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Perceived Classroom Environment and Mathematics Achievement: Mathematics Self- efficacy and Self- concept as Mediators

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ABSTRACT

The current study is intended to explore into the mediator role that mathematics self- efficacy and self- concept play in classroom environment and mathematics achievement. For this purpose, 400 students were chosen (178 boys and 222 girls) as respondents from 3rd grade of high school by means of cluster sampling technique (educational regions, high schools, classrooms, and students) and they responded to *What IS Happening In Classroom Questionnaire* (WIHIC), mathematic self- efficacy inventory, and mathematic self- concept questionnaire. Results of analysis indicated that direct coefficient of classroom environment has not significantly affected on educational achievement (0.04) while indirect coefficient of classroom might significantly effect on educational achievement by mediator variables of mathematic self- efficacy and mathematic self- concept. With respect to the results which have been derived, it seems that due its role that played in self- efficacy, environment might alter individual judgment about learning of mathematics and such judgment might effect on self- concept per se that is an organized system including beliefs regarding mathematics and it causes mathematical learning via emotional and behavioral reactions concerning to mathematical value and thinking techniques in this field.

KEYWORDS: Classroom environment, Mathematics self- efficacy, Self- concept

1. INTRODUCTION

To manage personal living effectively in daily life, it is crucially important to select the appropriate educational discipline and occupation [1]. Furthermore, mathematics is widely used in many scientific fields including economics, political sciences, social sciences, behavioral and medical and behavioral sciences. Thus, it is considered as an essential lesson in curricula at all educational degrees ranged from primary schools to higher [2] and educational achievement of school and academic students in this lesson and prevention from their educational failure have been turned into one of the main concerns for educational systems throughout the world so that many studies have sought for the effective factors on learning mathematics.

Baloglu and Kocak [2] have claimed that more than half of variance of educational achievement in mathematics might be interpreted by several variables rather than intellectual potential (intelligence). Classroom environment is one of these variables, which may play vital and strong role in educational, cognitive, psychological and behavioral performance of students [3, 4, 5].

Fraser defines learning environment as social, psychological and educational contexts where the learning occurs and its effects on students attitudes and achievement. Perception may be conceptualized as a common perception of a group of students in a certain environment and or ad perception of a student from his/ her classroom experiences [6]. Study on perceived classroom environment is based on this assumption that student's perception from classroom environment is linked to his/ her background and personal features and this, in turn, may effect on the way of his/ her thinking about the surrounding environment as well as his/ her approach toward the environment around [7]. Schonfeld [8] expresses that student's beliefs and ideas about mathematics are also extremely influenced by his/ her classroom experiences. Mathematics self- efficacy and self- concept are two types of such beliefs and perceptions that are affected by classroom environment.

Concept of self- efficacy is the key elements of social- cognitive theory of Bandura. Bandura defines self- efficacy as personal beliefs regarding one's capacities for learning or activities at certain levels. From viewpoint taken by Bandura [9], self- efficacy is context- specific, task- specific, and situation- specific. Namely, with respect to certain context of doing task (like mathematics or natural sciences lesson), certain situation of conducting duty and specific task, self- efficacy level is determined. Mathematics self- efficacy may be defined as situational evaluation of individuals' confidence from their abilities in successful doing or completion of mathematics certain task or problem [10].

Impressions and perceptions of any person from him/ her, which he / she might attach highly importance for them, is called self- concept. Self- concept is an integrated and dynamic totality derived from individual's images, beliefs, and attitudes toward his/ her extrinsic and intrinsic characteristics and features, which form by

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interaction of inside and outside experiences and gradually complicated and transformed [11]. Shavelson et al. [12] have purposed a hierarchical and multi- facet model of self- concept in which total self- concept is divided into two elements: educated self- concept and uneducated self- concept. Educated self- concept is also classified into some sub- components including mathematics and natural sciences self concept etc. and uneducated self- concept is subdivided into social self- concept, emotional self- concept, and physical self- concept [13].

