirect effect of mathematical self-efficacy on educational achievement in group of boys (0.14) is greater than this effect in girls' group (0.06). It can be mentioned that this effect in group of girls is significant at level 0.05.

Table 1. Fitting parameters of general route model in girls and students.

Gender	RMSEA	AGFI	GFI	CFI	χ^2/df	df	χ^2
Girl	**0.01**	**0.99**	**1**	**1**	**0.98**	**1**	**0.98**
Boy	**0.01**	**0.99**	**1**	**1**	**1.13**	**1**	**1.13**

Table 1. Coefficients of direct, indirect, and total value of route model and interpretation coefficients for both groups of and boys

Routes	Direct effect		Indirect effect		Total effect		Interpretation Coef.	
Variable	Girl	Boy	Girl	Boy	Girl	Boy	Girl	Boy
On mathematical self-efficacy from								
Perceived classroom climate	0.27 **	0.27 **	-	-	0.27 **	0.27 **	0.07	0.08
On mathematical self-concept from:								
Perceived classroom climate	0.46 **	0.28 **	0.06 *	0.10 **	0.52 **	0.28 **	0.32	0.26
Mathematical self-efficacy	0.22 **	0.35 **	-	-	0.22 **	0.35 **		
On mathematical achievement from								
Perceived classroom climate	-	-	0.18 **	0.21 **	0.18 **	0,21 **	0.13	0.27
Mathematical self-efficacy	0.22 **	0.20 **	0.06 *	0.14 **	0.28 **	0,34 **		
Mathematical self-concept	0.23 **	0.40 **	-	-	0.23 **	0.40 **		

0.05, P< 0.01 *, p<**

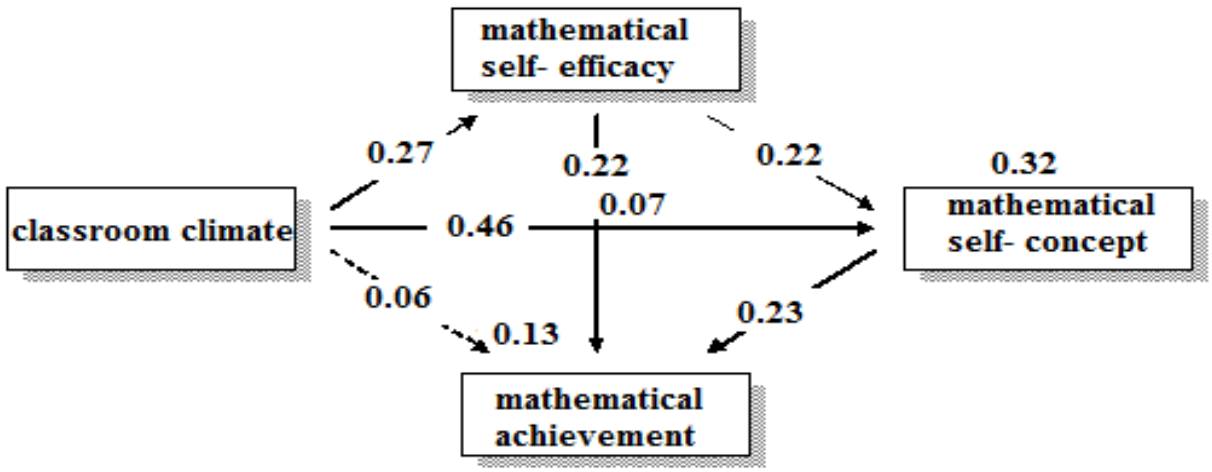

Fig. 1. Diagram of fitted routes model with standard coefficients for group of girls

