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MOTIVATION AND LEARNING STRATEGIES AS PREDICTORS OF HIGH SCHOOL STUDENTS' MATH ACHIEVEMENT

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ABSTRACT

As a country striving toward economic and technological development, having remarkable number of school age children, in need of improving it's science and mathematics education-particularly given the disappointing PISA results, and aiming at establishing highly functional school counseling services, Turkey will greatly benefit from studies exploring student variables associated with their success in various subject areas. Thus, the purpose of this study was to examine as to which motivation and learning strategies high school students use for mathematics courses predict their achievement level in the respective courses. A convenient sample of 440 high school students attending to two public high schools in the Altındağ District of Ankara, Turkey during the academic year of 2010-2011. A Personal Information Form and Motivation and Learning Strategies Scale were used for data collection. Step-wise regression analysis was used as the data analytic procedure. Results showed that factors such as task value (M), time/study environment (LS), self-efficacy (M), extrinsic goal orientation (LS), test anxiety (M), peer learning (LS) and organization (LS)] significantly predicted students' mathematics achievement. Some factors of motivation and learning strategies significantly predict students' achievement levels in mathematics according to gender. Different factors of motivation and learning strategies significantly predicted students' achievement levels in mathematics for each grade level. Results, limitations of the study, implications for school counseling services, mathematics education and future research were discussed.

Keywords: *Motivation, learning strategies, mathematics achievement, high school students, regression analysis.*

INTRODUCTION

Focusing on improvement of their educational system is a vital goal of countries striving toward advancement. A very vital component of these efforts involves a focus on science and mathematics education. A historical example of these efforts was the United States' (US) reaction to Soviet Union's launching of Sputnik in 1957, the first artificial satellite to be put into the Earth's orbit. The US perceived this as a failure in its competition with the Soviets and thus allocated enormous amounts of resources to science and mathematics education in an effort to not only catch up with this move by the Soviets but also to win the competition in the long run. Through the reminder of the last Century and in the wake of the new Millennium, many countries view advancement of their educational systems (and science and mathematics education) among their essential national priorities.

Parallel to this national and global focus on science and mathematics education, researchers and educators have also made remarkable improvements in science and mathematics education. They have accumulated

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a significant body of research regarding educational inputs, processes and outcomes. A significant number of these studies involve research on student variables. Some of these investigations have specifically focused on classroom variables such as students' motivational and learning strategies. Historically, studies exploring students' motivation and learning strategies were inspired by the self-regulated learning approach which views the student as capable monitoring and regulating his or her own learning processes. This approach is in line with the wish of various educators who believe "education should teach students how to learn." Indeed, an educational approach geared toward teaching "how to learn" will have to improve students' skills in effectively regulating a variety of aspects of their learning processes. It is worth noting that, recent studies have linked self-regulation with prefrontal cortex and mental disorders such as attention deficit hyperactivity disorder (Barkley, 2010; Heatherton & Wagner, 2011). Thus, according to these findings, self-regulation is not only closely related students' academic performance but also to their overall functioning and wellbeing (Dunn, Lo, Mulvenon & Sutcliffe, 2012).

The term "self-regulated learning" conceptualizes students as actively managing and monitoring cognitive, behavioral and motivational aspects of their learning processes. Part of its roots dates back to Albert Bandura's social learning theory. While there are various definitions of self-regulated learning, all definitions encompass three essential components (Pintrich & DeGroot, 1990). The first one involves individual's planning, monitoring and regulating one's metacognitive strategies. The second one has to do with the student's control and management of his or her effort through learning experiences (i.e., continuing focusing on the task despite existence of distracting stimuli in the learning environment). The third component involves cognitive strategies (i.e., rehearsal, elaboration and organization) students use toward understanding, acquiring and recalling learning material. Advocates of the self-regulated learning approach (i.e., Pintrich, 1988) claim that knowledge of cognitive and metacognitive strategies may not be sufficient to promote student learning. Students should also have reasons to use this knowledge. In other words, they should be motivated to use these strategies and regulate their cognition and effort.

