

A study of simple and multiple relations between mathematics attitude, academic motivation and intelligence quotient with mathematics achievement

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Abstract

Purpose of current study was to investigate simple and multiple relations between mathematics' attitude, academic motivation and intelligence quotient with mathematics achievement. The Statistical population involved the entire Ardabil province' high schools students in 2008 (N = 33982). From these, 1670 students are selected as sample by using Cochran's formula and multiple cluster sampling. For gathering data, the following instrument is used. Raven IQ test (=0.86), Hermense Academic Achievement Test (=0.83), Moenikia mathematics attitude questionnaire (=0.79), and students' mathematics score in final exam. Correlation method was the research method. For data analysis, Pearson coefficient correlation and multiple regression in enter model were used. The Results showed that all of the variables correlate with together significantly. Mathematics' attitude, academic motivation, and intelligence quotient were predictor of mathematics achievement statistically significant.

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Keywords: Mathematics attitude; academic motivation; intelligence quotient; mathematics achievement.

1. Introduction

Mathematics is a universal subject, so much a part of life that anyone who is a participating member of society must know basic mathematics. Students' mathematical achievement, however, is ultimately determined and limited by the opportunities they have had to learn. Mathematics is not restricted to a select group of students. "All students must learn to think mathematically, and they must think mathematically to learn" (Kilpatrick, Swafford, and Findell, 2001).

Teaching and learning mathematics are complex tasks and there are many problems about the mathematics education in the schools. Student engagement in mathematics refers to students' motivation to learn mathematics, their confidence in their ability to succeed in mathematics and their emotional feelings about mathematics. Student engagement in mathematics plays a key role in the acquisition of math skills and knowledge. Students who are engaged in the learning process will tend to learn more and be more receptive to further learning.

Student engagement also has an impact upon course selection, educational pathways and later career choices (Stigler, & Hiebert, 2004).

The relationship between student engagement in mathematics and math achievement is complex and often circular. Regardless, the strong link between student engagement in mathematics and math performance suggests that high motivation and attitude and low mathematics anxiety are important outcomes in themselves. The math problems have an intra-personal source and are initiated from the students' personal characteristics in mental and learning processes, attitudes, cognitive aptitude and motivation ones (Mohsenpour, Hejazi, Kiamanesh, 2008).

Attitude is important concept about learning mathematics. Students' attitude toward mathematics affects how well or how often they do it, and how much enjoyment they derive from it. Many students taking mathematics courses in

college have a negative attitude toward mathematics that can be described as 'math anxiety' or 'math avoidance'. But this difficulty is not related to ability but rather is related to the attitudes that are held about math (Yenilmez, Girginer, & Uzun, 2007).

Attitude is a mental set or disposition, readiness to respond and the psychological basis of attitudes, their permanence, their learned nature and their evaluative character. It includes object things, peoples, places, ideas or situations. Attitudes are not just a passive result of past experience; instead they impel behavior and guide its form and manner. The components of attitudes are: (i) a cognitive component (opinion information or strength of belief or disbelief; (ii). an affective component (emotional component of like (or) dislike) and (iii) an action (co nature behavioral component of habit or readiness to respond) (Guimaraes, 2005).

Mathematics attitude should be viewed as a predisposition to respond in an unfavorable or favorable way to mathematics. By accepting this view, mathematics attitude includes relevant beliefs, behavior and attitudinal or emotional reactions. Researches indicated that, there is a positive relation between mathematics attitude and mathematics achievement (Ma, & Kishor, 1997a; Saha, 2007; Thomas, 2006). Kadujevich (2008) in study, which used a sample on thirty three countries that participated in the TIMSS 2003 project in the eighth grade, found that each dimension of mathematics attitude alone was positively related to mathematics achievement for almost all of the thirty three countries. In the context of the TIMSS assessment, Mullis and et. al (2000) found that students who show positive attitudes toward math were more likely to perform well.

Researches revealed that some variables mediated the effect of math attitude and mathematics achievement (Kabiri, & Kiamanesh's, 2004; Kiamanesh, Hejazi, & Esfahani, 2004). Some of these variables are intelligence quotient (Blair, Gamson, Thorne, & Baker, 2005; Bull & Scerif, 2001, Evans, Floyd, McGrew, & Leforgee, 2002; Grissmer, 2000) and motivation for mathematics (KhoushBakht, and Kayyer, 2005; Md. Yunus, & Wan Ali, 2009).

A detailed review of over 50 studies using naturalistic observation, post-hoc statistical comparisons, and cohort-sequential analysis concludes that there is an association between enhancement of cognitive skills related to IQ and schooling (Ceci, 1991). Experimental and differential studies of math achievement in typically developing children and children with learning disorders indicated that the importance of fluid cognition and intelligence for math ability (Bull & Scerif, 2001; Evans, & et. al, 2002; McGrew & Hessler, 1995; McLean & Hitch, 1999).

