The Self-Determination Theory and Mathematics Motivation: Grade Levels and Gender Differences among United Arab Emirates Students

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The objective of this study was to investigate the impact of students' grade levels, gender, and interaction between the two on mathematics motivation. In addition, the relationship between students' various types of mathematics motivation and achievement were examined. Four hundred twenty four elementary school students (186 boys and 238 girls), 588 middle school students (296 boys and 292 girls), and 276 high school students (154 boys and 122 girls) completed the MMS. The findings of this study showed that all types of motivation in mathematics steadily decreased with grade advancement (elementary through high school) with the exception of introjected regulation. Moreover, results indicated a significant gender difference in each type of mathematics motivation, exception regarding intrinsic motivation, where the difference was not significant. In addition, the interaction between grade levels and gender was significant only in students' introjected regulation; the differences in intrinsic, external regulation, and amotivation were consistent between males and females in different grade levels. Finally, the results revealed a significant relationship between all types of motivation and mathematics achievement as well as overall academic achievement.

Keywords: motivation, self-determination, mathematics, achievement

نظرية تقرير الذات والدافعيه لتعلم الرياضيات :

أثر المرحلة الدراسية والجنس على الدافعيه لتعلم الرياضيات لدى الطلبة في دولة الامارات العربية المتحدة

جلال حاج حسين

المنطقة التعليمية لولاية وسكانسن – الولايات المتحدة الامريكية

هدفت الدراسة الحاليه التعرف على أثر المرحله الدراسية والجنس والتفاعل ما بينهما على النماط ا الدافعيه لمختلفه لتعلم الرياضيات . وكذلك التعرف على العلاقه ما بين انماط الدافعيه المختلفه لتعلم الرياضبات من جهه والتحصيل في مادة الرياضيات والتحصيل الاكاديمي من جهه أخرى .

أشتملت عينة الدراسه على (٤٢٤) طالبا في المرحله الابتدائيه (١٨٦ ذكور و ٢٣٨ اناث) - (٥٨٨) طالبا في المرحلة المتوسطه (٢٩٦ ذكور و ٢٩٢ اناث) - و (٢٧٦) طالبا في المرحله الثانوبه (١٥٤ ذكور و١٢٢ اناث) .

أظهرت النتائج بان للمرحله الدراسيه أثر ذي دلالة على كافة أنماط الدافعيه لتعلم الرياضيات. كما بينت النتائج أن لمتغير الجنس أثر ذي دلاله على كافة أنماط الدافعيه لتعلم الرياضيات باستثناء نمط الدافعيه الداخليه . كما أشارت النتائج الى أن هنالك علاقه ذات دلاله ما بين كافة أنماط الدافعيه لتعلم الرياضيات من جهه والتحصيل في مادة الرياضيات والتحصيل الاكاديمي من جهه اخرى .

Motivation has been intensely researched in Western nations (Mayer, Faber, & Xu 2007). Professionals from different disciplines have studied motivation. In education students' ability to learn and the variables that impact their achievement have been the main concern. Unfortunately, the research on motivation in general and the relationship between students' motivation and their achievement in the Arab world is very limited.

Educational literature in motivation has focused on achievement, the decline of students' motivation with age, and gender differences. With regard to the relationship between academic motivation and academic achievement Ahmed and Bruinsama (2006) found that autonomous motivation had positive significant influence on academic achievement of European and Asian graduate students. Similarly, Tella(2007) reported that academic motivation associated significantly with academic achievement of Nigerian secondary students. Hayenga and Corpus (2010) also found a significant positive relationship between intrinsic motivation and academic GPA, while the relationship between extrinsic motivation and academic GPA of American middle school students was significantly negative. Lepper, Henderlong, and Iyengar(2005) found a significant positive relationship between intrinsic motivation and overall GPA, mathematics GPA, and language arts GPA, while the relationship between extrinsic motivation and overall GPA, mathematics GPA, and language arts GPA of American students (3rd through 8th grades) was significantly negative. Um, Corter, and Tatsuoka (2005) confirmed that intrinsic motivation positively impacts mathematics performance, while external regulation motivation negatively influences mathematics performance of American eighth graders. Finally, Lau (2009) demonstrated that Chinese students enrolled in high achievement school scored higher than students enrolled in low achievement school in intrinsic, extrinsic, and social motivation for reading.

In contrast, Cokley, Bernard, Cunningham, & Motoike (2001) found that the relationships among all types of motivation and GPA of American university students were not significant except that the relationship between external regulation motivation and academic GPA was negatively significant. Likewise, Barkoukis, sorbatzoudis,Grouios, and Sideridis (2008) found that the relationships among all types of motivation and academic GPA of Greek students in high school (8th & 9th graders) were not significant with except that the relationship between amotivation and academic GPA was negatively significant. The outcomes of these two studies contradict what expected theoretically and other empirical evidence related to the self-determination theory. The two studies used the Academic Motivation Scale (AMS) (Vallerand et al., 1992, 1993) to measure academic motivation. Cokley et al., (2001) and Fairchild et al., (2005) found that AMS lack construct validity in measuring self-determination continuum. Therefore the validity of these findings should be questioned.