As noted by Pintrich and De Groot (1990) the motivation and learning strategies line of research conceptualizes student motivation in accordance with a general expectancy-value model of motivation. The model proposes that there are three motivational components possibly associated with the three different components of self-regulated learning: (a) an expectancy component, which involves students' beliefs about their ability to perform a task, (b) a value component, involving students' goals and beliefs about the importance and interest of the task at hand, and (c) an affective component, having to do with students' emotional reactions to the given task. While the expectancy component of student motivation has been viewed "in a variety of ways in the motivational literature such as 'perceived competence', 'self-efficacy', 'attributional style', and 'control beliefs' (Pintrich & De Groot, 1990. p. 33), in all such definitions, it refers to students' beliefs regarding their ability to perform the given task. Various authors have viewed the value component of motivation in different lights, such as "learning vs. performance goals, intrinsic vs. extrinsic orientation, task value, and intrinsic interest" (Pintrich & De Groot, 1990. p. 34). It basically has to do with the students' reasons for doing the task. Likewise, there have been various ways in which the affective component has been conceptualized, yet it often refers to test-anxiety (Wigfield & Eccles, 1989). Literature shows that the expectancy and value components have positive relationship with the three self-regulated learning components while their relationship with test anxiety is not as simple (Pintrich & DeGroot, 1990).

Since students' academic performance depends in part on their motivation and learning strategies, Schunk and Zimmerman (1998) state that students learning depends on the following self-regulatory processes: (a) setting specific and attainable goals; (b) utilizing effective strategies toward attaining these goals; (c) observing their performance for signs of progress; (d) arranging their physical and social environment in ways that are compatible with the realization of the goals; (e) using their time efficiently; (f) self-evaluating their methods; (g) associating their methods and the resulting outcomes; and (h) developing methods for the future (Zimmerman, 2002). Indeed, Zimmerman (2002) goes further as to claim that "with such diverse skills as chess, sports, and music, the quantity of an individual's studying and practicing is a strong predictor of his or her level of expertise'' (p. 66).

There are numerous studies reporting significant relationships between students' motivation and learning strategies (self-regulation) and achievement (i.e., Mousoulides & Philippou, 2005; Tanner & Jones, 2003). For example, using Self-Regulated Learning Interview Schedule (SRLIS by Zimmerman & Martinez-Pons, 1986), Zimmerman and Martinez-Pons (1988) compared high and low achievement groups of high school students. Their results showed that groups differed significantly on all fourteen self-regulated learning strategies (self-evaluating; organizing and transforming; goal-setting and planning; seeking information; keeping records and monitoring; environmental structuring; self-consequating; rehearsing and memorizing; seeking peer, teacher, or adult assistance; and reviewing tests, notes, and textbooks) but self-regulation. The authors examined the results as to control for students' general abilities and found that the fourteen self-regulated learning strategies contributed to student achievement independent of students' general levels of ability.

Given the high proportion of 0–18 year old population of Turkey (over 1/3 of the general population), the country's urgent need for development and the disappointing (29^{th} place among the participating 30 countries) PISA (Programme for International Student Assessment) results in both 2003 and 2006 which was held by the Organization for Economic Cooperation and Development (Eraslan, 2009), the need for improving student learning for Turkey is vital. Part of the success of such improvement efforts will to great extent depend upon the degree to which such work is guided by empirical data. In other words, these efforts will lead to desirable results in part if they are based on scientific studies examining student achievement according to a rich variety of variables.

Part of such studies should involve exploration motivation and learning strategies of students in specific courses and age groups. Indeed, studies following the self-regulated learning tradition focus on specific courses as opposed to one's general motivation and learning strategies. Thus, mathematics classes in high school were chosen for this study because of math being one of the major areas in which student in Turkey scored poorly in PISAs. More specifically, this study attempts to examine the degree to which motivation and learning strategies high school students use predict their achievement levels in mathematics courses. Results of the study are hoped to have implications for both high school mathematics education and school counseling and guidance services. Further, given societal emphasis on gender role differences (Dinç Kahraman, 2010) exploring students' motivation and learning strategies and mathematics achievement according to gender could contribute to the diversity of research on self-regulated learning. Likewise, examining these variables according to students' grade level might provide important insight on their use of these strategies through time. Finally, identifying motivation and learning strategies male and female students and those attending to different grades use for mathematics classes will guide efforts toward improvement of mathematics education.

In short, the purpose of this study was to examine as to which motivation and learning strategies high school students use for mathematics courses predict their achievement level in these courses. Thus, the study sought answers to the following specific research questions:

1. Which factors of motivation and learning strategies significantly predict students' achievement levels in mathematics?
2. Which factors of motivation and learning strategies significantly predict students' achievement levels in mathematics according to gender?
3. Which factors of motivation and learning strategies significantly predict students' achievement levels in mathematics according to grade level?

