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The influence of modern algebra anxiety on afghan undergraduate students' achievement

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Abstract
The main purpose of present study was to first determine factors of modern algebra1 anxiety rating scale (MA1RS) and then examine their influence on students' achievement in modern algebra. Data were collected from 97 undergraduate students by administering MA1RS, anxiety factors were determined via exploratory factor analysis and then examined the influence of the factors on students' achievement by conducting multiple linear regression analysis. The results of exploratory factors analysis revealed that the reliability of the MA1RS was satisfactory with a Cronbach alpha of 0.892. Furthermore, principle-component factor analysis with Varimax rotation determined possible factors. Some of these factors were positively/negatively correlated with students' final exam scores as their achievement in modern algebra1. Due to not being able to draw solid conclusions on the actual factors and their direction of the relationship with students' achievement, we propose more research be conducted to determine the actual number of factors of modern algebra1 anxiety rating scale and its relationship direction with students' achievement.

Keywords: mathematics anxiety, modern algebra1 anxiety, achievement

1. Introduction

Mathematics anxiety has been described as "feelings of tension and anxiety that interfere with the manipulation of mathematical problems in a wide variety of ordinary life and academic situations" [1, p.551]. Tall contends that mathematics anxiety is "manifested by physiological factors such as increased heart rate and sweaty palms, as well as a horrendous inability to recall factors under pressure and a genuine antipathy to mathematics" [2, p.122]. Results of researches conducted by Steele and Artin in 1998, Jackson and Leffingwell in 1999, Hembree in 1990, Bitner, Austin and Wadlington in 1994, and Tobias in 1990, all have shown that mathematics anxiety occurs at primary school through college levels. It is believed that mathematics anxiety is widespread among students learning mathematics. Burns in 1998 claimed that about "two-thirds of all American adults had a hatred and deep fear of mathematics." Jones's study with more than 9,000 American students showed that a quarter of them "had a moderate to high need for help with their mathematical anxieties" [2, p. 122]. Suinn and Winston in [1] argued based on findings of several researches that mathematics anxiety is "associated with poorer performance in mathematics and statistics courses and mathematics avoidance behaviors such as avoidance of careers requiring mathematics content" [1, p.167].

Tall cites from Sheffield and Hunt that mathematics anxiety has long been studied and measured by questionnaires that ask "respondent to rate their reactions to a number of [mathematical] statements" [2, p.122]. The first questionnaire as a measurement of mathematics anxiety was the Mathematics Anxiety Rating Scale (MARS) with 98 items that has long been used by many researchers to measure factors relating to mathematics anxiety since 1972 [1]. There have been extensive efforts to shorten this useful questionnaire in order to reduce the administration time. For example, Rounds and Hendel in 1980 devised a 30-item scale, Plake and Parker in 1982 designed a 24-item scale, and Alexander and Martray in 1989 developed a 25-item scale [1]. Though all were promising each of these shortened versions had its own difficulties. For instance, all participants in Rounds and Hendel were female and all of them were enrolled in a mathematics anxiety treatment program, which in turn puts limitations on the generalizability of the scale to other populations. Plake and Parker again in 1989 studied a stricter sample of upper undergraduate and graduate students in a statistics course. Alexander and Martray in 1989 focused on a sample from which the results from a 69-item, abbreviated version of MARS, were more generalizable, but little information was provided regarding its derivation.

Suinn and Winston in [1] developed a shorter version of the original MARS questionnaire with 30 items. The 30-item MARS composed of items derived from three factor analytic studies of the MARS 98-item reported in the literature; namely from Alexander and Cobb study in 1987, Alexander and Martray study in 1989 and Rounds and Hendel study in 1980. The common findings of these studies was that there were to major factors, one Mathematics Test Anxiety and the other Numerical Anxiety. Then the 30-item MARS with 98-item MARS were administered in two sessions one week apart on 124 female and male volunteers (63 women, 61 men) from an introductory psychology course with mean age 18 years in the range of 17-26 year in a state university. The internal consistency of 30-item MARS were measured, the calculated Cronbach alpha was 0.98, indicating a high internal consistency, consistent with previous findings of 0.97 for the 98-item scale. The one-week test-retest reliability for 30-item MARS was 0.90 ($p < 0.001$), which was close to the previous test-retest reliability of 0.91 ($p<0.001$) in the literature. A factor analysis of the 30-item MARS showed similar factor loadings reported for 98-item scale in the literature. Two main factors emerged,

mathematics test anxiety accounting for 59.2% of the variance and numerical anxiety accounting for 11.1% of the variance, and the "content [was] consistent with findings of other researchers who factor analyzed the long version of MARS" [1, p. 171].