In summary, the previous literature provides strong evidence that intrinsic motivation positively influences academic achievement, while extrinsic motivation negatively affects academic achievement, with the exception of Lau (2009) finding that students in high achievement schools scored higher than students enrolled in low achievement schools in extrinsic motivation for reading.

The decline of students' academic motivation with age is alarming. The previous studies in general revealed that intrinsic motivation declined with age or grade levels, while the findings with regards to extrinsic motivation were not consistent and require further investigation.

In a longitudinal study Gottfried, Fleming, and Gottfried (2001) demonstrated that

students' intrinsic motivation in math, reading, science, and school in general declined across the ages of 9, 10, 13, 16, and 17 years in American students. They also found that the largest decline occurred in math, followed by science with no significant decline in intrinsic motivation for social studies. Lepper, Henderlong, and Iyengar (2005) also found that intrinsic motivation decreased significantly with grade levels (3rd through 8th grades). However, they did not find significant change in extrinsic motivation with grade levels with exception of 3rd graders scoring higher than 4th graders among American students. Likewise, Corpus, McClintic-Gilbert, and Hayenga (2006) reported a decrease in intrinsic motivation with grade levels (3rd through 8th grades) and no significant change in students' extrinsic motivation across grade levels (3rd through 8th grades) among American students. Athanasiou and Philippou (2007) confirmed that students' motivation in mathematics declined during the transition from elementary to secondary school (6th to 7th grade) among Greek students. Lau (2009) found that both intrinsic and extrinsic motivation in reading declined with increasing grade levels (primary, secondary, and senior secondary schools) among Chinese students, with the exception of social motivation for boys which remained relatively low across different grade levels. However girls' social motivation seems to be high in primary grades and gradually drops in senior grades. Similarly, Unrau and Schlackman (2006) found that intrinsic and extrinsic motivation for reading declined as students progressed from Grade 6 to 7 and from Grade 7 to 8 among American students. Finally, Carreria (2006) found that Japanese third graders displayed higher intrinsic and extrinsic motivation for learning English as a foreign language than the sixth graders.

It appears that the decline of intrinsic motivation with grade levels or age is a phenomenon not limited to one country or culture, researchers from the USA, Greece, Hong Kong and Japan reported the decline of intrinsic motivation among the students in their countries. Thus many researchers recommended further investigation of this phenomenon in different cultures. Also, Lepper, Henderlong, and Iyengar (2005) recommended further investigation of the decline of intrinsic motivation using a motivational scale that measures various degrees of internalized reasons for engaging in the academic activities

With regard to the students' gender and academic motivation, Vallereand et al. (1992) reported that Canadian university female students scored significantly higher than Canadian university male students on intrinsic, identified regulation, and introjected regulation. However, no significant gender differences were found on either external regulation or amotivation.

Thibert and Karsenti (1996) found that Canadian girls scored significantly higher than Canadian boys on intrinsic and identified regulation than Canadian boys, but they scored significantly less than Canadian boys on external regulation and amotivation throughout all levels of schooling from sixth grade to junior college.

Cokley, Bernard, Cunningham, & Motoike (2001) reported that there were no significant differences between male and female students in any type of academic motivation (intrinsic, identified regulation, introjected regulation, external regulation and amotivation) among university students in the U.S.A. They recommended further investigations for the impact of gender on academic motivation.

Barkoukis,Tsorbatzoudis,Grouios, and Sideridis (2008) reported that Greek girls in high school (8th & 9th graders) displayed higher intrinsic academic motivation only in the subscale To Know and lower scores on the amotivation scale in comparison with Greek boys in the same grades. They did not find significant differences between girls and boys in identified regulation, introjected regulation, external regulation and the rest of the intrinsic motivation subscales.

Unrau and Schlackman (2006) found no significant differences between American boys and girls in 6th to 8th grades in intrinsic motivation in reading, but girls reported higher extrinsic motivation than boys. In contrary, Lau (2009) found the Chinese girls (elementary, middle, & high school) to have higher intrinsic motivation in reading than boys, but no significant effect of gender on extrinsic motivation in reading.

Marsh, Trautwein, Ludtke , Koller, and Baumert (2005) found that German boys in 7th grade had significantly higher math interests (intrinsic motivation) than girls.