METHOD

Model and Participants

In this correlational survey study, students' scores on factors of Motivation and Learning Strategies Scale were used to predict their levels of achievement in their respective mathematics courses. A convenient sample of 440 high school students attending to two public high schools in the Altındağ District of Ankara, Turkey during the academic year of 2010-2011 was utilized. Male and female students constituted 58.6% and 41.4% of the sample respectively. Students' age ranged between 14 and 17 years with a mean of 15.92 (SD=0.933). Thirty-eight percent of the students were ninth graders, 28% tenth graders and almost 35% were eleventh graders.

Procedure

Upon obtaining permission from school administration, students present in their respective mathematics classrooms were provided information about the nature and purpose of the study and their consent was obtained. Students who volunteered to participate were given the surveys during their respective class sessions. The survey consisted of the MSLQ scale and a Personal Information Form. Completion of the instruments took about 20–30 minutes.

Instruments

The Motivated Strategies for Learning Questionnaire (MSLQ): MSLQ was developed by Pintrich, Smith, Garcia and McKeachie in 1991, as a self-report instrument designed to measure college students' motivational orientation and their use of different learning strategies for a college course. The MSLQ consists of 81 items divided into two sections: (1) a *motivation* section and (2) a *learning strategies* section. The motivation section is made of 31 items that assess students' goals and value beliefs for a course, their beliefs about their skills to succeed in the course and their anxiety about tests in the course. The learning strategy section consists of 50 questions: 31 items regarding students' use of different cognitive and metacognitive strategies and 19 items concerning students' management of different learning resources (Garcia & Pintrich, 1996). The motivation section has six factors and the learning strategies section has nine factors. Table 1 lists these two sections and their subscales.

Students rate themselves on a 7-point Likert type scale which has responses ranging between 1 (*not at all true of me*) and 7 (*very true of me*). Scores for the individual scales are computed by taking the mean of the items that make up the scale. Several items within the MSLQ are negatively worded and must be reversed before the respective score is computed. The MSLQ "assumes that students' responses to the questions might vary as a function of different courses, so that the same individual might report different levels of motivation or strategy use depending on the course" (Duncan & McKeachie, 2005, p. 119).

The MSLQ was adapted into Turkish by Karadeniz, Büyüköztürk, Akgün, Çakmak and Demirel (2008). In the adaptation study the scale was administrated to 1114 students aged between 12 and 18 years. Results of the confirmatory factor analyses showed that the first subscale, "motivation", had six factors, and the second subscale, "learning strategies", consisted of nine factors which were parallel to the factor-structure of the original scale. Based on the results of the confirmatory factor analysis; 6 items from motivation subscale and 5 items from learning strategies subscale were eliminated due to their low factor loadings. The corrected item-total correlations ranged between 0.58 and 0.15 for motivation subscale, and between 0.68 and 0.19 for learning strategies subscale (Karadeniz et al., 2008). The authors found an internal consistency coefficient of 0.26 for control beliefs. Internal consistency coefficients for other motivation factors ranged between 0.54 and .72; between 0.51 and 0.83 for learning strategies factors.

Table 1. Listing of motivation and learning strategies in MSLQ

Scale	Subscale
Motivation	1. Value Components
	a. Intrinsic Goal Orientation
	b. Extrinsic Goal Orientation
	c. Task Value
	2. Expectancy Components
	a. Control Beliefs
	b. Self-Efficacy for Learning and Performance
	3. Affective Components
	a. Test Anxiety
Learning Strategies	1. Cognitive and metacognitive Strategies
	a. Rehearsal
	b. Elaboration
	c. Organization
	d. Critical Thinking
	e. Metacognitive Self-Regulation
	2. Resource Management Strategies
	a. Time and Study Environment
	b. Effort Regulation
	c. Peer Learning
	d. Help Seeking

Personal Information Form: Participants were given a personal information form inquiring information on their age, gender (female or male), grade level (open ended) and their grades in mathematics courses which was to be based on their grade report cards of the Fall Semester of the 2010-2011 academic year.

RESULTS

In this study, six factors of motivation and nine factors of learning strategies of MLSQ were used to predict high school students' mathematics achievement. Step-wise regression analysis was used as the data analytic procedure. Mathematics achievement was the outcome variable. In all analyses 0.05 was used as the level of significance.

Prior to the analyses, data was examined to test for normality, linearity and multicollinearity assumptions. As illustrated in Figure 1, standardized residual values histogram shows that the normality assumption is met. Likewise, in Figure 2 the normal probability plot resembles a straight line which was considered as indicative of normal distribution.