On the other hand, many studies conducted to determine the relationship between mathematics anxiety and mathematics achievement. As reported by Sherman and Wither, some studies showed "a moderate but significant negative correlation between the two" [3, p. 138]. Woodard in [4] also observed a negative relationship between mathematics anxiety and mathematics achievement. However, the multiple regression study by Hunsley in 1987 and the analysis of variance study by Hadfield and Maddux in 1988 did not indicate a significant relationship between mathematics anxiety and mathematics achievement. More importantly, the meta-analysis of Hembree in 1990 including the results of 151 studies "indicated a consistent negative correlation of 0.3 or more for studies involving school children, and one of 0.25 or more for those involving tertiary students" [3, p.138]. The longitudinal cross-lagged panel with structural regression model study by Sherman and Wither on five years of the relationship between mathematics anxiety and mathematics achievement with the goal of establishing one of the three hypotheses, stating "that mathematics anxiety causes an impairment of mathematics achievement, that lack of mathematics achievement causes mathematics anxiety, or that there is a third underlying cause of the two," showed that the observations did not support the first hypothesis and it was rejected, and there was "insufficient evidence to show a significant difference between the other two, that is, whether poor mathematics achievement causes mathematics anxiety, or whether there is a third factor causing both." [3, pp. 138 & 149].

Though previous research on mathematics anxiety and mathematics achievement has reported several important factors and aspects of it, the author believes that the results of these revised MARS scale questionnaire may not be generalizable to measure undergraduate students' anxiety and relate it to their achievement in a specific subject such as for modern algebra1, because the more mathematical concepts become abstract, the more intense and multifaceted the anxiety will be. Thus, in this study, we are mainly interested to first find anxiety factors in modern algebra1 and then determine its influence on Afghan undergraduate students' achievement in modern algebra1. As far as we searched the literature, there has not been anxiety rating scale questionnaire specific to modern algebra1. Therefore, we first adapted the shorter version of Mathematics Anxiety Rating Scale(MARS) with 30 items developed by Suinn and Winston and administered it in order to understand about Afghan undergraduate students' anxiety and then determine its influence on students' achievement.

Method and materials

Participants

Junior and Senior undergraduate students studying at the mathematics department of school of education of a public university, located in the north of Afghanistan, are the participants of this study. The sample of the study included 97 undergraduate Afghan students, 34.02% male and 65.98% female, who already took modern algebra1 course in their third semester of undergraduate education during the years 2016 and 2107. The participants varied in terms of socio-economic situation, majority were coming from low income families and rural areas. Most of them do not have access to good housing and computer facilities where they study, and most of them cannot afford to buy textbooks and lecture notes required for their courses, some unable to borrow textbooks from vary hardly accessible public or private libraries. Most of them come to class worrying about their families living in villages under attack either by Afghan, US or Taliban forces and being under continuous fear of war and bombing.

Instruments

The adapted 30-item mathematics anxiety rating scale (MARS)

Not having a particular instrument previously developed to measure undergraduate students' anxiety in modern algebra1 subject in tertiary level mathematics, I adapted all the items on measuring modern algebra1 anxiety from Suinn and Winston in [1] and changed the 'mathematics' term to key concepts of group theory in modern algerba1, but I tried to keep intact as good as possible the overall measuring item statement in each item. Then I translated it from English to Farsi language which is one of the official languages in Afghanistan and is also the main medium of instruction in the context. There were originally 30 items in the shortened MARS, measuring students' level of anxiety in the range of 1 to 5 (1= almost not anxious, 2=slightly anxious, 3=fairly anxious, 4=very anxious, 5=extremely anxious). In addition, we were interested in determining how many factors are in each category, we also wanted to find the overall influence of these factors on students' achievement in modern algebra1.