Rusillo and Arias (1997) found that boys in 9th and 10th grades from Spain scored higher on extrinsic motivation in mathematics and language arts than girls, while gender has no significant effect on their intrinsic motivation.

Athanasiou and Philippou(2007) found that Greek boys (6th & 7th grade) are more performance oriented and seek tangible rewards, social power and status for math work than girls while girls scored higher in relationship and responsibility goals than boys.

Tella (2007) reported that Nigerian boys in secondary grades (age range 15-22 with the average age 18.6 years) scored significantly higher in mathematics motivation than girls.

Else-Quest, Hyde, and Linn (2010) analyzed two major international data sets, the 2003 Trends in International Mathematics and Science Study and the Programme for International Student Assessment. The sample involved 493,495 students (14–16 years of age) from 69 countries. The results of the meta-analysis revealed that boys reported higher extrinsic and intrinsic mathematics motivation.

The findings of the previous literature in regard to the effect of gender on the students' academic motivation were inconsistent. The inconsistency in the findings of the previous studies may be due to cultural differences, variation of students' age, or/and measuring motivation using different instruments which reflect various constructs of motivation.

Researchers have utilized different theories to investigate academic motivation. The main objective of the current study was to investigate mathematics motivation among the UAE students utilizing the self-determination theory as a theoretical frame of reference. The self-determination theory (SDT) is one of the most pertinent theories in education. According to Ryan & Deci, (2000) motivation is not a unitary phenomenon; it varies in quality (type or kind) and quantity (level or amount) among students. This theory distinguishes between three distinct types of motivation based on the reasons or goals that lead the individual to act. These three types are intrinsic motivation, extrinsic motivation, and amotivation (Deci, Vallereand, Pelletier, & Ryan, 1991; Vallereand et al., 1992; Ryan & Deci, 2000; Vansteenkiste, Lens, & Deci, 2006).

Intrinsic motivation involves the behaviors the students perform willingly without internal or external pressure or seeking separable consequences (Vallerand et al., 1992). The students engage in this behavior for itself and the reward or satisfaction derives from the behavior itself.

Extrinsic Motivation involves the behaviors the student performs because of internal or external pressure seeking separable consequences from his/her engagement in these behaviors. The behavior is performed as a means to an end. Empirical research in western culture has confirmed three types of extrinsic motivation: Identified regulation, introjected regulation, and external regulation (Vansteenkiste, Lens, & Deci, 2006). The three types of external motivation vary in their degree in relation to self-determination or autonomy (Vansteenkiste, Lens, & Deci, 2006).

External regulation involves performing the behavior to obtain a reward or avoid punishment; the reasons for performing the behavior have not been internalized at all; and the locus of causality is externally perceived (Vansteenkiste, Lens, & Deci, 2006).

Introjected regulation involves performing the behavior in response to internal pressure related to self-aggrandizement or avoidance of guilt or shame (Cokley, 2000; Cokley et al., 2001). The student has partially internalized the reasons for performing the behavior (Ryan & Deci, 2000)

Identified regulation involves performing the behavior for the value of the behavior itself. The student identifies with the reasons for performing the behavior as his or her own and engages in the activity volitionally (Deci, Vallereand, Pelletier, & Ryan, 1991). The student has internalized the reasons for performing the behavior (Ryan & Deci, 2000).

Amotivation: The amotivated student has no intent of engaging in an activity as a result of not valuing the activity, feeling incompetent, and a loss of control (Ryan & Deci, 2000). Amotivated students do not perceive contingencies between their behaviors and the outcomes. They are neither extrinsically nor intrinsically motivated.

The four types of motivation vary in their degree in relation to self-determination or autonomy. The four types of motivation represent a motivational continuum of self-determination or autonomy from the most to least as follows: Intrinsic → identified regulation → introjected regulation, → external regulation→ amotivation (Vallerand et al., 1992; Cokley, 2000; Cokley et al., 2001; Fairchild et al., 2005; Ryan & Deci, 2000; Vansteenkiste, Lens, & Deci, 2006).

In conclusion, many researchers have demonstrated that motivation significantly influences academic achievement. The findings of the previous studies revealed that intrinsic motivation declines with age or grade levels, while the findings with regards to extrinsic motivation were not consistent and require further investigation. More specifically Lepper, Henderlong, and Iyengar (2005) recommended further exploration of the decline of intrinsic motivation using a motivational scale that measures various degrees of internalized reasons for engaging in the academic activities. In addition, findings concerning the effect of gender in the students' academic motivation were inconsistent and further exploration is still needed. Finally, researchers (e.g., Ahmed & Bruinsama, 2006) questioned the generalization of motivational research findings across cultures, and Lau (2009) reported that the change in academic motivation in various cultures has not been completely examined.