In order to test the data for linearity assumption, the standardized residuals plot for standardized residuals and standardized predicted values (Figure 3) was used. As seen in Figure 3, residuals clustered around the zero line for the predicted values which was considered as supporting evidence for the linearity assumption.

In order to test for multicollinearity among predictor variables, tolerance statistics, variance inflation factor (VIF) and condition indices (CI) were calculated. Given that the tolerance statistics were higher than 0.10, the VIF was lower than 10 and the condition index was lower than 30, thus it was concluded that multicollinearity was not present among the predictor variables.

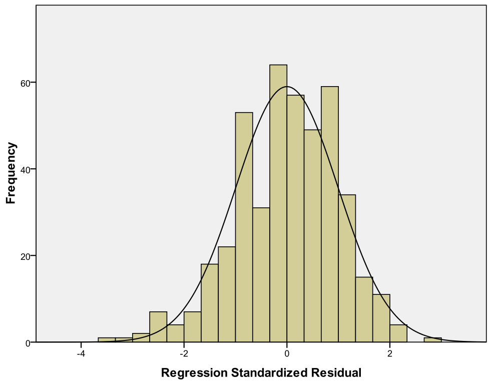

Figure 1. Histogram

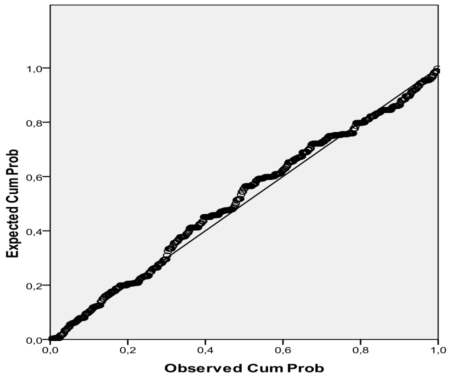

Figure 2. Normal probability plot

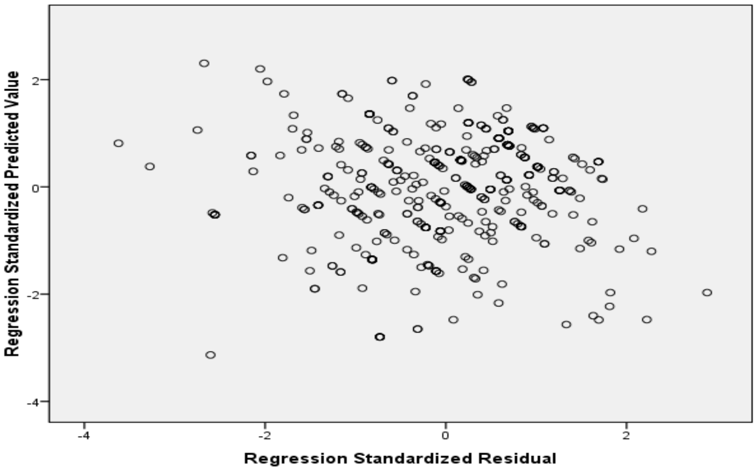

Figure 3. Standardized Residuals Plot

Step-wise regression analysis was used to determine as to which factors of motivation and learning strategies significantly predict students' achievement levels in mathematics. Results showed that seven factors [task value (M), time and study environment (LS), self-efficacy for learning and performance (M), extrinsic goal orientation (LS), test anxiety (M), peer learning (LS) and organization (LS)] were significant in predicting mathematics achievement. As illustrated in Table 2, multiple correlation (R), coefficient of determination (R^2), adjusted R^2, change in R^2 and change in F values were obtained by entering each significant predictor variable to the regression model at each step.

Table 2. Summary of the regression model

					Change Statistics				
Model	**Step**	**R**	R^2	R^2_{adj}	ΔR^2	F_{chg}	df_1	df_2	**p**
1	(M) Task value	.504	.254	.252	.254	148.75	1	438	.000
2	(LS) Time/s.env.	.555	.308	.305	.055	34.435	1	437	.000
3	(M) Self-efficacy	.577	.333	.329	.025	16.627	1	436	.000
4	(M) Extrinsic g.	.593	.351	.345	.018	11.930	1	435	.001
5	(M) Test anxiety	.606	.368	.360	.016	11.177	1	434	.001
6	(LS) Peer learning	.616	.380	.371	.012	8.709	1	433	.003
7	(LS) Organization	.628	.395	.385	.014	10.336	1	432	.001