Modern algebra achievement

Students' final exam sores from the official records of department of mathematics was used as students' achievement in modern algebra1. The final exam assesses how much students learned in overall topics discussed in modern algebra1. The final exam usually consists up to 30 questions, of which 50% are multiple choice and the rest are questions that require written response for proving theorems, defining concepts and solving conceptual problems. The correct response for each multiple choice question is worth of one point, while other questions that require written response is worth up to 5 points each, depending on the degree of difficulty of the questions and the amount of work it requires; the distribution of scores, type of questions and the ceiling for the final exam is determined by the ministry of higher education bylaw of examinations; also a maximum of 70 points are allocated for the final exam for modern algebra1 subject.

Data Collection and Procedure

To collect data, first the questionnaire was developed based on the original 30-item MARS. The questionnaire was sent to an instructor teaching at department of mathematics to collect data from students. The objectives of research as well as the questionnaire was explained to the instructor via wechat communicating app commonly used in China. The instructor then got permission from the department and sought participants consent to respond to the questionnaire. The questionnaire was then distributed to students who already took modern algebra1 course with the researcher in

the years of 2016 and 2017. The questionnaire was administered during one-week period, and most of the students responded to questionnaire in the class setting. Students who were absent on the day of questionnaire administration, they were asked to complete the questionnaire in the following week. After cross checking, few missing values was observed in the completed survey questionnaire. To deal with those missing values, either those students who did not respond to item(s) were asked to complete it or filled the missing value with the overall average score of the item(s). Finally, a request was made for the students' affaire office to provide a copy of participants' final exam scores from students' grade records. After collecting all the data via questionnaire administration and final exam scores, the data were entered into Stata14 for further exploratory factor analysis and ordinary least square(OLS) analysis.

Results

In present study, we are mainly interested to first find anxiety factors in modern algebra1 by adapting 30-item MARS and then determine its influence on Afghan undergraduate students' achievement in modern algebra1. The results of data analysis using STATA14 are given below in the form of descriptive statistics for each item, tests of reliability, exploratory factor analysis, and determining the influence of emerged factors of anxiety on students' achievement in modern algebra1.

Descriptive Analysis

The purpose of conducting this statistical analysis is to provide a deep understanding of the factors of learning modern algebra1 anxiety and then to relate it with students' achievement in order to determine how much it can influence, negatively or positively, their achievement. Descriptive analysis of the collected data through the 30-item modern algbra1 anxiety rating scale and students' final exam scores resulted the following statistics. The mean score for modern algebra1 anxiety rating scale range between 2.144 to 4.113 for items 1-30, of which the majority of the items are rated greater than 3; this indicates a relatively high level of anxiety among our students while dealing with modern algebra concepts, especially group theory concepts. Also the standard deviations(SD) for all items are narrowly spread around the mean. On the other hand, the skewness and kurtosis values are not far from zero, indicating that the distribution of each subscale does not differ substantially from a normal distribution [5].