The main objective of the current study was to investigate the impact of students grade levels (elementary, middle, & high school) on students' various types of motivation in mathematics postulated in the self-determination theory (Intrinsic, introjected regulation, external regulation, & amotivation). In addition, the impact of the student's gender (boy & girl) on students' various types of motivation in mathematics was explored. This study also investigated the impact of the gender and grade level interaction on students' various types of motivation in mathematics. Finally, the relationship between students' various types of mathematics motivation on one hand and achievement in mathematics and overall academic achievement on the other were examined.

Method

Participants

The participants in this study were 1288 students in grades 4th through 12th from Al Ain, Dubai, and Fujarah, UAE. Four hundred twenty four elementary school students (186 boys and 238 girls) with an average age of 10.3750 years, 588 middle school students (296 boys and 292 girls) with an average age of 13.5459 years, and 276 high school

students (154 boys and 122 girls) with an average age of 16.5652 years completed the MMS.

Measures

Motivation

This continuous variable was defined as participants' scores on each type of motivation in the mathematics motivation scale (MMS): Intrinsic motivation, introjected regulation, external regulation, and amotivation.

The MMS was designed by the author and others (2010) to measure motivation in mathematics for UAE students in grades 4 through 12 based specifically on the theoretical framework of the self-determination theory. The MMS contains 38 items or reasons why students study mathematics that reflect the various types of motivation: Intrinsic motivation, introjected regulation, external regulation and amotivation These items were rated on a 4-point scale (1 does not describe me at all, 2 describes me a little, 3 greatly describes me, 4 describes me completely).

Content validity: The MMS Content validity was substantiated by developing an item pool based on the self-determination continuum and by reviewing a number of published studies in measuring academic motivation in various cultures. Sixty items were developed as an initial item pool. The items were designed to measure specific reasons why the students study mathematics that reflect the various types of motivation: Intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation. The initial item pool was re-examined to guarantee content representation of self-determination continuum. Based on this review 10 items were eliminated because of redundancy and language ambiguity. Further investigation of the items' content validity was examined by 10 experts who hold PhDs in education. All the experts agreed that the 44 items were phrased and written in clear and precise language, as well as being classified in the same type of motivation that it was supposed to reflect. Furthermore 5 elementary teachers, 5 middle school teachers, and 5 high school teachers rated the appropriateness of the administration instructions and the phrasing of the 44 items for the students in the targeted grades. The analysis of the teachers' responses revealed that the phrasing of the items and the administration instructions were written clearly and the students in elementary, middle and high school would be able to read and understand the items and the instructions independently.

Factor structure: The expletory factor analysis (EFA) was performed to examine the factor structure of the MMS. The results of the EFA revealed that 4 factors accounted for 48.240% of the total variance: first factor accounted for 24.101%, second factor accounted for 15.031, third factor accounted for 5.811%, and forth factor accounted for 3.298%, respectively. The first factor consisted of 15 items reflecting the intrinsic motivation, the second factor consisted of 9 items reflecting the amotivation, the third factor consisted of 6 items reflecting the introjected regulation, and the fourth factor consisted of 8 items reflect external regulation. However, the fifth factor, identified regulation motivation, did not emerge as a factor in the MMS, maybe due to social contexts in the U.A.E's cultural and educational system.

Simplex pattern: The simplex pattern among the MMS subscales was examined by computing the correlation coefficients among the MMS subscales. The results were consistent with self-determination continuum. The strength of the relationships among the four types of motivation varied according to their degree in relation to self-determination or autonomy. The correlation between the intrinsic motivation on one hand and the introjected regulation, external regulation, and amotivation on the other were ($r = .519$, $p < .05$), ($r = 309$, $p < .05$), and ($r = -$

.017 not significant p > .05) respectively. The correlation between the introjected regulation on one hand and the external regulation and amotivation on the other were (r = .390, p < .05), (r = -.073, p < .05) respectively. Finally, the correlation between the external regulation and amotivation was (r =. 472, p < .05)

Test-retest stability: Test-retest stability was examined by administering the MMS twice to 130 students. The interval between test-retest was 14 days. Test-retest reliability coefficients were at adequate levels of temporal stability for the intrinsic motivation(r = 0.848, p < .05), introjected regulation (r = .677, p < .05), external regulation (r = .745, p < .05), and amotivation(r = .763 p < .05).

Internal consistency: Internal consistency was also adequate for the intrinsic motivation (Cronbach's Coefficient α = .898, p < .05), introjected regulation (Cronbach's Coefficient α = .773, p < .05), external regulation (Cronbach's Coefficient α. = .788, p < .05), and amotivation (Cronbach's Coefficient α = .896, p < .05).

Mathematics achievement

This continuous variable was defined as participants' grade point average in mathematics (GPA-Math) reported by the mathematics teachers.

