Predicting Mathematics Achievement by Motivation and Self-Efficacy Across Gender and Achievement Levels

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This study investigated the extent to which self-efficacy and motivation served as a predictor for mathematics achievement of fifth grade students in United Arab Emirates (UAE) across gender and achievement levels. Self-efficacy was measured by two scales, which differed in levels of specificity—Category Specific and Task Specific. Motivation was measured through four sub-constructs of motivation—Amotivation, External Regulation, Introjected Regulation, and Intrinsic Motivation. A total of 287 fifth grade students with an average age of 10.3 years were randomly selected to participate in this study. The multiple regression model showed that the six predictors were able to explain together high percentage (32%) of the variance of mathematics achievement. Also the results indicated that the best three predictors were Task Specific, External Regulation, and Intrinsic Regulation. When conducting the regression model across gender, the results showed that 30% of the variance in mathematics achievement was explained by the six predictors for the male group while only 21% of the variance was explained for the female group. The regression model was not invariant across achievement levels. While the model predicted approximately 20% of the variance of mathematics achievement for each of the low and high achieving students, the model was not statistically appropriate for the medium achievement students as it predicted only 5% of the variance of mathematics achievement. Additionally, the performance of the six predictors varied according to the achievement level.

Keywords: mathematics, self-efficacy, gender, academic performance, intrinsic motivation, extrinsic motivation, amotivation, external regulation, introjected regulation

Over the past three decades, much attention has been focused on mathematics education in relation to self-efficacy beliefs, motivation, and mathematics achievement (Bandura, 1986; Klassen, 2004; Pajares, 1996). Self-efficacy research evolved from the works of Albert Bandura (1977), who theorized that one's beliefs about his/her capabilities are strongly related to the way he/she behaves and learns. According to Bandura's (1986) *Social Cognitive Theory*, self-efficacy beliefs play a major role in human development. Self-efficacy influences people's motivation, the efforts they are willing to exert, and the degree to which one may persist or persevere when carrying out tasks. In fact, self-efficacy has also been shown to affect one's self-concept and self-esteem. In addition, Bandura (1986) made a clear distinction between self-efficacy beliefs and the outcome expectations of one's actions. Outcome expectations depend more on people's judgment of what they can accomplish rather than their beliefs about their academic capabilities. Although there is a positive relationship between the two, this form of relationship is not always consistent (Usher & Pajares, 2009).

A substantial body of research shows the predictive value of self-efficacy beliefs and students' academic achievement across all areas and levels and students' career choices (Brown & Lent, 2006; Pajares & Urdan, 2006). According to this research, students who are more confident in their capabilities tend to work harder, solve problems more efficiently, monitor their progress regularly, and hence, achieve better than their able peers who do not have high self-efficacy. Similarly, experiencing failure will have a negative impact on one's self-efficacy (Brown & Lent, 2006).

Pajares and Miller (1994) found that mathematics self-efficacy was more predictive of problem solving than was mathematics self-concept. Further, they found that self-efficacy played a meditational role on the effect of gender and prior experience on mathematics self-concept, perceived usefulness of math, and math problem-solving performance. These researchers also noted that even when there were gender differences in self-concept and mathematics performance, these differences were ascribed to differences in self-efficacy beliefs. That is, ". . . the poorer performance and lower self-concept of the female students were largely due to lower judgments of their capability" (p. 200). Thus, Pajares and Miller recognized the value of self-efficacy beliefs not only in explaining students' motivation, but also in informing school practitioners as to how to strengthen competence and confidence in students.

In a more recent study, Stevens, Olivarez, Lan and Tallent-Runnels (2004) evaluated self-efficacy and motivational orientation in 358 Hispanic and Caucasian students in grades 9 and 10. They found that self-efficacy strongly predict mathematics achievement and motivation across ethnicity.

Individuals develop self-efficacy beliefs from four underlying sources—mastery experience, vicarious experience, social persuasions, and emotional and physiological states (Bandura, 1977). According to Bandura, the first and most powerful source, mastery experience, refers to one's interpretation and evaluation of results; whereas, vicarious experience refers to students' interpretation of their capabilities in relation to the performance of others. In other words, students compare themselves to others like classmates, peers, and even adults. In addition to comparing themselves to others, students build their self-efficacy beliefs through social persuasions and encouragement, which they receive from others such as parents, teachers and loyal friends. Finally, the emotional and physiological states of an individual serve as a source of one's efficacy beliefs. If an individual engages in a particular behavior and experiences anxiety for example, he or she will be less likely to participate in that behavior again.

