The Role of Self-Efficacy, Achievement Goals, Learning Strategies and Persistence in Math Achievement of 11th Grade High Schools Students in Tehran

Maryam Mohsenpour[1]

Elaheh Hejazi (Ph. D.)[2]

Alireza Kiamanesh (Ph. D.)[3]

Abstract

The purpose of the present research was to investigate the effect of self-efficacy and achievement goals as motivational variables and learning strategies and persistence as cognitive variables on student mathematics achievement. Tehran public secondary schools were stratified and 389 boy and girl students from among third grade of the secondary schools were selected randomly. A questionnaire consists of 6 subscales including self-efficacy, mastery goals, performance-approach goals, avoidance-approach goals, learning strategies and persistence adopted from instruments of Miller and et.al. (1996) and Middleton and Midgley (1997) was administered.

1 - M. A. in Educational Research
2 - Assistant professor of the University of Tehran
3 - Professor of the Teacher Training University, Tehran

Furthermore, students' final math exam grades were used to assess their achievement. Path analysis method was used for data analysis. The results revealed that there was a relatively good fit between the hypothesized model and the observed data. The direct effects of performance-approach goals, avoidance-approach goals, self-efficacy, learning strategies and persistence on mathematics achievement were confirmed. Self-efficacy had the most direct effect on mathematics achievement, compare to other variables of the proposed model. Mastery goals had a significant indirect effect on mathematics achievement through self-efficacy, learning strategies and persistence. The mediating role of persistence between avoidance-approach goals and mathematics achievement was significant but small in magnitude.

Key Words: Path Analysis, Self-Efficacy, mastery Goals, Performance-Approach Goals, Avoidance-Approach Goals, Learning Strategies, Persistence and Mathematics Achievement.

Introduction

Based on needs and their values system, different societies have studied mathematics from different perspectives in various time periods. In the current era, human life has become complicated due to the technological achievement; therefore mathematics has stabilized its position in all social and industrial fields. Having no other option, man has depended on mathematics for reaching the suitable answers to his complex questions (Narouyi Danesh, 1989).

Considering the importance of mathematics, the education systems have tried to help students develop their mental faculties and reasoning abilities by incorporating mathematics in their school curriculum and prepare the students to cope with scientific developments and technological achievements in the future life. It

is obvious that suitable education and achievement in the subject of mathematics requires the recognizing of obstacles that exist in the students learning process. It is said that the imposed difficulties on students in mathematics have either a source that is within mathematics or a source outside mathematics. The source that is outer for math difficulties are either intra personal or outer personal. The math problems that have an intra-personal source are initiated from the students' personal characteristics in mental and learning processes, motivation and attitudes. This is while the outer-personal difficulties are due to cultural, social, and educational factors and the method of teaching and teachers' treatments (Alamol-Hoda, 2002).

From amongst the intra-personal elements which effect on mathematical achievement, we can name the motivational and the cognitive ones. From long times ago, psychologists and educators have considered the effect of motivational factors in learning and performance of students of various subject fields (LinnenBrink and Pintrich, 2002). Much of the early research on students' learning and achievement separated cognitive and motivational factors and persuade different paths. Since the 1980s, researches on the interaction of motivational and cognitive elements have been conducted which cooperatively influence the students learning and achievement. Today, there is the agreement that students need both the cognitive skills and the motivational will to do well in school (Pintrich & Schunk ,2002, cited by Linnenbrink & Pintrich, 2002).

Among different models which have been presented to explain the relationship between motivational and cognitive factors and educational achievement, we can refer to Pintrich and De Groot 's study(1990).To show the relationship between cognitive and motivational variables and achievement they used a self-regulated learning model and an expectancy-value model .According to Pintrich and De Groot (1990), three components related to self-regulated learning are important for students performance in the

classroom. The first is metacognitive strategies for planning, monitoring, and changing of cognition. The second one is student management and control of the effort on classroom academic tasks. The third is the actual cognitive strategies that students use to learn, remember, and understand the materials. It should be added that their study showed students who used cognitive strategies had a better performance compare to those who were not inclined using these strategies, and also metacognitive strategies and persistence in doing task were the strongest predictors of performance.

On the whole, researches conducted by Zimmerman & Martinez-Pons (1990); Pintrich and De Groot (1990); Zimmerman, Bandura and Martinez-pons (1992); Greene & Miller (1996); Miller & et. al.

(1996); Elliot, McGregor and Gabel (1999); Pajares & Graham (1999); Simons, Dewitte, & Lens (2004) and Mousavi-Nezhad (1997) indicate that using deep learning strategies (compare to shallow learning strategies) and having persistence in doing tasks lead to better students academic performance.