As shown in Table 2, the task value factors factor of motivation (M) had a relationship of 0.504 with mathematics achievement. All significant independent variables had a multiple-correlation coefficient of 0.628 with mathematics achievement. While task value factor explained 25.4% of the variance in mathematics achievement, all independent variables having significant relationships with the outcome variable accounted for 39.5% of the variance in mathematics achievement. Change in the coefficient of determination (ΔR^2) indicates the change in the variance of the outcome variable upon entry of an additional independent variable to the model. As such, while the task value factor of motivation by itself had 25.4% contribution to the variance in mathematics achievement, the time and work environment factor of learning strategies had 5.5% contribution; self-efficacy had 2.5%, extrinsic goal orientation had 1.8%, test anxiety 1.6%, peer learning had1.2% and organization had 1.4% contribution to the variance in mathematics achievement.

Partial and bivariate correlations between the outcome variable (mathematics achievement) and of the independent variables are shown in Table 3. The correlation coefficients in the table show that the task value factor had a moderate and positive relationship with mathematics achievement (r_{yx1}=.504). The two variables had a correlation of 0.231 when all other variables were partialed out. Time and study environment factor had a moderate and positive relationship with mathematics achievement (r_{yx2}=.421). These two variables had a correlation of 0.203 when all other variables were partialed out. Self-efficacy for learning and performance factor had a moderate and positive relationship with mathematics achievement (r_{yx3}=.434). These two variables had a correlation of 0.239 when all other variables were partialed out. Extrinsic goal orientation factor had a low and negative relationship with mathematics achievement (r_{yx4}=-.100). The two variables had a correlation of -0.204 when all other variables were partialed out. Test anxiety factor had a low and positive relationship with mathematics achievement (r_{yx5}=.056). On the other hand, these two variables had a negative correlation of -0.142 when all other variables were partialed out. Peer learning factor had a low and negative relationship with mathematics achievement (r_{yx6}=-0.032). These two variables had a correlation of -0.188 when all other variables were partialed out. Organization factor had a low and positive relationship with mathematics achievement (r_{yx7}=.317). The two variables had a correlation of 0.153 when all other variables were partialed out.

Given the standardized regression coefficients (β), their relative predictive importance was listed as follows: self-efficacy for learning and performance, task value, time and study environment, extrinsic goal orientation, peer learning, organization and test anxiety.

Table 3. Coefficients table for regression model

							Collinearity Statistics	
Variables	**B**	**β**	**t**	**p**	**Zero-order r**	**Partial r**	**Tolerance**	**VIF**
Constant	46.37	-	11.63	.000	-	-	-	-
(M) Task value	.608	.252	4.938	.000	.504	.231	.536	1.865
(LS) Time/s.envir.	.402	.208	4.305	.000	.421	.203	.599	1.670
(M) Self-efficacy	.571	.253	5.124	.000	.434	.239	.575	1.740
(M) Extrinsic goal	-.655	-.188	-4.331	.000	-.100	-.204	.746	1.341
(M) Test anxiety	-.221	-.129	-2.984	.003	.056	-.142	.746	1.341
(LS) Pear learning	-.541	-.169	-3.969	.000	-.032	-.188	.770	1.298
(LS) Organization	.351	.167	3.215	.001	.317	.153	.521	1.919
R= .628 R^2=.395 R^2_{adj}=.385 F(7,432)=40.210 p=.000								

These seven factors had a correlation of 0.623 with mathematics achievement which was significant [F(7,432) =40.210; p=.000]. These variables accounted for approximately 40% of the variance in the outcome variable.

The second research question of this study inquired as to which factors of motivation and learning strategies significantly predict students' achievement levels in mathematics according to gender. The results of multiple regression analysis are shown in Table 4.

Table 4. Results of multiple regression according to gender

Gender	Variables	B	β	t	p	Δ R^2	Correlation r	
							Zero-order	Partial
Female	Constant	54.993		10.876	.000			
	(M) Self-efficacy	.861	.447	6.128	.000	.253	.503	.418
	(LS) Time/s.environ.	.541	.281	3.838	.000	.038	.424	.277
	(M) Test anxiety	-.336	-.237	-3.490	.001	.030	-.003	-.254
	(M) Extrinsic goal	-.540	-.159	-2.392	.018	.021	.009	-.177
R= .586	R^2=.543 R^2_{adj}=.329	F(4,137)=23.137	p=.000					
Male	Constant	25.525		5.844	.000			
	(M) Task value	1.013	.412	6.588	.000	.280	.530	.383
	(LS) Effort regulation	.646	.248	4.046	.000	.053	.315	.247
	(M) Self-efficacy	.454	.188	3.200	.002	.028	.424	.198
	(LS) Organization	.492	.231	3.158	.002	.012	.297	.195
	(LS) Metacognitive	-.215	-.194	-2.25	.025	.012	.300	-.141
R= .622	R^2=.386 R^2_{adj}=.374	F(5,252)=31.750	p=.000					