Overall academic achievement

This continuous variable was defined as participants' grade point average in all school subjects (GPA-Overall) reported in students' progress report cards.

Grade levels (cycle)

This categorical variable involved three levels: Elementary (involved only 4th grade to 6th grade), middle (7th to 9th grade), and high school (10th to 12th grade) based on the UAE education system.

Gender

This categorical variable involved two levels: Male and female

Procedure

Written directions with examples were presented to the participants which explained how to complete the MMS. Mathematics program support teachers also presented this information verbally to the participants, and emphasized that the information collected would remain confidential.

Research design and data analysis

This study utilized an ex post facto research design. The following statistical procedures were employed to analyze the data:

1. Descriptive statistics which involved means and standard deviations in each type of motivation according to each variable were calculated.
2. A two factor 3 (grade levels) x 2 (students' gender) was utilized. An analysis of variance was performed to examine the main effect of grade levels (elementary, middle, and high school), students' gender (male & female), and interaction between the grade levels and students' gender on the participants' scores in each type of motivation in the MMS.
3. Scheffe was used to examine the significance of the differences between pairwise mean scores or pairwise mean differences of a differences for the results of the analysis of variance which showed significant effects.
4. Correlation coefficients between various mathematics motivation types and GPA-Math and GPA-Overall for 263 high school students (10th to 12th grade) were computed.

Results

The purpose of the current study was to investigate the impact of students' grade levels, students' gender, and the

interaction between students' gender and students' grade levels on students' various types of motivation in mathematics. Moreover, the relationship between students' various types of mathematics motivation on one hand and achievement in mathematics and overall academic achievement on the other were examined.

Data concerning types of motivation in mathematics was collected using the MMS. The System for Statistics 12 (SYSTAT, 2007) was used to analyze the data in the form described earlier.

Descriptive statistics: Means and standard deviations for each type of mathematics motivation according to students' gender and students' grade levels, students' gender are presented in Table 1.

Two- Factors ANOVA: A two factor 3 (grade levels) x 2 (students' gender) was utilized. An analysis of variance was performed to examine the main effect of students' grade levels (elementary, middle, and high school), students' gender (male & female), and interaction between grade levels and gender on the participants' scores in the intrinsic, introjected regulation, external regulation, and amotivation. The results of these analyses are **presented in Tables 2, 3, 4, and 5 respectively**. Based on these results the students' grade levels had significant effect ($p < .05$) on the participants' scores in each types of mathematics motivation.

Moreover results indicated significant ($p < .05$) gender differences in each types of mathematics motivation, with the exception of intrinsic motivation where the difference was not significant ($p > .05$). Female students scored significantly ($p < .05$) higher than male in the introjected regulation and significantly ($p < .05$) less in external regulation and amotivation.

Finally, the interaction between the students' grade levels and students' gender revealed a significant ($p < .05$) effect on students' introjected regulation, whereas the interaction effects were not significant ($p > .05$) in the intrinsic, external regulation, and amotivation.

Table 1

Sample, Mean and Standard Deviation Scores for Each Type of Motivation According to Gender by Grade Levels

Gender	Grade levels		AM	EMER	EMIN	IM
Male	Elementary School	N	174	177	180	177
		Mean	18.8046	22.2599	19.5889	47.4237
		Std. Deviation	7.96791	6.32907	4.39246	6.94754
	Middle School	N	268	280	285	273
		Mean	16.9552	20.3679	19.5404	40.4799
		Std. Deviation	7.58311	5.14350	3.57947	9.92696
	High school	N	148	147	152	147
		Mean	14.6622	17.0816	19.1711	37.6463
		Std. Deviation	7.15480	5.32699	3.90750	10.50297
	Total	N	590	604	617	597
		Mean	16.9254	20.1225	19.4635	41.8409
		Std. Deviation	7.73442	5.86738	3.90958	10.03466
Female	Elementary School	N	219	223	228	213
		Mean	15.9041	21.2704	21.0877	49.4977
		Std. Deviation	7.55378	6.12637	3.27872	6.99031
	Middle School	N	278	281	283	270
		Mean	13.9173	18.5801	19.8799	40.5148
		Std. Deviation	5.56001	5.75029	3.72737	9.99841
	High school	N	114	117	119	113