As was pointed out before, expectancy-value model was the second model used by Pintrich & De Groot(1990) for selecting motivational variables. This model consists of three components: expectancy, value and affection. In this research the focus has been on two components of expectancy and value.

The expectancy component has been conceptualized in a variety of ways such as perceived mastery, self-efficacy and control beliefs. Self-efficacy which involves student's belief about their abilities for understanding or performing an academic task (Hergenhahn & Olson 2001, cited by Seif, 2003) has been focus of many researches. Based on Bandura 's social-cognitive theory(1997) and many researchers conducted by Pajares & Miller(1994 & 1997);Pajares & Graham(1999);Greene & et.al (2004) and Kabiri(1382) self-efficacy plays a major role in predicting academic achievement at different levels of education and in different subject matters specifically mathematics.

Researches done by Zimmerman & Martinez-Pons (1990); Pintrich and De Groot (1990); Ames & Archer(1988); Miller & et. al. (1996); Elliot, McGregor and Gabel (1999);Multon , Brown & Lent (1991);Wolters(2004) and Dali abdi-Nia(1377) also indicate high level of self-efficacy has a significant relationship with using high level of cognitive and metacognitive strategies and persistence in doing academic tasks.

The value component has been conceptualized in different ways such as task value, performance vs. mastery goals and intrinsic interest. In most researches achievement goals have been categorized in two or three types. According to Elliot, McGregor, and Gabel (1999), achievement goals are divided into three groups: a-mastery goals emphasize on the development of mastery and task mastery, b- performance-approach goals directed towards the attainment of favorable judgments of mastery and c- performance-

avoidance goals focused on avoiding unfavorable judgments of mastery. Based on achievement goals theory, mastery goals have a significant relationship with learning outcomes such as self-efficacy (Wolters, Yu, & Pintrich, 1996; Shunk, 1996; Skaalvik, 1997), using deep learning strategies (Ames & Archer, 1988; Elliot & McGregor ,1999; Middleton & Midgley, 1997), and persistence in doing tasks (Miller, et. al., 1993 & 1996; Elliot, McGregor & Gabel 1999). Also, the relationship between performance-approach goals and learning outputs with regard to the nature of outcomes, characteristics of individuals and environment conditions is different. For example, in researches done by Midgley, Anderman & Hicks (1995) and Midgley & Urdan (1995) there is a positive relationship between performance-approach goals and self-efficacy. However, study by Anderman and Young (1994) showed that there is a negative relationship between performance-approach goals and self-efficacy. It should be added that Kaplan,Maehr(1999) ,Pajares,Brinter & Valiante(2000) and Middleton & Midgley (1997) could not find a significant relationship between

performance-approach goals and self-efficacy. Wolters (2004) who also investigated the relationship between motivational and cognitive constructs found that mastery goals and avoidance-approach goals were positive and negative predictors of persistence respectively, while the relationship between persistence and performance-approach goals was not significant.

With regard to the relationship between achievement goals and academic achievement research findings indicate that there is a significant relationship between mastery goals and academic achievement (Pintrich ,2000;McWhaw & Abrami, 2001;Barron & Harackiewicz ,2001 and Wolters 2004),but the relationship between performance-approach goals and academic achievement varys from nonsignificant relationship(Pintrich ,2000;McWhaw & Abrami, 2001 and Wolters,Yu & Pintrich ,1996) to positive relationship(Elliot, McGregor and Gabel ,1999 and Elliot & Church ,1997).Also avoidance-approach goals have a negative effect on academic achievement in various levels of education (Skaalvik, 1997;Elliot, McGregor and Gabel, 1999 and Wolters ,2000).

Overall, review of researches literature shows that the relationship between some aspects of achievement goals and the learning outputs is not quite clear and demands more investigations. The main purpose of this study then is to test the predictions of a casual model that explain the impact of motivational variables (self-efficacy & achievement goals) and cognitive variables (learning and persistence strategies) on educational achievement of students in the field of mathematics.