As illustrated in the table 4, self-efficacy for learning and performance, time and study environment, test anxiety and extrinsic goal orientation were significant factors predicting mathematics achievement of female students [F(4,137)=23.137; p=.000]. These variables accounted for 54% of variance in mathematics achievement of female students. Task value, effort regulation, self-efficacy for learning and performance, organization, metacognitive self-regulation significantly predicted mathematics achievement of male students [F(5,252)=31.750; p=.000]. These variables accounted for 39% of variance in mathematics achievement of male students.

The third research question of this study inquired as to which factors of motivation and learning strategies significantly predict students' achievement levels in mathematics according to grade level. The results of multiple regression analysis are shown in Table 5. The results show that the task value factor significantly predicted mathematics achievement of 9th grade students [F(1,165)=41.354; p=.000]. It accounted for 20% of variance in mathematics achievement of 9th graders. Self-efficacy for learning and performance, organization, effort regulation and peer learning factors were significant in predicting 10th grade students mathematics achievement [F(4,114)=25.947; p=.000]. These factors accounted for 48% of the variance in the outcome variable. Four out of 6 motivation factors and 8 out of 9 learning strategies factors were significant in predicting mathematics achievement of 11th graders. These factors accounted for 82% of the variance in mathematics achievement.

Table 5. Results of multiple regression according to grade level

Grade	Variables	B	β	t	p	Δ R^2	Correlations: Zero-order	Correlations: Partial
9th Grade	(Constant)	49.236		11.540	.000			
	(M) Task value	.949	.448	6.431	.000	.200	.448	.448
R= .448	R^2=.200 R^2_{adj}=.196 F(1,165)=41.354 p=.000							
10th Grade	(Constant)	34.763		5.501	.000			
	(M) Self-efficacy	.959	.436	5.877	.000	.348	.590	.482
	(LS) Organization	.702	.251	3.508	.001	.060	.393	.312
	(LS) Effort regu.	.554	.186	2.536	.013	.040	.414	.231
	(LS) Peer learning	-.668	-.175	-2.521	.013	.029	-.252	-.230
R= .690	R^2=.477 R^2_{adj}=.458 F(4,114)=25.947 p=.000							
11th Grade	(Constant)	71.054		11.818	.000			
	(M) Intrinsic	3.827	1.155	12.454	.000	.387	.622	.724
	(LS) Organization	1.890	1.046	11.104	.000	.122	.465	.683
	(LS) Peer learning	-1.487	-.494	-9.682	.000	.113	.047	-.632
	(M) Learning contr.	-1.718	-.272	-6.267	.000	.057	.074	-.467
	(LS) Metacognitive	-.722	-.797	-5.725	.000	.026	.475	-.434
	(G) Extrinsic goal	-1.171	-.327	-6.845	.000	.012	-.086	-.499
	(G) Task value	-1.487	-.573	-5.993	.000	.013	.545	-.451
	(LS) Critical thin.	.937	.433	7.218	.000	.024	.320	.519
	(LS) Time/s.env.	1.059	.625	5.878	.000	.018	.499	.444
	(LS) Effort reg.	-.878	-.348	-4.513	.000	.017	.458	-.355
	(LS) Rehearsal	.754	.343	4.488	.000	.022	.421	.354
	(LS) Elaboration	-.393	-.279	-3.017	.003	.012	.406	-.246
R= .906	R^2=.822 R^2_{adj}=.806 F(12,141)=54.119 p=.000							