Several studies [10, 14, 15] signify that self- efficacy, particularly in mathematics field, is a strong predictor variable for mathematics achievement. Findings from a meta- analysis also reflect the relations among self- efficacy and educational achievement at average level (r=0.38) [16]. In his studies, Schunk [17] shows that self- efficacy ideas may approximately predict twenty five percent variance of educational achievement and even beyond the effects of educational insights. In another investigation, Pajares and Miller [18] found that the impact of self- efficacy might affect on performance in mathematics as the same as general intellectual ability on performance in mathematics lesson [19].

On the other hand, many studies [13, 20-23] reported a positive and significant relationship among mathematics self- concept and mathematics achievement. A survey conducted by Winston [24] indicated that there is positive significant relationship among mathematics self- concept and mathematics achievement. The result derived from study done by Nasri [25], regarding review of the relationship among mathematics performance and some psychological variables in students, showed that variables of mathematics self- efficacy and self- concept might affect on mathematics performance and interpret this variable.

Rather than the existing relations among classroom environment, self- efficacy, self- concept, and educational achievement, variables of self- efficacy and self- concept are also related together. In a study done by Pajares and Miller [18] by means of route analysis method, the role of mathematics self- efficacy is examined in mathematics performance with respect to variables of mathematics self- concept, anxiety, perceived usefulness, previous experiences, and gender in a sample space with 350 respondents based on social- cognitive theory. Direct impact of mathematics self- efficacy has been reported high and significant on variable of mathematics self- concept and at the same time by impact on mathematics self- concept, mathematics self- efficacy affected indirectly on mathematics performance.

Thus, the present study is aimed at review of fitting of the following conceptual model (Fig. 1), which interpret the relationship among perceived classroom environment and educational achievement with mediator variables of mathematics self- efficacy and self- concept. Therefore, in this research the hypothesis expresses that perceived classroom environment might affect indirectly on mathematics achievement through self- efficacy and self- concept.

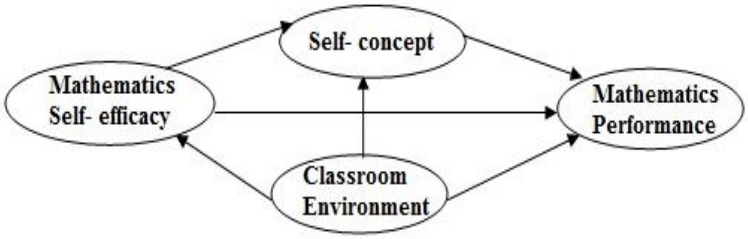

Fig 1: Primary route model of research

2. MATERIAL AND METHODS

The current research was carried out by means of non- trial (correlation) technique.

2.1. Population and Sample

The participants in this study included girl and boy students at 3rd grade of high school in the field of math- physics from Tehran public high schools in academic year 2012-3. To conduct this study, the sample space was attained at least the needed 383 participants but in order to approximate default adequate sample for modeling this number was increased to 400 respondents. Therefore, 178 boys and 222 girls were chosen by means of cluster sampling technique (from Tehran educational regions no 1, 2, 4, 6, and 19; school, classroom, and students).

2.2. Research Tools

2.2.1. What Is Happening in Classroom (WIHIC) Questionnaire: made by Fraser [6] was used for measurement of perceived classroom environment of high school students. This questionnaire was made based on "What is happening in this classroom" (WIHIC), including 56 questions and by using LIKERT Five Scale Spectrum with seven sub- scales (8 questions per each one). In Iran, Nikdel in year 2010 has validated this questionnaire where the factor analysis confirmatory indices (goodness of fit index 0.96; adjusted parameters of goodness of fit 0.94) are appropriate. In study which was done by Nikdel, coefficients of internal consistency among sub- scales were derived from 0.89 to 0.95. Total value of test internal consistency was also 0.89 in the

current study while values in sub scales internal consistency were given respectively for students' cohesiveness (0.74), teacher's support (0.71), students' involvement (0.80), investigation (0.85), task- orientation (0.84), cooperation (0.76), and equity (0.82).