In order to predict the existence of a causal relationship between the above mentioned variables and mathematics achievement, a theoretical model was designed based on research findings and literature. Path diagram of the model has been provided in diagram number 1.
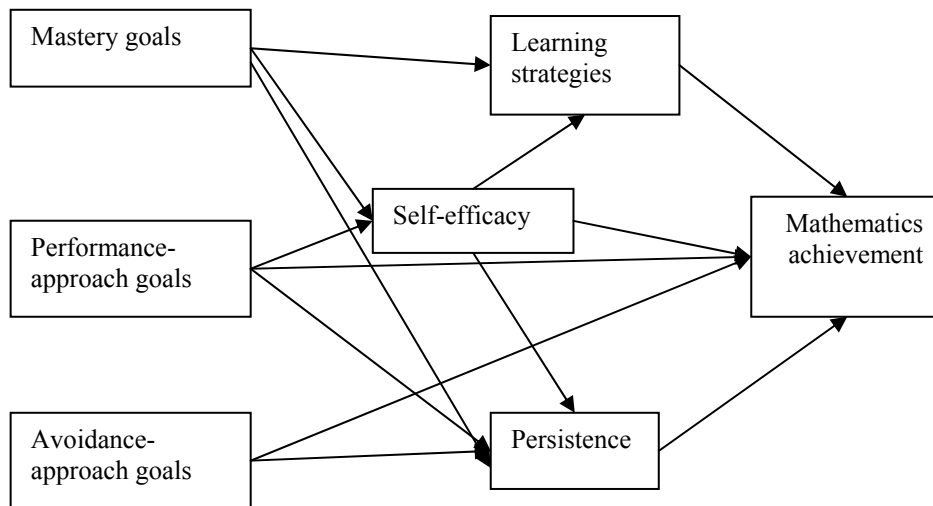
Fig 1– Hypothesized model for prediction mathematics achievement

Method

Participants and Procedures

The population in this research was all the male and female students of 11th grade in the Mathematics branch in public high schools of the city of Tehran in the school-year 2004-2005 .Out of

40528 students 389 students were randomly selected through stratified sampling technique .The instrument used in this study was a self-report questionnaire and were specific to the math domain and used a 4-point scale (1=strongly disagree to 4=strongly agree). The questionnaire consisted of six sub-scales including mastery goals (α=.77), performance-approach goals (α=.83), avoidance-approach goals (α=.65), self-efficacy (α=.79), persistence (α=.70) and learning strategies (α=.78). All the sub-scales were adapted from Middleton & Midgley(1997) and Miller & et.al(1996).

Mathematics achievement was computed on the basis of students' final grade in math.

Confirmatory factor analysis(CFA) using LISREL 8.25 was used in order to confirm that the factor structure of achievement goals is comprised of three unique factors, and the factor structures of self-efficacy, persistence and learning strategies is each comprised of one factor. Table 1 shows the fit statistics for all confirmatory factor analysis.

Table 1-Result of CFA for achievement goals, self-efficacy, persistence and learning strategies

subscales	Fit statistics			
	χ^2/d	GFI	AGFI	RMR
Achievement goals	2.33	.96	.93	.05
Self-efficacy	1.54	1	.98	.005
Persistence	1.45	1	.98	.01
Learning strategies	1.42	.99	.96	.03

As it is shown in table 1, the result confirmed our hypothesis.

Analysis

An examination of zero-order correlation is shown in table 2.According to table 2 the strongest correlation is between mastery goals and learning strategies(r=.63).Among all predictors variables, self-efficacy has the strongest correlation with mathematics achievement(r=.52).Avoidance-approach goals do not have significant correlation with learning strategies, self-efficacy and mastery goals.

Table2-Zero-order correlation between math achievement and predictor variables

variables	1	2	3	4	5	6	7
1.math achievement	1						
2.learning strategies	.44**	1					
3.persistence	.48**	.44**	1				
4.self-efficacy	.52**	.38**	.53**	1			
5.mastery goals	.50**	.63**	.61**	.59**	1		
6.performance-approach goals	.24**	.30**	.17**	.26**	.42**	1	
7.avoidance-approach goals	-.21**	-.03	-.15**	-.10	-.06	.34**	_

* $P < 0.05$ ** $P < 0.01$

Path Analysis

Path analysis was conducted using LISREL 8.25 in order to assess how well the proposed model on fig 1 fit the data. Fig. 2 depicts the path coefficients for the proposed relationships among the variables in the model. Based on the fit indices, the hypothesized model fit the data quite well. The χ^2 value for the present model was 4.56(p=.2), indicating that the observed and model-implied correlation matrices are not significantly different. Furthermore, GFI and AGFI indices were 1 and .97 respectively. Finally, the RMSEA value for the present model was .04, indicating acceptable fit.

With respect to the predicted direct paths, mathematics achievement was significantly and positively predicted by self-efficacy (β=.31,t=6.31), persistence (β=.16,t=3.24), learning strategies (β=.17,t=.85), performance-approach goals (β=.2,t=4.22), but the effect of avoidance-approach goals was negatively significant (β=-.28,t=-5.94).The predictors accounted for 42% of variance in mathematics achievement.