DISCUSSION

Results of this study showed that factors such as task value (M), time/study environment (LS), self-efficacy (M), extrinsic goal orientation (LS), test anxiety (M), peer learning (LS) and organization (LS)] significantly predicted students' mathematics achievement. The relationships between mathematics achievement and extrinsic goal orientation; peer learning and test anxiety were negative. These results are overall in line with those by Öztürk, Bulut and Koç (2007) who worked with a sample of 752 9^{th} graders from Turkey and tested if scores on subscales of Motivation and Learning Strategies Questionnaire (MLSQ, Pintrich et al., 1991) significantly predicted their mathematics achievement. The authors report that factors of self-efficacy, test-anxiety and extrinsic goal orientation were significant in predicting students' mathematics achievement. These factors accounted for 10% of the variance in mathematics achievement. Similar with the current study, Öztürk and colleagues also reported a significant negative relationship between mathematics achievement and test-anxiety and extrinsic goal orientation. Likewise, findings of the current study are only partially parallel to those by Üredi and Üredi (2005) who examined the degree to which factors of self-regulated learning predicted mathematics achievement levels of 8^{th} grade students. These investigators also found that self-efficacy, test-anxiety and extrinsic goal orientation were significant in predicting students' mathematics achievement. Self-efficacy had a positive relationship with mathematics achievement while test-anxiety and extrinsic goal orientation had a negative relationship.

Results of the current study showed that some factors of motivation and learning strategies significantly predict students' achievement levels in mathematics according to gender. While factors of self-efficacy, time and study environment, test-anxiety and extrinsic goal orientation significantly predicted female students' achievement levels in mathematics, effort regulation, self-efficacy and metacognitive self-regulation were factors significantly predicting male students' levels of mathematics achievement. Furthermore, self-efficacy accounted for 25% of variance in predicting female students' mathematics achievement whereas task-value accounted for 28% of variance. On the other hand, Üredi and Üredi (2005) who worked with a sample of 8^{th} graders from Turkey and found motivation and learning strategies overall predicting male students' mathematics achievement better than that of female students. Use of cognitive strategies and self-regulation were factors significantly predicting female students' mathematics achievement while use of cognitive strategies, self-regulation, self-efficacy and intrinsic value perception were significant in predicting male students' mathematics achievement. The authors attributed this result to male students' higher scores on self-efficacy and intrinsic goal orientation. Their findings regarding male students scoring higher on self-efficacy was confirmed by the findings of the current study as well as a number of previous studies (i.e., Pintrich & De Groot, 1990). On the other hand, comparisons between findings from samples of differing age groups should be done carefully. Some authors (i.e., Schraw & Moshman, 1995; Moschner, Anschuetz, Wernke & Wagener, 2008) have warned that adolescents mastery on metacognitive processes (awareness, knowledge and control over one's cognition) continue through teen years. Thus, these authors suggest that while investigating self-regulation strategies of elementary school students, results should be interpreted with caution.

Self-efficacy for learning and performance factor of MSLQ consists of items measuring two aspects of expectancy; expectancy for success and self-efficacy. The two aspects are about students expectations and beliefs as to what degree they see the task (i.e., mathematics course) manageable ("doable") and their self-appraisals about their ability to master the task. In the case of participants of this study, self-efficacy for learning and performance refers to students' judgments about their ability to succeed in the mathematics course and their confidence in their skills toward doing so. The factor of task value on the other hand, has to do with high school students' evaluation of how interesting, how important and how useful their respective mathematics courses are. In other words, it is about students' perceptions of the course material with respect to their interest, importance and utility. Thus, task value is closely associated with one's degree of involvement in his or her learning. Given that findings of this study showed that self-efficacy accounted for 25% of variance in predicting female students' mathematics achievement whereas task-value accounted for 28% of variance, might be taken as evidence female students' trust in their ability to succeed in high school mathematics courses is an essential part of their motivation and success in these courses whereas the degree to which male students perceived their respective mathematics classes was essential part of their motivation and success in this courses. Indeed, various studies have documented that overall, female students report lower self-efficacy in mathematics than their male peers (i.e., Lynch, 2010; Ferla, Valcke & Cai, 2009). It appears that self-efficacy is an essential factor associated with female students' performance in mathematics. Previous studies attempting to predict mathematics achievement of male and female students by factors of MLSQ found mixed results. For instance, Yükseltürk and Bulut (2009) found that test anxiety accounted for significant proportion of variance in female students' mathematics achievement while self-efficacy and task value did so for variance in male students' mathematics achievement.

Findings showed that different factors of motivation and learning strategies significantly predicted students' achievement levels in mathematics for each grade level. Task value was the only significant factor predicting mathematics achievement for 9^{th} graders, while self-efficacy for learning and performance, organization, effort regulation and peer learning factors significantly predicted mathematics achievement for 10^{th} graders. Finally, none of the several factors significantly predicting mathematics achievement levels of 11^{th} graders were significant for 9^{th} or 10^{th} graders. Four out of 6 motivation factors and 8 out of 9 learning strategies factors were significant in predicting mathematics achievement levels of 11th graders.