In regards to motivation, Haj Hussein, AlSawaie, Alghazo, Tibi, and Sartawi (in press) attempt to explain the concept of "motivation" and its impact on academic achievement. The approach primarily used to explain this phenomenon is the Self Determination Theory (SDT). The SDT postulates that motivation is not a unitary phenomenon, it varies in quantity and quality among people. After reviewing numerous studies, Haj Hussein et al. (in press) asserted that motivation is a complex phenomenon consisting of three different types—intrinsic motivation, extrinsic motivation, and amotivation. They also found that motivation is varied in both quantity and quality (Ahmed & Bruinsma, 2006; Kyoung Um, Corter, & Tatsuoka, 2005; Lepper, Corpus, & Iyengar, 2005; Ryan & Deci, 2000; Shih, 2008; Vansteenkiste, Lens, & Deci, 2006) In intrinsic motivation, behavior is exhibited willingly without any internal or external influences. This type of behavior is mediated with rewards or satisfaction that derives from the behavior itself. Extrinsic motivation has internal or external influences—that is, the behavior is not exhibited for itself, but rather as a means to an end in which consequences are expected as a result of producing the behavior (Vallereand et al., 1992; Vansteenkiste et al., 2006).

According to their review of the literature, Haj Hussein et al. (in press) asserted that extrinsic motivation can be divided into three categories—identified regulation, introjected regulation and external regulation. Extrinsic motivation with identified regulation refers to behavior that is exhibited internally and willingly based on the value and internal causes of the behavior. Extrinsic motivation with introjected regulation refers to behavior that is associated to partial internal influences with externally perceived locus of causality. Extrinsic motivation with external regulation refers to behavior that is exhibited as a result of external influences to obtain a reward or avoid punishment (Cokley, Bernard, Cunningham, & Motoike, 2001; Deci, Vallereand, Pelletier, & Ryan, 1991; Vansteenkiste et al., 2006). Finally, amotivation refers to a lack of motivation—i.e., students are not internally or extrinsically motivated to produce the behavior. They lack the intention and perceive themselves as incompetent (Ryan & Deci, 2000b). Thus, the difference between intrinsic and extrinsic motivation stems from the nature, derivation, and consequences of the behavior.

Based on the above discussion, it seems plausible that both self-efficacy and motivation may play a role in mathematics achievement. The relationship between self-efficacy and mathematics achievement has been well documented in the literature. For example, Langenfeld and Pajares (1993) reported a significant correlation between mathematics self-efficacy and mathematics performance of American undergraduate students. In another similar study, Pajares and Kranzler (1995) reported that American high school students (grades 9, 10, 11, and 12) mathematics self-efficacy had a direct impact on their mathematics anxiety and mathematics performance. In addition, mathematics self-efficacy of gifted and regular eighth grade students from the U.S.A. was investigated. The findings confirmed that mathematics self-efficacy was a significant contributor in predicting their mathematics performance (Pajares, 1996).

In Australia, Nielsen and Moore (2003) found that ninth grade Australian students' mathematics self-efficacy scores were significantly and positively correlated with their mathematics scores from the previous year. Similarly, Nasser and Birenbaum (2005) reported that the mathematics self-efficacy of Palestinian and Jewish eighth grade students had a significant positive impact on their scores on the National Assessment Test in Mathematics.

Ayub (2010) investigated the relationship between intrinsic and extrinsic motivation on the academic performance of 200 college students in India. The findings in this study supported the significance of motivation to academic performance, and hence made recommendations to

University teachers with regard to motivating their students during instruction. These findings conform to earlier findings by Stevens et al., 2004 who reported that mathematics self-efficacy of American ninth grade students was significant in predicting their mathematics performance and motivation.

In another study, Adeyemo and Torubeli (2008) explored the effectiveness of self-efficacy, self-concept, and peer influence in predicting the academic performance (English language, mathematics, biology, and geography) of Nigerian students with ages ranging from 12 to 18 years. These authors found that self-efficacy was the stronger contributor in predicting students' academic achievement.

Regarding gender, Ayub (2010) investigated the relationship between intrinsic and extrinsic motivation on the academic performance of 200 students (100 male; 100 female) and found gender difference ($t=4.324$, $p <.05$) on both motivation and academic performance. Specifically, the findings revealed that females were more intrinsically motivated, whereas, males were more extrinsically motivated. Ayotola and Adedej (2009) also examined the relationship between gender and mathematics achievement, along with several other variables. More than 1,000 students participated in this study. Based on the findings, mathematics self-efficacy was identified as the best predictor of mathematics achievement followed by gender.

Method

The purpose of this study was to determine the extent to which self-efficacy and motivation can predict mathematics achievement across gender and achievement levels. In this study, we attempted to answer the following three research questions with respect to fifth grade students:

1. Can motivation toward mathematics and mathematics self-efficacy predict student mathematics achievement?
2. Is this prediction invariant across gender?
3. Is this prediction invariant across achievement levels?