Persistence was predicted by self-efficacy (β=.27,t=5.42) and mastery goals (β=.44,t=8.47) and avoidance-approach goals (β=-.12,t=-2.72).The predicted link from performance-approach goals to mathematics achievement was not confirmed. 43% of variance in persistence was accounted by predictors variables. Learning strategies was predicted by mastery goals (β=.75,t=9.21) and self-efficacy (β=-.16,t=-2.31).40% variance of learning strategies was explained. The only significant predictor of self-efficacy was mastery goals (β=.59,t=13.79) which explained 37% of variance in self-efficacy.

With regard to the predicted indirect path, the effects of mastery goals (β=.4,t=10.6) and avoidance-approach goals (β=-.02,t=-2.18) on mathematics achievement were significant. Mastery goals had a significant indirect effect on persistence (β=.16,t=5.05).
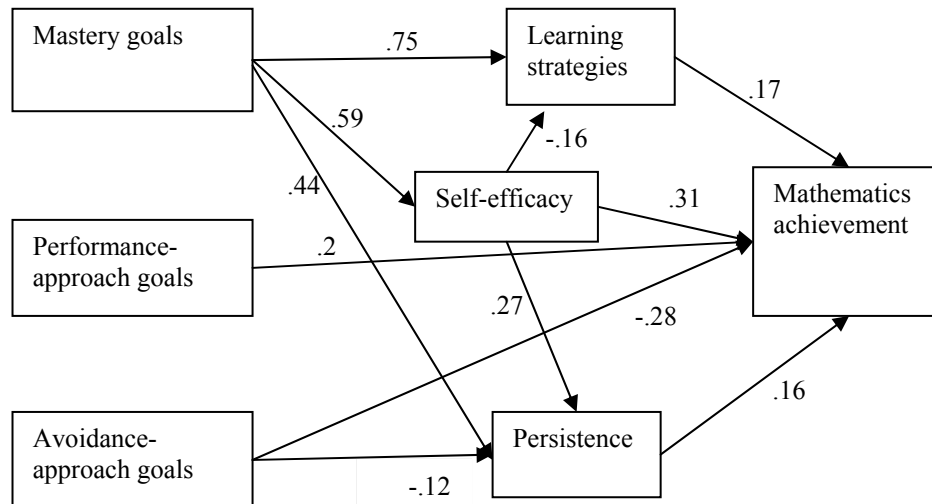
Fig. 2 shows the fit model.

Fig.2-Path model with path coefficient for predicting mathematics achievement.

Discussion & Conclusion

The results of path analysis show that mastery goals have no significant direct impact on self-efficacy, persistence, and learning strategies. These findings are similar to the findings in researches by Wolters, Yu & Pintrich (1996), Miller et. al. (1993 & 1996), Elliot & McGrigor & Gabel (1999), Ames & Archer (1988), Middleton & Migley (1997), Schunk(1996), and Skaalvik (1997).In general, it can be concluded that students who adopt mastery goals orientation emphasize on increasing the level of their self- efficacy. As well, students who express a strong focus on mastery goals, tend to report using more deep learning strategies and greater effort and persistence in doing difficult mathematics task.

Another finding is that performance-approach goals have no significant impact on self-efficacy and persistence. This finding is

fit with some earlier researches (Middleton and Midgley ,1997; Kaplan and Maehr, 1999 and Pajares , Britner & Valiante, 2000), however it is not similar to the researches done by(Midgley & Urdan ,1995 and Anderman & Young ,1994). One of the findings was that performance-approach goals do not have a significant effect on persistence. This finding is in line with the research done by Wolters (2004), but is different from the research by Eliot, McGrigor, & Gabel (1999). It was also found that the performance-approach goals have direct and significant impact on mathematics achievement. In the same way, Elliot & Church (1997) and Elliot & McGrigor (1999,2001) reached similar findings; however McWaw and Aabrami (2001), Pintrich (2000) and wolters, Yu, & Pintrich (1996) have not been able to find a clear relationship between performance-approach goal and class score. In general, students' performance-approach goals are not a significant predictor of their self-efficacy and persistence in doing mathematics assignment; however students who adopt this type of orientation have a better performance in mathematics. Considering the investigations by Midgley, Kaplan, and Middleton (2001), the relationship between performance-approach goals and learning outputs is depended on the essence of learning outputs, individuals' characteristic, and the environmental conditions. For this reason, the contradictions between the research findings of some of the researches is possibly due to utilization of diverse tools, different age groups, and dissimilar educational setting. For example adopting performance-approach goals in university environments perhaps requires more effort and persistence compared to high school environments. Findings also show that avoidance-approach goals are negative and significant predictors of persistence and mathematics achievement.