2.2.2. Mathematics Self- efficacy Questionnaire: This inventory was prepared by Pooraqdam Yamchi and Behrangi [26]. Mathematics self- efficacy questionnaire (13 questions) has been designed based on guidelines from Bandura [27, 28] about similarity among self- efficacy and field of performance measurement. To respond to this questionnaire, with respect to questions of their former math exam, participants mark their ability per question in 11 degrees scale that ranged from zero (I never do it at all) to 10 (I perfectly do it). Its construct validity was confirmed (goodness of fit index as 0.90; adjusted goodness of fit index as 0.86) and reliability of this questionnaire was given as 0.91 in the study done by Pooraqdam Yamchi and Behrangi [26] and in this research as 0.86.

2.2.3. Mathematics Self- concept Questionnaire: To measure mathematics self- concept, Marsh's Revised Inventory (1990) was adopted. This criterion is responded in LIKERT five scale spectrum (ranged from completely agreed to completely disagree). Pooraqdam Yamchi and Behrangi [26] examined factor analysis for this scale and showed that this scale has two variables: interest in mathematics (7 questions) and perceived mathematics ability (5 questions) and it possesses construct validity (goodness of fit index, 0.97; adjusted goodness of fit index, 0.90). Similarly, in order to examine reliability of this questionnaire, internal consistency technique was utilized where test total coefficient was given as 0.81 and these values for variables of interest in mathematics and perceived mathematics ability were 0.70 and 0.76 respectively.

2.2.4. Mathematics Educational Achievement: Student's score in final written exam in mathematics was considered as the parameter for educational achievement in mathematics.

2.3. Technique of Execution

After talking to teachers and acquiring their permission, total goal of research was explained for participants (we intended to know what your opinion is about some educational issues). Then they were told that each one who would not like to respond to this questionnaire, he/ she could express opinion. Similarly, they were told to read instructions in questionnaires carefully before answering to their questions and then check out answer sheet against the given phrases hereunder with respect to their real idea and comment.

3. RESULTS

To examine the relations among classroom environment and mathematics achievement as well as the mediating role of mathematics self- efficacy and mathematics self- concept, route analysis technique was used.
Results came from Pearson Correlation showed that there was a positive significant relationship among mathematics self- efficacy, perceived classroom environment, mathematics self- concept with achievement in mathematics as 0.36, 0.25, and 0.42 respectively. Also there is a positive significant relationship among variables of mathematics self- concept and perceived classroom environment at level 0.44. (Table 1).

Table 1: Correlation matrix of the studied variables

Row	Variable	Mean	Standard Deviation	1	2	3
1	Educational Achievement	16.10	3.59			
2	Mathematics Self- efficacy	86.37	27.11	0.36**		
3	Perceived Classroom Environment	188.21	31.91	0.25**	0.31**	
4	Mathematics Self- concept	43.29	7.77	0.42**	0.41**	0.44**

P<0.01; N= ** 400

Before implementation of route analysis implementation, presuppositions for model execution (normality, linearity, and multiple non- collinearity) were examined that it showed test hypotheses were approved. Fitness index of model (X^2/df= 1.01; CFI= 1; GFI= 1; RMSEA= 0.01) verified model fitness with the given data.
The results of route analysis indicated that standard regressive coefficient for variable of perceived classroom environment is not directly and significantly related to variable of educational achievement (0.04). the standard regression coefficient of variable of perceived classroom environment indirectly significant (0.21) via mathematics self – efficacy, and also mathematics self- concept with educational achievement so that in this model 22 percent of variance of educational achievement is interpreted by means of variables of perceived classroom environment, educational self- concept, and mathematics self- efficacy (Table 2).

Table 2: direct and indirect coefficients in route analysis model

Routs	Direct	Indirect	Total	Interpreted Coefficient
From perceived classroom environment on self- efficacy	0.31 **	-	0.31 **	0.10
From perceived classroom environment on educational self- concept	0.35 **	0.09 **	0.44 **	0.28
Mathematics Self- efficacy	0.30 **	-	0.30 **	
From perceived classroom environment on educational achievement	0.04	0.21 **	0.25 **	
Mathematics Self- efficacy	0.23 **	0.10 *	0.33 **	0.22
Mathematics Self- concept	0.32 **	-	0.32 **	
P< 0.01; p<0.05 **; N= 400 *				

In the following, the given model was drawn to improve understanding of the relationships between variables. Dotted lines refer to insignificant relations (Diagram 1).