Table 1: The descriptive statistics for all items

Items of modern algebra1 anxiety rating scale	Mean	SD	Skewness	Kurtosis
1. Taking an examination (final) in modern algebra1.	3.433	1.399	-0.413	1.909
2. Thinking about an upcoming modern algebra1 test one week before.	3.124	1.474	.001	1.576
3. Thinking about an upcoming modern algebra1 test one day before.	3.588	1.491	-0.597	1.909
4. Thinking about an upcoming modern algebra1 test one hour before.	3.665	1.613	-0.735	1.876
5. Thinking about an upcoming modern algebra1 test five minutes before.	4.113	1.298	-1.418	3.814
6. Waiting to get a modern algebra1 test returned in which you expected to do well.	3.721	1.305	-0.746	2.446
7. Seeing your final modern algebra1 grade posted on the announcement wall.	3.907	1.369	-0.980	2.648
8. realizing that you have to take a number of modern algebra1 classes to fulfill the requirements in your major.	2.588	1.375	0.335	1.918
9. Being given a "pop" quiz in modern algebra1 class.	2.464	1.225	0.494	2.267
10. studying for modern algebra1 test.	2.495	1.466	0.499	1.824
11. Taking modern algebra section in becoming a school teacher or master degree entrance examination.	3.536	1.415	-0.518	1.925
12. Taking an examination (quiz) in modern algebra1 course.	3.423	1.306	-0.423	2.123
13. Picking up the modern algebra1 textbook to begin working on a homework assignment.	2.299	1.363	0.688	2.231
14. Being given a homework assignment of many difficult modern algebra1 problems which is due the next class meeting.	3.031	1.482	-0.015	1.610
15. Getting ready to study for modern algerba1 test.	2.948	1.453	0.089	1.674
16. determining whether a given binary algebraic structure forms a group in private with pencil and paper.	2.546	1.384	0.400	1.858
17. Finding subgroups of a group on paper.	2.319	1.279	0.616	2.249
18. Defining concepts related to group theory.	2.422	1.289	0.435	2.039
19. Proving theorems in group theory.	3.093	1.422	-0.077	1.669
20. Reading theorems and proofs in group theory.	3.206	1.414	-0.058	1.685
21. Being given conceptual problems related to group theory to be solved on paper.	3.031	1.365	0.067	1.806
22. Defining group theory concepts while someone watching you.	3.206	1.513	-0.226	1.640
23. Watching someone solving modern algebra1 problems with a calculator	2.144	1.392	0.975	2.646
24. Being given a set of symmetric group problems to solve.	3.082	1.304	0.017	1.877
25 Being given a set of problems related to homomorphism and isomorphism of groups to solve.	2.938	1.352	0.214	1.863
26. Being given a set of problems related to cosets to solve.	2.907	1.407	0.075	1.729
27. When you are asked to prove Lagrange's theorem.	3.155	1.409	-0.186	1.804
28. Being given a set of problems to be solved by using Lagrange's theorem.	3.216	1.340	-0.191	1.951
29. Being given a set of normal subgroup problems to solve.	2.886	1.391	0.157	1.751
30. Being given a set of factor group problems to solve.	2.989	1.461	0.118	1.667

Reliability Analysis

Internal consistency of the adapted 30-item modern algebra1 anxiety rating scale was measured to estimate its reliability. A Cronbach alpha of 0.892 was found, indicating a relatively high internal consistency. This internal consistency estimate is less than that of the 30-item MARS found to be 0.96 for mathematics anxiety [1]. The test-retest reliability cannot be measured since we administered the 30-item modern algebra1 anxiety rating scale once and then we were not able to administer it once again after passing a week or two, however, the one-week test-retest reliability for the 30-item MARS was already measure to be 0.90 ($p < 0.001$).

Exploratory Factor Analysis

We may expect finding more factors in the 30-item modern algebra1 anxiety rating scale compared to the 30-iteam MARS due to the huge difference among the items specific to modern algebra concepts. As we mentioned earlier, the factor analysis for 30-item MARS resulted the emergence of two factors, mathematics test anxiety and numerical anxiety. Therefore, we believe that there can be several factors including test anxiety, numerical anxiety, proof reading and proof production anxiety, concept-specific anxiety and so on; we let STATA14 software determine what factors emerge from the data. To conduct exploratory factors analysis, we first performed the Kaiser-Meyer-Olkin (KMO) and Bartlett's sphericity tests in order to determine adequacy of the sample and to check whether the data fitted for factor analysis. KMO ratio should be above 0.50 [6]. The KMO value calculated from the sample was 0.761, indicating that data set was appropriate for factor analysis. The value for Bartlett's test of sphericity was $\chi^2 = 1193.566$ ($df = 435, p < .000$), indicating that variables are intercorrelated. And the determinant of the correlation matrix was estimated to be close to 0.000 for all items. Furthermore, principle-component factor analysis with Varimax rotation produced 10 factors. These 10 dimensions, selected based on the eigenvalues greater than 1, of the 30-item modern algebra1 anxiety rating scale questionnaire explained about 70% of total variance and the most variance.

The results found in factor analysis indicated that all item loadings found were above the recommended cut-off point 0.40. Also the reliability value 0.892 obtained for all 30 items showed that it met the suggested minimum value of 0.70 [7]. Apparently, due to the limited number of subjects and only one-time study on the problem under consideration, we are not in a position to categorize each factor as a theoretically psychological construct contributing to modern algebra1 anxiety, rather we will name them as variables that may be influencing students' final exam scores in modern algebra achievement.