Luo, Thompson, and Detterman (2003) tested the hypothesis that the correlation between psychometric 'g' and academic achievement was in large part associated with a mental speed component. Initially, the shared variance between general intelligence and academic achievement was approximately 30. Spatial ability tasks, especially those involving visualization, are able to predict which engineering students will excel in the area of technical drawing (Adanez & Velasco, 2002).

Intelligence is not the only determinant of academic achievement. High motivation and engagement in learning have consistently been linked to reduced dropout rates and increased levels of student success (Kushman, Sieber, & Harold, 2000). Motivation has long been a controversial issue with researchers on math learning. This is not because there is any doubt about the importance of motivational factors in general for math learning, but because the contrast between intrinsic and extrinsic motivation, which has dominated the debate, is subject to serious criticisms. During the last 40 years or so, a large body of literature has helped to highlight the importance of motivation in math learning (Cleary, Chen, 2009).

Motivation refers to "a student's willingness, need, desire and compulsion to participate in, and be successful in the learning process" (Md. Yunus, Wan Ali, 2009). There are many students who are highly motivated and do anything their teacher asks. However, the number of poorly motivated students is substantial and seems to be growing. In high schools, these students tend to be clustered in beginning level classes because their lack of effort keeps them from gaining the skills needed to take more advanced mathematics. 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, & Pintrich, 2002).

On the assumption that a student's effort can vary with the task at hand (Kloosterman, 1996), students were asked about their level of effort in mathematics class, on homework, and in other school subjects, they were also asked directly about what motivated them in mathematics. According to findings of KhoushBakht, and Kayyer, (2005), Md. Yunus, and Wan Ali (2009), Middleton, and Spanias (1999) there is significant positive relation between motivation and students' mathematics achievement.

Some studies have attention to gender differences in math motivation, attitude towards math and math achievement. Mullis et al. (2000) found that there was a significant gender difference in math motivation and attitudes towards mathematics internationally, but that gender was not related to math performance. Also Um, Corter, & Tatsuoka (2005) indicated that there is difference between females and males in math motivation, attitude towards math and math achievement.

So goal of the current study was to determine the role of mathematics' attitude, academic motivation and intelligence quotient on mathematics achievement and compare gender differences in these variables. **2. Method**

2.1. Participants

The Statistical population involved the entire Ardabil province's high schools students (N = 33982) to be included 1359 classes in 2008-9 academic year. From these, 76 classes included 1670 students are selected as sample by using Cochran's formula and multistage cluster sampling.

2.2. Materials

The instruments of this research are Raven IQ test (=0.86), Hermense Academic Achievement Test (=0.83), Moenikia mathematics attitude questionnaire (=0.79), and students' mathematics score in final exam. Several researches confirmed the validity of the questionnaire (MoeniKia, Abtin, 2006).

2.3. Procedure

Research method was correlation. The questionnaire was distributed among participants and gathered data was analyzed by using Pearson coefficient correlation and multiple regression in enter model. **3. Results**

Table 1. Correlation coefficient, mean and standard deviation

	1	2	3	4	Mean	Std. Deviation
mathematics' attitude	1				65.77	13.42
academic motivation	.383**	1			85	7.41
intelligence quotient	.227**	.116**	1		105.10	15
mathematics achievement	.455**	.21**	.446**	1	11.2	4.68

< .05 ** p < .01

Results from Table 1, showed that there is a positive and significant correlation between mathematics' attitude and academic motivation ($r = .383, P < .01$); mathematics' attitude and intelligence quotient ($r = .227, P < .01$); academic motivation and intelligence quotient ($r = .116, P < .01$). Also Table 1 indicated that there are positive and significant simple correlation between mathematics' attitude, academic motivation and intelligence quotient with mathematics achievement .455, .21, and .446 respectively.

In order to determine the influential mathematics' attitude, academic motivation and intelligence quotient in predicting the math achievement, taking the advantages of the enter method, multiple regression analysis was used.

Table 2. Predicting the math achievement on the base of math' attitude, academic motivation and intelligence quotient

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13111 3		4370	275.57	.000
	Residual	26438 1667		1586		
	Total	39549 1670				
Coefficients						
Model	C	Unstandardized	Coefficients	Standardized	t	Sig.
		B		Std. Error		
		Beta				

	(Constant)	-.42	.908		-11.24	.000
1	mathematics' attitude	.56	.011	.362	16.36	.000
	academic motivation	.08	.12	.030	1.36	.17
	intelligence quotient	.61	.017	.360	17.52	.000
a. Dependent Variable: math achievement						
Note. R = .576, R Square = .332, Adj. R Square = .330						

As it can be seen from the results of table 2, adjusted R square is .33 and $F = 275.57$ is significant ($p < .01$). So, mathematics' attitude, academic motivation and intelligence quotient may predict math achievement. From among these, the shares of mathematics' attitude, academic motivation and intelligence quotient were .362, .030, and .360, respectively in predicting of math achievement. It should be mentioned that the share of academic motivation in this prediction in the presence of two other variables is not significant.