These finding do fit with some reseaches by Wolters (2004), Skaalvik (1997), Elliot, McGrigor, and Gabel (1999). This means that students, who expressed a strong focus on wanting to avoid appearance of incompetence, tend to put off their math work when work got difficult and tend to receive lower grads in math.

Another important finding was that self-efficacy is a significant predictor of persistence and mathematical achievement. Ames & Archer (1988), Miller et. al. (1993), Pajares & Miller (1994, 1997), Pajares & Graham (1999), Green& et. al. (2004) and Kabiri (2003) found the same results. One of the finding of this study was that self-efficacy is a negative predictor of learning strategies. In contrast, findings by Ames & Archer (1988), Multon & Brown & Lent (1991), Elliot & McGrigor & Gabel (1999), Miller & et. al. (1996) and Abdi-Nia (1998) showed that self-efficacy is a positive predictor of learning strategies. To justify this contradiction we can say since learning strategies has been impacted by two variables , mastery goals and self-efficacy ,in the meantime self-efficacy and mastery goals (r=0.59) have relatively high co-relation. As well, mastery goals have a stronger correlation with learning strategies compared with self-efficacy (r=0.63). Therefore, after explanation a part of learning strategies' variance by mastery goals, the remaining variance is not explainable through the self-efficacy.

The results also indicate that the direct effect of persistence and learning strategies on mathematics achievement is significance. Zimmerman, Bandura, & Martinez-pons (1992); Pajares & Graham (1999); Simons, Dewitte, & Lens (2004), and Mousavi-Nezhad (1376) found the same results. In general, students who report more persistence in doing their tasks and useing more learning strategies for their tasks, have a better performance in mathematics.

The investigation of mediating role of self-efficacy, persistence, and learning strategies shows that:

Students who adopt mastery goal orientation and use learning strategies such as organizing, planning, and monitoring in performing difficult math tasks, are those who have higher self-efficacy in mathematics and show more persistence in performing their difficult math tasks. Also students who report using of above learning strategies, have high self-efficacy and more persistence in

performing tasks which resulted in mathematics achievement through gaining higher scores.

The research findings show that students who adopt avoidance-approach goals orientation show less persistence in performing difficult math tasks. Also, having less persistence in performing math tasks causes obtaining lower scores in math. It should be added that the path coefficient of the indirect impact of performance-approach goals on mathematics achievement is significant but very minimal and should be practically looked upon with doubt.

In a general investigation of the model, we can refer to the following results:

From among the three endogeneous variables (self-efficacy, persistence, and learning strategies), self-efficacy has the highest direct impact on mathematics achievement. Similar to the findings of this research, Greene, et. al. (2004) and Miller ,et. al. (1996) also showed that self-efficacy has a deeper direct impact on mathematics achievement. Furthermore, the research results by Pintrich and DeGroot (1990) showed that the cognitive components such as cognitive and meta-cognitive learning strategies and persistence have stronger impact on students' mathematics achievement in comparison with self-efficacy. Perhaps this contradiction can be justified in this way that the extra unexplained variance of mathematics achievement can be explained with other learning strategies which have not been dealt with in this research .

Mastery goals have a deeper indirect impact on mathematics achievement compared to other variables. This finding shows that mastery goals play an important role in predicting cognitive variables and by effecting on these variables it is possible to have a strong indirect influence on mathematics achievement.

In the fit model of this research, the explained variance of mathematics achievement is .42. There seems to be other influential

factors for the prediction of this variable. Therefore efforts to identify these factors are essential. For this reason, it is suggested that more cognitive strategies are included in the learning strategies tools for prediction of mathematics achievement.

Findings of the present research indicate that performance-approach goals had a positive direct impact on mathematics achievement. Considering that the results of studies by Midgley, Kaplan, & Middleton (2001) showed that performance-approach goals are influenced by different environmental conditions, age groups, and the essence of outputs, therefore achievement goals construct need more investigation in various age groups, different educational settings, and more diverse educational outputs.

In this research, mastery goals and performance-approach goals are related to learning outputs in a positive way. Mastery goals predicted self-efficacy, persistence, learning strategies, and performance-approach goals predicted mathematics achievement. As well, positive correlation between these two goal orientations (r=.34) was found in this research, therefore, it is suggested that future researches investigate the interaction between achievement goals and their impact on various educational outputs.

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