Participants

This study included a total of 287 fifth grade students (167; 58.2% females; 120; 41.8% males) from the United Arab Emirates (UAE). The sample was selected using the following cluster-sampling method. First, three school districts were randomly selected from the UAE's 10 school districts. The three districts selected were Al Ain, Dubai, and Fujarah. As schools in the UAE are segregated by gender, two male schools and two female schools from each district were randomly selected. Finally, one section of grade 5 students was randomly selected from each school. The average age of the students participating in the study was 10.3 years (SD=1.16).

Instrumentation

Students' motivations toward mathematics were assessed using the *Mathematics Motivation Scale* (MMS) developed by Haj Hussein et al. (in press), based on the theoretical framework of the self-determination theory. This scale was psychometrically assessed on a sample of 1,481 UAE students in grades 4 through 12. The scale consisted of four subscales: Amotivation (9 items), External Regulation (8 items), Introjected Regulation (6 items), and Intrinsic Motivation

(15 items). Internal consistency for this instrument was assessed by computing Cronbach's alpha for each subscale based on the entire sample population. The results ranged from 0.77 to 0.91. As for validity, ten experts in the field reviewed the instrument and approved its final version. The MMS results indicated acceptable levels of content validity, structure validity, and convergent validity.

Two self-efficacy scales in mathematics were also used in the study. These scales (see Alsawaie, et al., 2010) represented two levels of specificity of mathematics problems. The first scale, the *Mathematics Self-Efficacy Task Specific Scale* (TSS) was comprised of 45 items and included multiple choice mathematics problems representing specific task correspondence. This scale included statements about students' confidence in solving mathematics problems in different domains of mathematics—numbers and operations, algebra and patterns, geometry, measurement, and probability and Statistics. The second scale, the *Mathematics Self-Efficacy Category Skill Scale* (CSS), was comprised of 28 items that asked students about their confidence in solving various types of mathematics problems without really stating specific problems.

Reliability and validity scores for the TSS and CSS were calculated using a sample of 645 students who completed 4^{th} grade. Internal consistency and the stability were examined as two parameters of reliability. Internal consistency was measured by computing the correlation coefficients and Cronbach's alpha among the domains and total score (Alsawaie, Haj Hussein, Sartawi, Alghazo, & Tibi, 2010).

The correlation coefficients for each domain of the TSS (numbers and operations, algebra and the correlation coefficients for each domain of the TSS (numbers and operations, algebra and patterns, geometry, measurement, and probability and statistics) ranged from 0.436 to 0.697; the correlations coefficients between each of the domains and the total score ranged from 0.736 to 0.927. Cronbach's Alpha was calculated for each domain of the TSS (Table 1). The results indicated that the TSS has acceptable levels of internal consistency as the coefficients ranged between 0.660 and 0.927.

Table 1

Internal Consistency Coefficients (Cronbach's Alpha) of the TSS Domains

Domain	Number of Items	N	Alpha Coefficient
Numbers and Operations	17	604	0.818
Algebra and Patterns	6	615	0.846
Geometry	7	632	0.660
Measurement	9	637	0.686
Probability and Statistics	6	628	0.755
Total Score	45	574	0.927

The correlation coefficients among CSS domains (numbers and operations, algebra and patterns, geometry, measurement, and probability and statistics) ranged from 0.372 to 0.579; the correlation coefficients between each domain and the total score ranged from 0.727 to 0.801.

Cronbach's Alpha was calculated for each domain of the CSS (Table 2). The results indicate that the TSS has acceptable levels of internal consistency as the coefficients ranged between 0.625 and 0.919. The results indicated that the CSS also has acceptable levels of internal consistency.

Table 2
Internal Consistency Coefficients (Cronbach's Alpha) of the CSS Domains

Domain	Number of Items	N	Alpha Coefficient
Numbers and Operations	8	578	0.827
Algebra and Patterns	4	609	0.627
Geometry	7	599	0.738
Measurement	5	610	0.625
Probability and Statistics	4	630	0.849
Total Score	28	524	0.919

Results

Prior to the statistical analyses, all variables in the data set were screened for outliers or extreme values. No outliers or extreme variables were identified. The data sets were also screened for missing values. Most of the variables had very few missing cases. The highest percentage of missing data was around 6%, while many variables had no missing data. Because all variables were used in calculating the multiple regression, include all participants' responses in the data analysis, variables with missing data were replaced using the series mean.