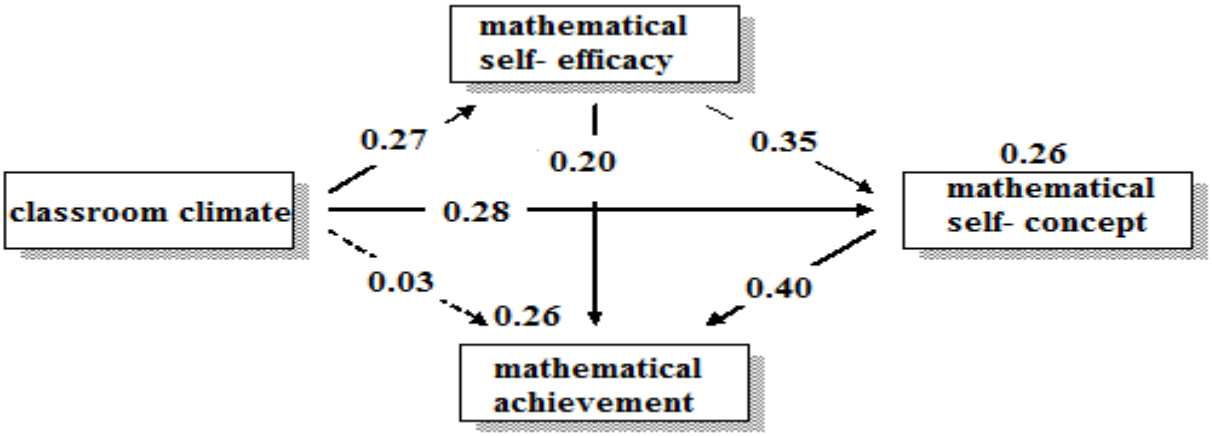

Fig. 2. Diagram of fitted routes model with standard coefficients for group of boys

DISCUSSION

The results suggest that mathematical self-efficacy in girls' group was interpreted lower than in group of boy based on perceived classroom climate. This finding is complied with the results of studies done by Naghsh and Hejazi (2006), Bali Lashak (2003), Afsharinia (1988), Fenema and Sherman (1978), Hack and Betz (1981) (quoted from Wolfolk Hoy and Spiro, 2005), and Pajares and Miller (1994) (quoted from Wolfolk Hoy and Spiro, 2005) so compared to girls, the boys have greater confidence in mathematical skills.

According to the reported findings in the present research, the higher percentage of mathematical self-concept was interpreted in group of girls than in boys' group based the perceived classroom climate. The studies conducted by Mull and Scott and Martin (1997), Khalili (1996), and Elizi et al (1998) showed that girls have acquired higher scores in variable of self-concept than in boys. So it is because of this fact that girls are further affected by those persons who play important role in their life; girls are further encouraged by teachers and moreover girl are more sociable than boys and more influenced by others. As a result, they possess self-concept more than boys and they will be affected by classroom climate.

The results of this study indicated that the effective coefficient of mathematical self-concept on mathematical achievement was reported stronger in boys than in girls. This finding is in line with results of investigations conducted by Pajares and Miller 1994, Skalovic and Rankling 1994, Teddman and Faber 1995 (quoted from Apapchich Yeung and Clark 1999), marsh 1998 (after Pajares and Shank, 2001) indicated male academic and high school students in primary schools and high schools have reported greater rate of mathematical self-concept than in female academic and high school students in primary schools and high schools.

Similarly, score of mathematical achievement in boys' group was interpreted higher than group of girls based on parameters inside the model. Hide, Fenema and Lamone (after Gluebookand and fivesh, transl. Shahraray 1991) in 1990 with analysis on one hundred studies in which gender differences had been explored in mathematical capability and they concluded that male students have generally better performance than girls.

Direct, indirect, and total coefficients are significant in both groups. Direction of effective coefficients in both groups is positive for all routes. There is noticeable difference among effect coefficients in groups of girls and boys including indirect effects of perceived classroom climate on mathematical self-concept and mathematical self-efficacy on mathematical achievement. These effects are significant only in girls while both effects were stronger in boys' group.

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