Gender	Grade levels		AM	EMER	EMIN	IM
		Mean	12.3772	17.0513	19.6891	38.1770
		Std. Deviation	5.03860	5.65357	3.90946	9.66144
	Total	N	611	621	630	596
		Mean	14.3421	19.2581	20.2810	43.2819
		Std. Deviation	6.38845	6.07750	3.65379	10.12084
Total	Elementary School	N	393	400	408	390
		Mean	17.1883	21.7083	20.4265	48.5564
		Std. Deviation	7.86332	6.22849	3.87767	7.03832
	Middle School	N	546	561	568	543
		Mean	15.4084	19.4724	19.7095	40.4972
		Std. Deviation	6.79664	5.52394	3.65464	9.95337
	High school	N	262	264	271	260
		Mean	13.6679	17.0682	19.3985	37.8769
		Std. Deviation	6.41183	5.46359	3.90961	10.13005
	Total	N	1201	1225	1247	1193
		Mean	15.6112	19.6843	19.8765	42.5608
		Std. Deviation	7.19568	5.98801	3.80303	10.09933

*Intrinsic motivation (IM), Introjected regulation (EMIN), External regulation (EMER), and Amotivation (AM)

Table 2

Results of the Two Factors Analysis of Variance: The Impact of Gender, Grade Levels, and Gender x Grade Levels on Students' Scores in Intrinsic

Source	Type III SS	df	Mean Squares	F-ratio	p-value
Gender	208.838	1	208.838	2.501	0.114
Grade levels	21,294.818	2	10,647.409	127.520	0.000
Gender* Grade levels	240.950	2	120.475	1.443	0.237
Error	99,110.115	1,187	83.496		

Table 3

Results of the Two Factors Analysis of Variance: The Impact of Gender, Grade Levels, and Gender x Grade Levels on Students' Scores in Introjected Regulation

Source	Type III SS	df	Mean Squares	F-ratio	p-value
Gender	173.697	1	173.697	12.276	0.000
Grade levels	154.115	2	77.058	5.446	0.004
Gender* Grade levels	83.916	2	41.958	2.965	0.052
Error	17,559.573	1,241	14.150		

Table 4

Results of the Two Factors Analysis of Variance: The Impact of Gender, Grade Levels, and Gender x Grade Levels on Students' Scores in External Regulation

Source	Type III SS	df	Mean Squares	F-ratio	p-value
Gender	241.698	1	241.698	7.389	0.007
Grade levels	3,519.369	2	1,759.684	53.798	0.000
Gender* Grade levels	141.261	2	70.630	2.159	0.116
Error	39,872.502	1,219	32.709		

Table 5
Results of the Two Factors Analysis of Variance: The Impact of Gender, Grade Levels, and Gender x Grade Levels on Students' Scores in Amotivation

Source	Type III SS	df	Mean Squares	F-ratio	p-value
Gender	2,038.696	1	2,038.696	42.199	0.000
Grade levels	2,320.554	2	1,160.277	24.016	0.000
Gender* Grade levels	25.513	2	12.756	0.264	0.768
Error	57,732.791	1,195	48.312		

Post-Hoc Pairwise Comparisons: The results of the analysis of variance showed significant effects of the students' grade levels on the participants' scores in each of the various types of mathematics motivation. The results of the Scheffe, which are the pairwise mean differences of the effect of the students' grade levels on the participants' scores in each types of mathematics motivation, are presented in Table 6. Based on these results the students' scores in the intrinsic, external regulation and amotivation decreased significantly ($p < .05$) with increasing of students' grade levels (elementary through high school).

Table 6
Results of the Post Hoc Test for the Effect Grade Levels on Students' Scores in Each Types of Mathematics Motivation using Scheffe : Pairwise Mean Differences

(I) cycle	(J) cycle	Amotivation Mean Difference (I-J)	External regulation Mean Difference (I-J)	Introjected regulation Mean Difference (I-J)	Intrinsic Mean Difference (I-J)
Elementary	Middle	1.7799*	2.2359*	.7170*	8.0592*
	High	3.5204*	4.6401*	1.0279*	10.6795*
Middle	Elementary	-1.7799*	-2.2359*	-.7170*	-8.0592*
	High	1.7405*	2.4042*	.3110	2.6203*
High	Elementary	-3.5204*	-4.6401*	-1.0279*	-10.6795*
	Middle	-1.7405*	-2.4042*	-.3110	-2.6203*

*$p < 0.05$

The results of the analysis of variance also showed significant effects of the interaction between the students' grade levels and students' gender on the participants' scores in the introjected regulation, whereas the interaction effects were not significant in the intrinsic, external regulation, and amotivation. Based on these results the boys' scores in the introjected regulation did not differ significantly ($p > .05$) with grade levels (elementary, middle or high school). The

results also indicate that girls in elementary school scored significantly ($p < .05$) higher than girls in middle and high school. However, there was no significant ($p > .05$) difference between girls in middle and high school in the introjected regulation. Finally, the findings indicate that girls in elementary school scored significantly ($p < .05$) higher than boys in the elementary level while there were no significant ($p > .05$) gender differences in middle or high school students.