Based on the previous year final grade in mathematics, students were classified into three ability groups—a low ability group (students with mathematics achievement in the lowest 33%), a high ability group (students with mathematics achievement in the highest 33%), and a medium ability group (all of the remaining students). The first analysis calculated the mean, standard deviation, and range of achievement in mathematics for the sample as a whole, for gender, and achievement group. The results of this analysis (see Table 3) gives an idea about the range of achievement scores, how spread out they are, how many students were in each group, and how each group differed.

Table 3
Mathematics Achievement Scores for Sample Population
Showing Gender and Achievement Group

	N	Mean	SD	Range
Sample	287	76.51	15.50	72.00
Males	120	71.70	15.93	72.00
Females	167	79.97	14.26	67.00
Low Ability	93	63.00	13.60	63.00
Medium Ability	93	77.25	11.69	50.00
High Ability	101	87.64	10.67	48.00

Table 4 shows the means and standard deviations for students' responses on the mathematics motivation and self-efficacy scales reported in relation to gender.

Table 4

Means and Standard Deviations for Responses on Both Mathematics Scales by Gender

Gender		Mathematics Motivation Scale				Mathematics Self-Efficacy Scale	
		Amotivation	External Regulation	Introjected Regulation	Intrinsic Motivation	Task Specific	Domain Specific
Females	Mean	16.64	22.22	20.80	49.17	143.48	60.38
(n = 167)	SD	7.25	5.31	3.27	6.36	19.97	10.30
Males	Mean	20.39	23.02	19.81	47.54	141.24	57.48
(n =120)	SD	7.29	5.15	3.20	6.72	23.20	11.75

Responses of the two genders were not similar on most of the subscales. However, these differences were practically small except for the Amotivation subscale where a noticeable difference between males and females could be observed. This difference is also statistically significant as assessed by independent t-test ($t = -4.30$, (males = 102, females = 167), $p < .01$). The difference between genders on Amotivation is not so surprising in the context of the UAE. Females in the country are usually more motivated than males for different social and economic reasons.

Table 5 presents the means and standard deviations for students' responses on the mathematics motivation and self-efficacy scales in relation to achievement group.

Table 5

Means and Standard Deviations for Responses on Both Mathematics Scales by Achievement level

Ability Group		Mathematics Motivation Scale				Mathematics Self-Efficacy Scale	
		Amotivation	External Regulation	Introjected Regulation	Intrinsic Motivation	Task-Specific	Domain-Specific
Low Ability	Mean	20.80	23.13	20.03	47.16	136.75	58.21
(n = 93)	SD	7.45	4.77	3.52	6.21	22.43	10.44
Medium Ability	Mean	18.96	23.19	20.14	48.21	141.75	58.46
(n= 93)	SD	7.33	4.98	3.16	6.79	21.49	11.98
High Ability	Mean	15.12	21.41	20.94	49.96	148.60	60.71
(n=101)	SD	6.60	5.76	3.09	6.39	18.68	10.50

To estimate differences in responses across achievement level, an ANOVA test was performed for each subscale. The results indicated that the differences were statistically significant for all subscales except for Domain Specific and Introjected Regulation. Table 6 summarizes these results.

Table 6
ANOVA Results for Mathematics Self-Efficacy and Motivation Subscales Across Achievement Level

			Sum of Squares	Mean Squares	df	F	Sig.	Eta2
Mathematics Self-Efficacy Subscales	Task Specific	Between Groups	6885.083	3442.541	2	7.903	.000	.05
		Within Groups	123711.336	435.603	284			
		Total	130596.419					
	Domain Specific	Between Groups	372.626	186.313	2	1.545	.215	.01
		Within Groups	34243.015	120.574	284			
		Total	34615.642					
Mathematics Motivation Subscales	Amotivation	Between Groups	1641.323	820.661	2	16.178	.000	.10
		Within Groups	14406.746	50.728	284			
		Total	16048.06					
	External-Regulations	Between Groups	201.113	100.556	2	3.712	.026	.03
		Within Groups	7692.839	27.087	284			
		Total	7893.951					
	Introjected Regulation	Between Groups	48.288	24.144	2	2.275	.105	.02
		Within Groups	3014.612	10.615	284			
		Total	3062.900					
	Intrinsic Motivtion	Between Groups	391.183	195.592	2	4.676	.010	.03
		Within Groups	11878.535	41.826	284			
		Total	12269.718					

The results of ANOVA tests above indicated that there is a significant difference among the three groups of achievement for four subscales: Task Specific, Amotivation, External Regulation, and Intrinsic Motivation. However, these results did not show which groups differ. Therefore, a post hoc analysis was conducted for each of these four scales on the three achievement groups. Table 7 shows the achievement groups that have significant differences.