Table 3. Correlation coefficient, mean and standard deviation

gender	variables	N	Mean	Std. Deviation	t	df.	Sig.
Females	mathematics' attitude	678	66	13.49	.776	1668	.51
Males		992	65	13.37			
Females	academic motivation	678	86	7.40	1.47	1668	.54
Males		992	85	7.41			
Females	intelligence quotient	678	106	15	2.03	1668	.061
Males		992	105	15			
Females	mathematics achievement	678	12.5	4.51	11.11	1668	.000
Males		992	9.9	4.80			

According to Table 3, there is any difference between males and females in mathematics attitude, academic motivation and intelligence quotient statistically significant. Between males and females are different only in the math achievement significantly ($p < .01$).

4. Discussion

Findings of present study showed that mathematics attitude, academic motivation, and intelligence quotient can be identified and explained 33 % of mathematics achievement. These findings are coherent with findings by Kadijevich (2008), Ma, and Kishor (1997a), Mohsenpour, and et al (2008), Saha (2007), Thomas (2006), Yenilmez, and et al (2007). All of these researchers in the role of mathematics attitude, academic motivation and intelligence quotient on academic achievement were stressed. Most researchers believe that the math problems have an intrapersonal source and are initiated from the students' personal characteristics in mental and learning processes, attitudes, cognitive aptitude and motivation ones.

Findings showed that the shares of mathematics' attitude, and intelligence quotient in predicting of math achievement were statistically significant but the share of academic motivation in this prediction in the presence of two other variables was not significant. Of course, this is so there are positive and significant simple relations

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between mathematics attitude, academic motivation, intelligence quotient and mathematics achievement. The relation between mathematics attitude and math achievement is in compliance with the findings of Adanez, and Velasco (2002), Blair, et al (2005), Bull and Scerif (2001), Evans, et al (2002), Grissmer (2000), Kushman, et al (2000), Luo, et al (2003). All of these researchers in the relation between intelligence quotient and academic achievement were stressed. Also relation between academic motivation and mathematics achievement is in compliance with the findings

of Cleary, and Chen (2009), KhoushBakht, and Kayyer, (2005), Linnenbrink, and Pintrich, (2002), Md. Yunus, and Wan Ali, (2009), Middleton, and Spanias (1999).

In contrast with Mullis et al. (2000) in present research was not found significant gender difference in math motivation and attitudes towards mathematics but was found that gender was related to math performance. Also this finding is consistent with findings of Um, et al (2005) because he indicated that there is difference between females and males in math motivation, attitude towards math and math achievement.