Relationship between motivation and achievement

The relationship between motivation and achievement was investigated by computing the correlation coefficients between various types of motivation on one hand and achievement in mathematics and overall academic achievement on the other among high school students grade 10th to 12th (145 boys and 118 girls). The results of this analysis are shown in Table 8. These results show significant positive correlations ($p < 0.05$) between intrinsic and introjected regulation on one hand and students' GPA in mathematics and GPA in overall academic achievement on the other. The findings also indicate statistically negative correlations ($p < 0.05$) between external regulation and amotivation in one hand and GPA in mathematics and GPA in overall academics.

Table 8
Correlation between Types of Motivation and Achievement Measures

Measures	GPA- Math	GPA - Overall
Intrinsic motivation	.468**	.370**
Introjected regulation	. .297**	.223**
External regulation	-.145*	-.128*
Amotivation	-.347**	-.264**

**p < 0.01 *p < 0.05

Discussion

The objective of this study was to investigate the impact of students' grade levels, gender, and interaction between the two on mathematics motivation (intrinsic, introjected regulation, external regulation, and amotivation) as postulated in the self-determination theory. Moreover, the relationship between students' various types of mathematics motivation on one hand and achievement in mathematics and overall academic achievement on the other were examined. Four hundred twenty four elementary school students (186 boys and 238 girls), 588 middle school students (296 boys and 292 girls), and 276 high schools students (154 boys and 122 girls) completed the MMS. ANOVA, Scheffe, and correlation coefficient were employed to analyze the data.

The findings of this study showed that all types of motivation in mathematics steadily decreased with grade levels (elementary through high school) with the exception of introjected regulation. Moreover, results indicated significant gender differences in each type of mathematics motivation with the exception of intrinsic motivation, the difference was not significant. In addition, the interaction between grade levels and gender was significant only in one type, students' introjected regulation; the differences in intrinsic, external regulation, and amotivation were consistent between males and females in different grade levels. Finally, the results revealed significant relationships between all types of motivation and mathematics achievement and overall academic achievement.

Grade levels and mathematics motivation

Intrinsic motivation: The findings in this study provided evidence that the intrinsic motivation in mathematics of students from the UAE declined with increasing grade levels or age similar to the findings of the previous studies conducted in various cultures (Gottfried, Fleming, & Gottfried 2001; Lepper, Henderlong, &

Iyengar, 2005; Corpus, McClintic-Gilbert, & Hayenga, 2006; Athanasiou & Philippou, 2007; Lau, 2009; Unrau & Schlackman, 2006; Carreria, 2006).

According to Ryan and Deci (2000), after early childhood students' intrinsic motivation starts to decline with age because of the social demands that require them to engage in none intrinsically interesting activities. They added that many of the academic tasks students are expected to engage in are not inherently interesting or satisfying by themselves. Maintaining or enhancing students' intrinsic motivation for learning demand home, school, and classroom environments that meet students' innate needs for competence, autonomy, and relatedness (Ryan & Deci, 2000).

Research showed that social contexts of the culture, home, school, and classroom environments have a critical impact on maintaining or diminishing intrinsic motivation, and facilitate or impede internalizing of the extrinsic motivation (Ryan & Deci, 2000; Hoang, 2007; Edmunds, Ntoumanis, & Duda, 2008; Um, Corter, & Tatsuoka, 2005; Urdan & Schoenfelder, 2006; Wong, Wiest, & Cusick, 2002). Autonomy and supportive contexts enhance autonomous motivation , while controlling contexts diminish autonomous motivation (Ryan & Deci, 2000; Vansteenkiste, Lens, & Deci, 2006). The decline of students' intrinsic motivation may be the result of the controlling contexts imposed on students at home and school over the years. The extensive use of rewards and other external factors (e.g., controlling language, testing, & deadlines) are forms of social control which weakened students' intrinsic motivation in academic activities (Vansteenkiste, Lens, & Deci, 2006).

Extrinsic Motivation

The findings of the previous research with regard to grade levels or age differences in extrinsic motivation were not consistent. Unrau and Schlackman (2006); Carreria (2006); Lau (2009) reported a decline in extrinsic motivation as students progressed with grade or age. On the contrary Lepper, Henderlong, and Iyengar (2005); Corpus, McClintic-Gilbert, and Hayenga (2006) reported no significant change in extrinsic motivation with increasing of age or grade.

The current study, unlike previous studies, investigated two types of extrinsic motivation; these were the interjected regulation and external regulation rather than overall extrinsic motivation composite. These two types vary in their degrees of self-determination as explained previously. Concerning **external regulation** the findings of this study showed decline of students' external regulation in mathematics across grade levels from elementary to middle to high school. Students performed such tasks to meet external demands or to obtain or avoid imposed contingencies; the reasons for performing the behavior has not been internalized at all and the locus of causality is externally perceived. This type of motivation is in contrast to intrinsic motivation. Consequently it is not autonomous. The main reason for students to perform non-inherently interesting tasks is that they are appreciated by individuals such as parents, teachers, friends, or societies whom they like or feel connected with or belong to. The feeling of connection or belonging satisfies the need of relatedness.