Table 7
Post Hoc Analysis for Responses on Both Mathematics Scales by Achievement Level

	Domain	Achievement Groups	Mean Difference	Significance Level
Mathematics Self-Efficacy Scale	Task Specific	Low Ability and High Ability	-11.85	P < .001
Mathematics Motivation Scale	Amotivation	Low Ability and High Ability	5.68	P < .001
		Medium Ability and High Ability	3.84	P < .01
	External Regulation	Medium Ability and High Ability	1.78	P < .05
	Intrinsic Motivation	Low Ability and High Ability	2.80	P < .01

Predicting Math Achievement

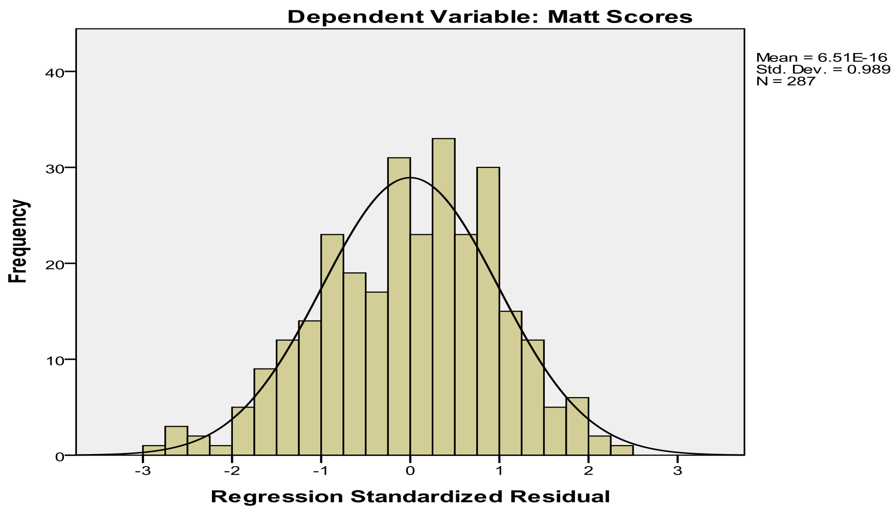
Six subscales were used to predict the fifth grade students' achievement in mathematics. To estimate the level of predication, a multiple regression was conducted using the six subscales as independent variables (predictors) and students' achievement in mathematics as the dependent variable. Multiple regression analysis relies statistically on several assumptions that should be checked before running the test. These assumptions include: independence of observations, normality, linearity, and homoscedasticity. The independence of observations means independent responding to the questionnaires. This assumption was met because all participating students answered the questionnaires used in this study independently in the classroom environment, and under the supervision of their teachers. As for normality assumption, normality in multiple regression means that the differences between the predicted and observed values (called residuals) are normally distributed around the dependent variable scores. This assumption was checked through drawing a histogram (see Graph 1), which showed that the residuals were normally distributed around the math scores.

The linearity assumption means that there is a linear relationship between the set of the independent variables and the dependent variable. This assumption was assessed through plot the regression standardized residuals and the dependent variable (math scores) as shown in Graph 2. The assumption was also met as the graph showed no curvilinear relationship.

The homoscedasticity assumption means that the variance of errors is the same (constant) across all levels of the independent variables. This assumption was also graphically checked (see Graph 3) through a plot of regression standardized residuals and regression standardized predicted values. If the values are randomly distributed around the value 0 of each axis (as it is in this case) then the assumption is met. In addition to these four important assumptions in multiple regression, the six predictor variables as well as the dependent variable should be metric (measure on at least interval level). This assumption was also met here.