Multiple Regression Analysis

At this point, we are lead to conduct a multiple regression analysis with these 10 factors as independent variables and students' final exam scores as dependent variables in order to determine whether these factors significantly contribute to or influence undergraduate Afghan students' achievement in modern algebra1. After determining these 10 factors as variables of modern algebra1 anxiety influence students' achievement, we calculated the mean value of all items under a specific factor by summing the items under a factor and dividing the sum by the number of items, and renamed each new variable as F_1, F_2, …, F_{10} in the regression model. So the multiple regression model to be analyzed was:

$$Y = \beta_0 + \sum \beta_i F_i, \quad (1)$$

where Y = final exam score, β_i parameter of the model and $F_i = i^{th}$ factor, $i = 1, \dots, 10$.

Table 2: Pairwise correlations among all 10 factors

	F1	*F2*	*F3*	*F4*	*F5*	*F6*	*F7*	*F8*	*F9*	*F10*
F1	1.0000									
F2	0.2037	1.0000								
F3	0.4208	0.4979*	1.0000							
F4	0.1918*	0.2383	0.3280*	1.0000						
F5	0.3667*	0.4811*	0.4755*	0.2404	1.0000					
F6	0.2305	0.4759*	0.3586*	0.0744	0.2568	1.0000				
F7	0.2894	0.1792	0.4254*	0.1012	0.2349	0.2178	1.0000			
F8	0.4444*	0.3143	0.3073	0.2199	0.2679	0.3358*	0.2133	1.0000		
F9	0.3313*	0.2935	0.2704	0.1278	0.2178	0.3695*	0.2302	0.3509	1.0000	
F10	0.3070	0.3320*	0.3939*	0.3227	0.3383*	0.3180	0.1740	0.2487	0.3982	1.0000

* $p < 0.05$ (using Bonferroni-adjusted significance level)

Correlation analysis of these 10 explanatory variables showed that there were relatively low correlations among these factors, though some were significant. This allows us to run multiple regression analysis. The pairwise correlations are given in Table 2.

Table 3: Estimates of parameters of OLS model in (1)

Source	SS	df	MS	Number of obs =	97
				F(10, 86) =	1.02
Model	1425.89799	10	142.589799	Prob > F =	0.4346
Residual	12035.4422	86	139.947002	R-squared =	0.1059
				Adj R-squared =	0.0020
Total	13461.3402	96	140.222294	Root MSE =	11.83

var31	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
F1	1.185044	1.378377	0.86	0.392	-1.55508	3.925168
F2	-1.242736	1.578756	-0.79	0.433	-4.381199	1.895727
F3	.631863	1.633696	0.39	0.700	-2.615816	3.879542
F4	-.4842821	1.060114	-0.46	0.649	-2.591718	1.623154
F5	1.334032	1.403731	0.95	0.345	-1.456492	4.124556
F6	-2.41307	1.354813	-1.78	0.078	-5.106348	.2802081
F7	-1.98528	1.25355	-1.58	0.117	-4.477255	.5066957
F8	.5683887	1.278607	0.44	0.658	-1.973399	3.110176
F9	-.153567	1.206694	-0.13	0.899	-2.552395	2.245261
F10	1.177743	1.31087	0.90	0.371	-1.428182	3.783667
_cons	19.23298	5.828635	3.30	0.001	7.646039	30.81992

The adequacy of sample size for multiple regression analysis was calculated by the online sample size calculator in www.danielsoper.com with anticipated effect size of 0.15, desired statistical power level of 0.8, with 10 predictors and probability level of 0.05; then the minimum required sample size was calculated to be 118 cases, but our sample size was 97 cases which we could sample as of our best effort since there were no more classes except these 97 students at the time of data collection. We run ordinary least squares(OLS) in STATA14 to estimate parameters of the model in (1). The results of analysis of variance, strength of the correlation, estimated unstandardized coefficients of model (1), their level of significance and confidence intervals are summarized in Table 3.