The decline of students' **external regulation** may be due to developmental changes (Lau, 2009; Lepper, Henderlong, & Iyengar, 2005). The students in middle and high school in general value, connect and relate to their peers more than the adults in their life. It seems that the peers value other activities more than non-inherently interesting academic activities. Thus the power of contingency imposed by peers is more powerful than the contingency imposed by teachers and parents.

With regard to **introjected regulation** the results of this study

indicate that students' introjected regulation did not change with grade levels, with the exception of girls in elementary schools who scored significantly higher than girls in middle, and high schools. This means that the students' performed the behavior to avoid guilt, anxiety or shame or to obtain ego-enhancement or pride does not vary with age for boys or girls in middle and high school. This may be due to the fact that pride and shame play significant roles in determining individuals' behavior in the Arab culture for all age groups.

Amotivation: The results of this study revealed that students' amotivation level declined steadily with increasing grade levels or age. This finding means that the students' lack of intent to engage in mathematics activities as a result of not valuing, or feeling incompetent, and/or lack of perception of the contingencies between their behaviors and the outcomes in mathematics decreased significantly with the advancement in grade levels. This decline may be due to developmental changes, students' sense of responsibility, the awareness of the relationship between their behavior and the outcomes, or recognizing the importance of mathematics towards their future goals simply increases with age.

Gender differences in mathematics motivation

The results of this study indicated that boys scored higher than girls in external regulation and amotivation. With regards to introjected regulation, girls in elementary school scored significantly higher than boys in the elementary, while there were no significant gender differences between middle or high school students. Finally, no significant differences between boys and girls in the intrinsic motivation were found. The differences in external regulation and amotivation between boys and girls may be due to the variation in the conditions and values imposed on males and females in the Arab culture. The external pressure and the expectations from boys to achieve academically are higher than girls in Arab culture. This may explain why boys scored higher than girls in external regulation.

In general the contingencies between the behaviors and the outcomes are more strictly reinforced among females than males in Arab culture. Also, a previous study in the UAE indicated that girls felt more confidence than boys in mathematics (Alsawaie et al., 2010). This may explain why boys scored higher than girls in amotivation.

Despite the consistency or inconsistency of the findings in this study versus previous studies in regard to the gender differences in motivation, it is difficult to compare the outcomes of this study with specific previous findings without violating one or more research methodology. The previous studies differ in one or more of the following: Theoretical framework, measures, target population, and/or cultural backgrounds. These differences should be considered in examining gender differences in motivation.

Motivation and mathematics achievement

The results showed significant positive correlations between intrinsic and introjected regulation on one hand and students' GPAs in mathematics and GPAs overall academic achievement on the other. The findings also indicate significant negative correlations between external regulation and amotivation on one hand and GPA in mathematics and GPA overall academic achievement on the other among high school students grades 10th thru12th. The findings of this study were consistent with findings of previous studies concerning the relationships between intrinsic and external regulation on one hand and achievement on the other (e.g., Lepper, Henderlong, & Iyengar, 2005, Um, Corter, & Tatsuoka, 2005; Ahmed & Bruinsama, 2006; Tella, 2007 Lau 2009; Hayenga and Corpus, 2010). More importantly these findings are consistent with what is theoretically expected as theorized by the self-determination theory.

Conclusion and recommendations

The findings of this study have significant implications for researchers, educators and parents. The current study provides educators in the UAE with important information which furthers their understanding of students' mathematics motivation. The findings demonstrate that the strength and the direction of the relationships between students' various types of mathematics motivation on one hand and achievement in mathematics and overall academic achievement on the other varies according to the degree of self-determination or autonomy reflected in each type of motivation.

The findings document that students' intrinsic motivation in mathematics decline with advancing grade levels among the UAE students and this is similar to other students from various cultures. This finding highlights to parents, educators and researchers the importance of further exploration of the social contexts that foster and maintain intrinsic or autonomous motivation and facilitate internalization of the extrinsic motivation among students in the UAE. In addition, the results revealed that students' external regulation and amotivation in mathematics decline with advancing grade levels, further investigation to the students' sense of relatedness and perceived competence in classroom are recommended. The findings showed that students' introjected regulation did not change with grade levels, with the exception of girls in elementary school scoring significantly higher than girls in middle, and high schools. Further exploration of introjected regulation in relation to the values of pride and shame in the Arab culture is recommended.

Finally, explaining gender differences in academic motivation require further investigations of gender role and expectations in the Arab culture.

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