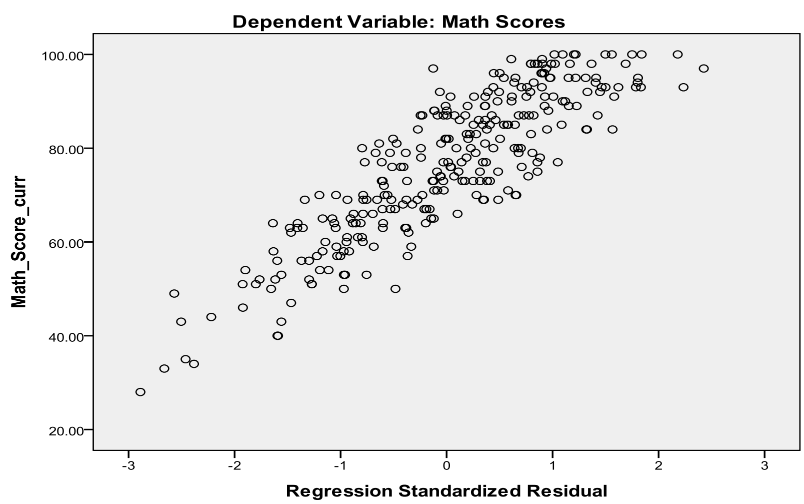
Graph 1

Normality Assumption



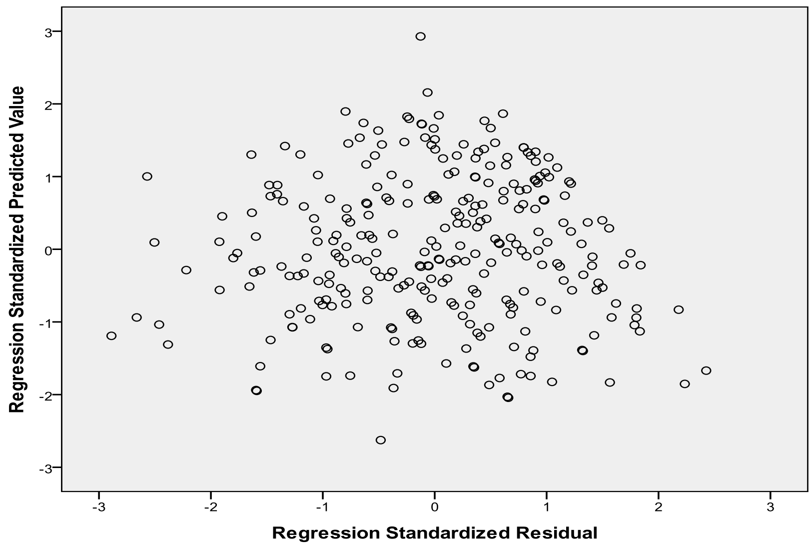
Graph 2

Linearity Assumption



Graph 3

Homoscedasticity Assumption



The results in the multiple regression analysis output was statistically significant (f = 7.1, p <.01) which indicated that the model is appropriate to predict the dependent variable (mathematics achievement). The results also indicated that the multiple correlation coefficient R was .66 and that the six predictors were able to explain together 32% of the variance in mathematics achievement. The performance of each predictor was also assessed in the multiple regression analysis. Table 8 displays Beta standardized coefficients and t-test results, which could be used to assess the performance of each predictor in the multiple regression analysis.

Table 8

Performance of the Six Subscales (Predictors) of Mathematics Self-Efficacy and Motivation Subscales in Predicting Mathematics Achievement

	Variable	Standardized Beta coefficient	t-test	Significance level
Mathematics Self-Efficacy Scale	Task Specific	.378	3.262	.002
	Domain Specific	-.212	-1.871	.065
Mathematics Motivation Scale	Amotivation	-.093	-.921	.360
	External Regulation	-.358	-3.014	.003
	Introjected Regulation	.243	1.995	.049
	Intrinsic Regulation	.243	2.052	.043

The results shown in Table 8 revealed that except Amotivation, the other five predictors contributed well in the prediction of mathematics achievement. The t-test values were statistically significant for Task Specific, External Regulation, Introjected Regulation, and Intrinsic Regulation. The Domain Specific was not statistically significant (p =.065). According to these results, the best predictor was Task Specific, then External Regulation, then Intrinsic Regulation, and the least one was Amotivation.

In order to assess the prediction of students' mathematics achievement across gender, the multiple regression analysis was conducted on each gender separately. ANOVA results were significant (F = 6.98, p < .01 for females and F = 7.99, p < .01 for males) for both genders, which indicated that the model is statistically appropriate. The multiple correlation coefficient R for females was found to be .46 and 21% of the variance in mathematics achievement was explained by the six predictors together. For the males, the multiple correlations R was .55 and 30% of variance in achievement was explained by the same predictors. This means that the performance of the predictors for the male group was better than that for females. Moreover, how each predictor affected in the total prediction was different between the two gender groups. The results of the performance of each predictor on each group appear in Table 9.

Table 9

Performance of the Six Subscales (Predictors) of Mathematics Self-Efficacy and Motivation Subscales in Predicting Mathematics Achievement Across Gender

		Females			Males		
	Variable	Standardized *Beta* coefficient	*t*-test	Sig. level	Standardized *Beta* coefficient	*t*-test	Sig. level
Mathematics Self-Efficacy Scale	Task Specific	.288	2.766	.006	.342	3.452	.001
	Domain Specific	-.106	-1.043	.299	-.053	-.552	.582
Mathematics Motivation Scale	Amotivation	-.036	-.445	.657	-.448	-4.677	.000
	External Regulation	-.305	-3.528	.001	.032	.303	.762
	Introjected Regulation	.135	1.440	.152	-.147	-1.410	.161
	Intrinsic Regulation	.230	2.419	.017	.212	1.985	.050

For female students, three variables (Domain Specific, Amotivation, and Introjected Regulation) do not have significant t-value. This means that these are not good predictors of mathematics achievement. On the other hand, the best three predictors were External Regulation then Task Specific, and then Intrinsic Regulation in the same order. As for male students, External Regulation was the least important predictor then Domain Specific and Introjected Regulation. The best predictors for males were Amotivation (negatively), Task-Specific, and then Intrinsic Regulation in the same order.