References

- Adanez, G. P., & Velasco, A. D. (2002). Predicting academic success of engineering students in technical drawing from visualization test scores. *Journal for Geometric and Graphics*, 6(1), 99-109.
- Blair, C., Gamson, D., Thorne, S., & Baker, D. (2005). Rising mean IQ: Cognitive demand of mathematics education for young children, population exposure to formal schooling, and the neurobiology of the prefrontal cortex. *Intelligence*, 33, 93-106.
- Bull, R., & Scerif, G. (2001). Executive functioning as a predictor of children's mathematics ability: Inhibition, switching, and working memory. *Developmental Neuropsychology*, 19, 273-293.
- Ceci, S. (1991). How much does schooling influence general intelligence and its cognitive components? A reassessment of the evidence. *Developmental Psychology*, 27(5), 703-722.
- Cleary, T. J., Chen, P. P. (2009). Self-regulation, motivation, and math achievement in middle school: Variations across grade level and math context. *Journal of School Psychology*, 47, 291-314.
- Evans, J., Floyd, R., McGrew, K. S., & LeFoege, M. (2002). The relations between measures of Cattell-Horne-Carroll (CHC) cognitive abilities and reading achievement during childhood and adolescence. *School Psychology Review*, 31(2), 246-251.
- Grissmer, D. W. (2000). The continuing use and misuse of SAT scores. *Psychology, Public Policy, and Law*, 6, 223-232.
- Guimaraest, H. M. (2005) Teachers and students views and attitude towards new mathematics curriculum. *Journal of Educational Studies in Mathematics*, 26, 347-365.
- Kabiri, M., & Kiamanesh, A.R., (2004). The Role of Self-Efficacy, Anxiety, Attitudes and Previous Math Achievement in Students' Math Performance. Proceedings of the 3rd International Biennial SELF Research Conference, Self-Concept, Motivation and Identity: Where to from here? Berlin, 4 - 7 July, 2004.
- Kadijevich, D. (2008). TIMSS 2003: Relating dimensions of mathematics attitude to mathematics achievement (MA). Retrieved June, 14, 2009 from: <http://www.doiserbia.nb.rs>.
- KhoushBakht, F., & Kayyer, M. (2005). A survey on motivational model of math learning in elementary students. *Journal of Psychology*, 9(1), 67-81.
- Kiamanesh, A.R., Hejazi, E., & Esfahani, Z.N., (2004). The Role of Math Self-Efficacy, Math Self-Concept, Perceived Usefulness of Mathematics and Math Anxiety in Math Achievement. Proceedings of the 3rd International Biennial SELF Research Conference, Self-Concept, Motivation and Identity: Where to from here? Berlin, 4 - 7 July, 2004.
- Kilpatrick, J., Swafford, J., & Findell, B. (2001). *The strands of mathematical proficiency. Adding It up: Helping Children Learn Mathematics*. Washington, DC: The National Academies Press.
- Kloosterman, P. (1996). Students' beliefs about knowing and learning mathematics: Implications for motivation. In M. Carr (Ed.), *Motivation in mathematics* (pp. 131-156). Cresskill, NJ: Hampton.
- Kushman, J. W., Sieber, C., & Harold, K. P. (2000). This isn't the place for me: School dropout. In D. Capuzzi & D. R. Gross (Eds.), *Youth at risk: A prevention resource for counselors, teachers, and parents* (3rd ed., pp. 471-507). Alexandria, VA: American Counseling Association.
- Linnenbrink, E.A., & Pintrich, P.R. (2002). Motivation as enabler of academic success. *School Psychology Review*. 31(3), 313-327.
- Luo, D., Thompson, L. A., & Detterman, D. K. (2003). The causal factor underlying the correlation between psychometric g and scholastic performance. *Intelligence*, 31(1), 67-83.
- Ma, X. & Kishor, N. (1997a). Assessing the relationship between attitude toward mathematics and achievement in mathematics: A meta-analysis. *Journal for Research in Mathematics Education*, 28(1), 26-47.
- McGrew, K. S., & Hessler, G. L. (1995). The relationship between the WJ-R GF-GC cognitive clusters and mathematics achievement across the life span. *Journal of Psychoeducational Assessment*, 13, 21-38.
- McLean, J. F., & Hitch, G. J. (1999). Working memory impairments in children with specific arithmetic learning difficulties. *Journal of Experimental Child Psychology*, 74, 240-260.
- Md. Yunus, A. S., Wan Ali, W.Z., (2009). Motivation in the Learning of Mathematics. *European Journal of Social Sciences*, 7(4), 93-101.
- Middleton, James A., & Spanias, Photini A. (1999). Motivation for achievement in mathematics: Findings, generalizations, and criticisms of the research. *Journal for Research in Mathematics Education*, 30(1), 65-88.
- Moenikia, M., & Abtin, J. (2006). Relation between using of ICT and psychological characteristics in Ardabil secondary schools' students. Iran, Ardabil, educational organization
- Motivation and Autonomy Support 16 from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade. (The International Study Center Boston College Lynch School of Education).
- Mohsenpour, M., Hejazi, E., Kiamanesh, A. (2008). The role of self-efficacy, achievement goals, learning strategies and persistence in math achievement of 11th Grade High Schools Students in Tehran. *Journal of Educational Innovations*, 24, 153-172.

- Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Gregory, K.D., Garden, R.A., O'Connor, K.M., Chrostowski, S.J., Smith, T.A., (2000). TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade. (The International Study Center Boston College Lynch School of Education)
- Saha, S. (2007). A study of Gender Attitude to Mathematics, Cognitive style and Achievement in mathematics. *Experiments in Education*, 35, 61-67.
- Stigler, J., & Hiebert, J. (2004). Improving Mathematics teaching. *Educational Leadership*, 61, 12-17.
- Thomas, J. (2006) The effects on student's achievements and attitudes using integrated learning systems with co-operative pairs. *Journal Educational Technology Research and Development* 45, 51-64.
- Um, E. K., Corter, J., & Tatsuoka, K. (2005). Motivation, autonomy support, and mathematics performance: A structural equation analysis. Retrieved June, 14, 2009, from: <http://cms.tc.columbia.edu>
- Yenilmez, K., Girginer, N., & Uzun, A O. (2007). Mathematics anxiety and attitude level of students of the faculty of economics and business administrator; The Turkey model. *International Mathematical Forum*, 2, 2007, no. 41, 1997 – 202, Retrieved July, 14, 2009 from: <http://www.m-hikari.com>.