Overall, findings related to grade levels seem to point to unique sets of factors for each grade levels. Similar results were reported by Öztürk and colleagues (2007) who found that self-efficacy for learning and performance was the most powerful factor in predicting mathematics achievement, explaining 7.4% of the variance. Likewise, many studies have reported self-efficacy as the most important factor in predicting mathematics as well as other courses (Ergöz, 2008; Yükseltürk & Bulut, 2005; Coutinho & Neuman, 2008; Mousoulides & Philippou, 2005; Niemcyzk & Savenye, 2005; Pintrich & DeGroot, 1990; Wolters & Pintrich, 1998). However, findings of the current study partially differ from those. For example, self-efficacy was among factors significantly predicting mathematics achievement levels of 9th and 11th graders. On the other hand, it was the first factor to enter into the regression equation and by itself explained 34.8% of variance in mathematics achievement levels of 10th graders.

Another unique finding of this study was that the task value accounted for 25.4% variance in mathematics achievement of all students and 28% of variance in mathematics achievement of male students. Task value also by itself, explained 20% of variance in mathematics achievement of 9th graders. Although Pintrich, Marx and Boyle (1993) propose that task value (the degree to which the student find the task worth the effort/completion) in general increases individuals effort toward successful completion of the task, Ergöz (2008) did not find task value as a significantly contributing mathematics achievement of 7th graders and Öztürk and colleagues (2007) did not find it significant contributing to mathematics achievement of 9th graders. Studies regarding task value have yielded to mixed results. Contrary to findings by Ersöz (2008), Öztürk and colleagues (2007), Seo and Taherbhai (2009) found task value as a significant factor in determining Korean 5th grade students' success or failure in mathematics courses.

LIMITATIONS AND RECOMMENDATIONS

This study explored relationship of motivation and learning strategies to mathematics achievement of 9th, 10th and 11th grade high schoolers by using multiple regression which could also be seen as a limitation of the study. Multiple regression assumes linear relationships. However, relationships between psychological constructs are not always linear. Sole reliance on self-report and use of a convenient sample were among other limitations of the current study. Thus, future studies can use nonlinear analyses, diverse assessment procedures and more representative samples in exploring these variables.

Results of this study showed that regression equations predicting mathematics achievement according to gender and grade level were significant. Thus, mathematics achievement seems at least in part a function of gender and grade level. Yet, no further inferences can be made based on findings of correlational studies such as the current one. Hence, the correlational nature of this study also poses limitations to the inferences that can be made about its results. Therefore, using causal models, future studies can acquire further insight into sources of mathematics achievement.

The most striking finding of this study was that factors predicting mathematics achievement differed remarkably according to grade level. Studies with more representative national samples can further examine achievement levels in each course or at least subject area according to a host of variables. Also, longitudinal studies can provide vital insight regarding what factors influence mathematics (or other courses) achievement through grades and age as well as according to family, personal, community and regional variables. Such insight will guide teachers and school counselors toward improved levels personal as well as national achievement in mathematics and other areas.

Results of the study have several implications for educators and school counseling and guidance personnel. For example, they show that teachers and counselors should not view students' overall (general) motivation or learning strategies but rather look into individual variables impacting student achievement on a course-to-course basis for each student. School counselors can develop programs geared toward improvement of students' self-regulated learning strategies. Ideally, as noted by Cleary and

Zimmerman (2004), such programs can have a "microanalytic assessment procedures to assess students' self-regulation beliefs and study strategies" and coach "students to use these strategies in a cyclical, self-regulation feedback loop" (p. 41). Given that factors associated with students' achievement in mathematics might change with gender, grade (perhaps age and many other variables), motivational and learning strategies can be viewed on an individual basis by counselors and teachers so as to reinforce their existing strengths but also empower and strengthen areas (factors) in need of improvement. Similarly, school counselors in collaboration with teachers, can explore factors associated with students' underachievement with respect to motivation and learning strategies. Indeed, such an approach is in line with student-centered views held by contemporary educators and school counselors.

Likewise, school counselors and educators can particularly be sensitive to building female students' self-efficacy as way of contributing to their achievement levels in traditionally male dominated areas such as mathematics and sciences and thus can contribute to efforts toward eliminating gender inequalities. Considering that countries wish impressive visions for their educational systems have the inspiring goal of leaving no child behind, providing teaching and counseling/guidance services not only in individualized manners but even specific to each course will have remarkable contributions to student learning and thus to their academic and personal development.

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