The third goal of this study was to assess the prediction of mathematics achievement by motivation and math efficacy across achievement levels. Three achievement levels were identified and used for comparison. A multiple regression analysis was conducted on each achievement level. Table 10 summarizes the multiple regression results for the three achievement levels.

Table 10

Multiple Regression Results cross Achievement levels

Achievement Level	R	R square	F	Sig. level
Low Achievement Level	.43	.18	3.167	.007
Medium Achievement Level	.21	.05	.627	.67
High Achievement Level	.46	.21	4.215	.001

The results above indicated that the achievement level influenced the prediction of mathematics achievement. While the model predicted around 20% of the variance of math achievement for low and high ability students, the model was not statistically appropriate for the medium ability students. The performance of the six predictors also varies according to the achievement level (see Table 11).

Table 11

Performance of the Six Subscales (Predictors) of Mathematics Self-Efficacy and Motivation Subscales in Predicting Mathematics Achievement Across Achievement levels

		Mathematics Self-Efficacy Scale		Mathematics Motivation Scale			
		Task Specific	Domain Specific	Amotivation	External Regulation	Introjected Regulation	Intrinsic Regulation
Low Ability	Standardized *Beta* Coefficient	.206	.055	-.178	-.267	.124	.193
	t-test	1.623	.426	-1.507	-2.063	1.001	1.518
	Significance Level	.108	.671	.135	.042	.320	.133
Medium Ability	Standardized *Beta* Coefficient	-.026	.163	-.100	-.116	-.036	.118
	t-test	-.161	.994	-.821	-.801	-.224	.751
	Significance Level	.872	.323	.414	.426	.823	.455

Table 11 Cont'd

		Mathematics Self-Efficacy Scale		Mathematics Motivation Scale			
		Task Specific	Domain Specific	Amotivation	External Regulation	Introjected Regulation	Intrinsic Regulation
High Ability	Standardized *Beta* Coefficient	.364	-.115	-.084	-.146	.076	.206
	t-test	3.266	-1.023	-.772	-1.324	.587	1.626
	Significance Level	.002	.309	.442	.189	.559	.107

As can be observed from Table 11, the performance of the six predictors was different across the three achievement levels. For the low ability group, only External Regulation was statistically significant predictor. The other five variables were not good predictor of students' achievement in mathematics. With respect to the medium ability group, the model was not statistically appropriate, and no variable was a significant predictor. Finally, the Task Specific was the only significant predictor for the high ability students.

Discussion

The results of ANOVA tests above indicated that there is a significant difference among the three groups of achievement for four subscales: Task Specific, Amotivation, External Regulation, and Intrinsic Motivation. These results can be explained according to the self-determination theory (SDT). According to SDT, external regulation is the classic case of extrinsic motivation in which rewards and punishment play a big role in individual's behavior (Deci & Ryan, 2000). Therefore, it is not surprising that high achievers in mathematics would be less likely to be externally regulated to study mathematics. These students are usually more intrinsically motivated.

Amotivation, according to the SDT, is the passive acting or the lack of intention for acting. Ryan and Deci (2000a, 2000b, 2002) suggest two possible reasons for that. The first is not seeing the value of activity and the second is the lack of feeling competent. With this understanding, it is logical to find that higher achieving students are motivated.

According to SDT, people are intrinsically motivated to do an activity because they find it interesting and enjoyable. Specifically, "intrinsic motivation is defined as the doing of an activity for its inherent satisfactions rather than for some separable consequences" (Ryan & Deci, 2000a, p. 56). Based on this definition, higher achieving students are more likely to be more intrinsically motivated than other students.

With introjected regulation, people perform behaviors under the pressure of others. They behave well in order for others to respect them, and they avoid bad behavior to avoid shame. It seems from the results of the study that students are equally regulated by introjects regardless of their achievement level. Students' scores on this domain ranged between 20.03 and 20.94 out of 24 indicating that all students are highly regulated by introjects. The conservative culture of the UAE and the Arabic world in general may have influenced these results. In this culture, children respect their parents and seek their respect. And since failure is considered a shame, children may put effort into study just to avoid such shame. This is true regardless of the achievement level of these children.

Unlike task specific, in category specific students are asked to evaluate their confidence in answering problems in certain domains without specifying these problems. Students -regardless of their achievement levels- might think that they are able to solve the problems. In task specific however, specific problems are presented. Therefore, high achievers are more likely to judge themselves as being able to solve the problems.