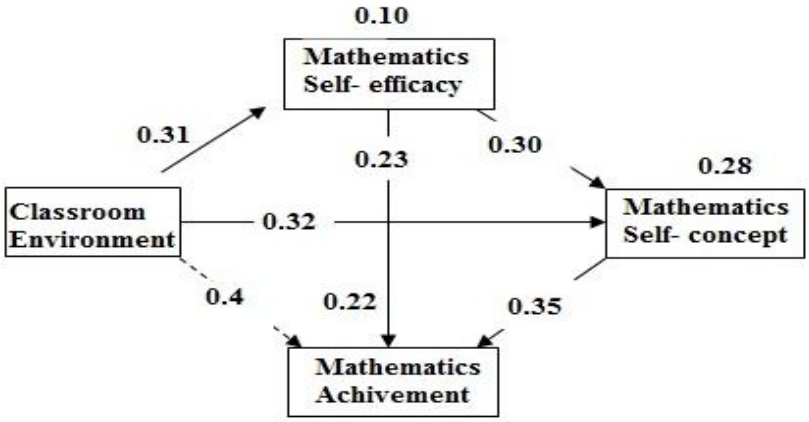

Diagram 1: standard direct and indirect coefficients (dotted lines: insignificant coefficients; solid lines: significant coefficients)

4. DISCUSSION AND CONCLUSION

The present study was intended to examine the relationship among learning environment and mathematics educational achievement by means of mathematics self- efficacy and mathematics self- concept. The results of this study presented some evidence about indirect role of learning environment in educational achievement while obtained findings did not approved the direct relation among learning environment and educational achievement.

As Lewin (1976) argues, the behavior is only significant within the context of the environment where it occurs. In other words, individual's behavior is a reflection of internal relations between conditions and forces which exist upon its accurate occurrence and act at this time. Individuals and their environment are like correlated existences that are interrelated to each other; both environment and environmental interactions with personality features of the present individuals in them are strong determinants for the results. Therefore, it may be concluded that classroom environment and the interactions made among them are related to personal attributes of students in terms of affection on their learning attitudes and behaviors. Several investigations have shown that students' perception of their classroom may affect on their related educational and social motive and belief, learning strategies, involvement in learning activities, getting help from others, educational achievement, and emotional performance [5, 29-32].

Similarly, along with theory of Bandura, it could be expressed that environment may play essential role in self- efficacy beliefs and as it inferred from definition purposed by Hacket and Betz [10], this causes the person to be aware of his/ her abilities in doing or completion of the certain task or issue in mathematics successfully and as a result, self- efficacy, which is context- specific, task- specific, and situation- specific, will occur [9]. At the same time, Bandura states that such self- efficacy and individual's confidence that forms through interaction with surrounding environment and interpretation of these interactions about them [12] and it is beneficial for him/ her may also form individual's self- concept and mathematics self-concept, which comprises of an organized system from beliefs in mathematics field, leads to emotional and behavioral reaction to mathematics value and its thinking techniques as well as trusting and motive for learning mathematics [33]. According to the model presented by Marsh and Shavelson [34], students comprise their own perceived mathematics skills with their other verbal skills and they employ such intrinsic comparisons as one basis or second cornerstone for achieving self-concept in any field. For example, I will have a positive mathematics self- concept if my perceived mathematics

skill is better than my other skills in my educational subjects in school. This positive self- concept also leads to further educational achievement in mathematics [18].

In a study conducted by Falati [35], the relationship among classroom environment and self- efficacy, which deals with review the relation of social support that serves as a component in classroom environment and self- efficacy in natural sciences lesson, is in line with this idea. Wolters [36] has also indicated the relation of classroom structure with positive educational outcomes including belief in self- efficacy. The relationship among self- efficacy and self- concept with mathematics achievement that was acquired in this research has been also verified by findings from studies done by Nasr Isfahani [37], and Winston [24].

Results of this study indicated that learning environment may indirectly affect on learning mathematics but as it already expressed, without considering its results on self- efficacy and self- concept no one could examine school environment so that to justify learning mathematics.

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