The multiple regression analysis indicated that the six predictors (Task Specific, Domain Specific, Amotivation, External Regulation, Introjected Regulation, and Intrinsic Regulation) were able to explain together 32% of the variance in mathematics achievement. This is a high percentage given the fact that students' achievement is generally affected by many variables. Moreover, many students see mathematics as difficult, complex, and as an abstract topic (Ernest, 2004), and many variables such as motivation to learn mathematics, mathematics anxiety, and attitudes toward mathematics are usually affecting achievement in mathematics more than other disciplines.

As for the performance of each predictor, it is expected that Task Specific self-efficacy will be a good predictor of mathematics achievement because students who are more confident in their capabilities tend to work harder, solve problems more efficiently, monitor their progress regularly and hence, achieve better than their peers who do not have high self-efficacy. Many previous studies showed the predictive value of self-efficacy beliefs and students' academic achievement (e.g., Brown & Lent, 2006; Pajares & Miller, 1994; Pajares & Urdan, 2006; Stevens, Olivarez, Lan, & Tallent-Runnels, 2004).

As for motivation, these results agree with some previous research and disagree with others. Gronlick and Ryan (1987) found that external, introjected, and identified regulation and intrinsic motivation were related to better conceptual learning. In their experimental study, the authors assessed the learning of 91 fifth graders under different conditions; two directed conditions (controlling & non-controlling) and contrasted with a spontaneous-learning context. Results showed that both the non-directed and the non-controlling directed-learning sets resulted in greater interest and conceptual learning of texts as opposed to rote learning. The authors explained the positive outcomes of students' learning in terms of the role of autonomy in learning and development as the internal locus of causality. Vallerand, Blais, Brieri, and Pelletier (as cited in Vallerand & Bissonnette, 1992) found that intrinsic motivation related positively to educational outcomes at college students; both external and introjected regulations were either negatively related or not related to educational outcomes; amotivation was strongly negatively related to educational outcomes. Motivational beliefs were found to have a considerable influence on Turkish students' mathematics achievement (Ozturk, Bulut, & Koc, 2007). Further, Ayub (2010) found that intrinsic and extrinsic motivation and academic performance were positively correlated ($r = .563$; $n=200$; $p < .000$).

When gender is considered, three variables (Domain Specific, Amotivation, and Introjected Regulation) were not good predictors of mathematics achievement. On the other hand, the best three predictors were External Regulation, Task Specific, and Intrinsic Regulation. As for male students, External Regulation was the least important predictor then Domain Specific and Introjected Regulation. The best predictors for males were Amotivation (negatively), Task-Specific, and then Intrinsic Regulation in the same order.

These results reveal two important differences between genders in the UAE. First, Amotivation plays an important role in males' lack of achievement in mathematics, and second, External Regulation is more predictive with females than males. Previous research seems to offer an explanation to these differences. It is suggested that females tend to attribute their mathematics successes to external factors and to effort and their failures to their own lack of ability, whereas boys tend to ascribe the causes of their mathematics successes to internal factors and their failures to external factors (Campbell & Hackett, 1986; Leung, Maehr, & Harnish, 1996; Swim & Sana, 1996; Wolleat, Pedro, Becker, & Fennema, 1980).

With respect to achievement, the performance of the six predictors was different across the three achievement levels. For the low ability group, only External Regulation was a statistically significant predictor. This result indicates that low achieving students usually need support and encouragement from outsiders to work toward achievement in mathematics. Those outsiders are usually teachers and parents. In the medium ability group, the model was not statistically appropriate and no variable was a significant predictor. Finally, the Task Specific was the only significant predictor for the high ability students. This is an expected result actually since high achievers are better able to judge their ability in solving specific mathematics problem. Therefore, their scores on the task specific self-efficacy scale should highly correlate with their mathematics achievement.

Conclusion

In conclusion, the study examined predicting students' math achievement through motivation toward math (Amotivation, External Regulation, Introjected Regulation, and Intrinsic Regulation) and math self-efficacy (Task Specific and Domain Specific). The multiple regression model showed that the six predictors were able to explain together high percentage (32%) of the variance of mathematics achievement. Also the results indicated that the best three predictors were Task Specific, External Regulation, and Intrinsic Regulation. When conducting the regression model across gender, the results showed that 30% of the variance in math achievement was explained by the six predictors for the males group while only 21% of the variance was explained for the females group. Also the rank order of the best predictors was different between males and females. Finally, the regression model differed also across achievement level. Specifically, while the model predicted around 20% of the variance of math achievement for each of the low and high ability students, the model was not statistically appropriate for the medium ability students. Additionally, the performance of the six predictors varies according to the achievement level.

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