The relevant information and estimates of parameters for constructing the least-squares regression equation (1) is presented in the coefficients table (see Table6). Substituting the estimated coefficients from table in (1), we get

$$Y = 19.23 + 1.18F_1 - 1.24F_2 + .63F_3 - .48F_4 + 1.33F_5 - 2.41F_6 - 1.98F_7 + .57F_8 - .15F_9 + 1.18F_{10} \quad (2)$$

To predict how these 10 factors of modern algebra1 anxiety influence students' achievement, one would put specific values in (2) to estimate the average score of a student in a modern algebra final exam.

Furthermore, the strength of the prediction equation (2) or R-squared is 0.1059. Thus, for our sample, the predictors, or factors of modern algebra1 anxiety, has explained 10.59% of the variance in the depended variable (final exam score in modern algebra). The ANOVA table shows that the computed F statistic is 1.02, with an observed significance level of greater than 0.05. Thus, the hypothesis that there is no linear relationship between the predictors and the dependent variable cannot be rejected for this sample of data, more research is needed to be carried out to reject or accept the hypothesis. The table also reports the unstandardized coefficients between predictor variables, $F_i, i = 1, \dots, 10$, and the dependent variable *Y*, the final exam scores. Half of these unstandardized coefficients (F_2, F_4, F_6, F_7 & F_9) are negative, indicating that these factors may negatively influence students' final exam scores in modern algebra1; also the other half of these unstandardized coefficients (F_1, F_3, F_5, F_8 & F_{10}) are positive, indicating that these factors may positively influence students' final exam scores in modern algebra1. However, none of these unstandardized coefficients were statistically significant.

However, looking close at the original 30-item MARS, we believe that it may not be possible to have 10 factors of anxiety for the adapted 30-item modern algebra anxiety rating scale(MAARS), there may be actually 3 factors of anxiety, namely test anxiety, problem solving anxiety, and definition→theorem→proof anxiety (see the discussion). Rerunning exploratory factor analysis with Varimax rotation and restricting STATA14 to give 3 factors, we found that the test anxiety factory(f_1) consisted of items 1-7, 11, 12, 20, 22, 23; problems solving anxiety (f_2) consisted of items 19, 21, 25-30; and the last factor (f_3) consisted of items 8-10, 13-18,24. And rerunning multiple regression analysis for these 3 factors as independent variables explaining final exam scores as dependent variable, we found that f_1 and f_2 were positively related to students' final exam scores, but none of them were statistically significant; Also f_3 was negatively related to students' final exam scores, and this negative relationship was statistically significant, indicating that the more students had higher level of this third anxiety factor, the less they scored in the final exam (see Table 4).

$$Y = 18.139 + 1.532f_1 + 2.338f_2 - 4.598f_3 \quad (3)$$

Table 4: Estimates of parameters of OLS model for the three factors f_1, f_2 and f_3

Source	SS	df	MS	Number of obs	=	97
				F(3, 93)	=	2.15
Model	873.921917	3	291.307306	Prob > F	=	0.0989
Residual	12587.4183	93	135.348584	R-squared	=	0.0649
				Adj R-squared	=	0.0348
Total	13461.3402	96	140.222294	Root MSE	=	11.634

var31	Coef.	Std. Err.	t	P>|t|	Beta
f1	1.532523	1.756573	0.87	0.385	.1045714
f2	2.337962	1.69726	1.38	0.172	.1740464
f3	-4.597577	1.835139	-2.51	0.014	-.3210787
_cons	18.13945	5.557028	3.26	0.002	.

Discussion and Conclusion

Math anxiety is believed to be a very important variable affecting students' performance and achievement. Soni and Kumari in [8, p.332], citing from Bekdemir [9] and Ma [10], contend that negative feelings associated with math anxiety can affect students' "confidence to learn and perform in math". They also cite from Ashcraft and Faust [11] and contend that "math-anxious individuals [have] limited command of the subject, [are] less eloquent in computations, and [are] also less likely to have figured out any special approach in the field of mathematics."

Looking at the literature, little is known about the influence of this affecting variable on undergraduate students' achievement in university mathematics. In present study, we aimed to determine the influence of modern algebra1 anxiety on undergraduate Afghan students' achievement. After collecting data through a revised 30-item MARS from a sample of 97 students, conducting exploratory factor analysis to specify factors contributing to modern algebra1 anxiety rating scale questionnaire, and eventually performing multiple regression analysis to find how much those factors of modern algebra1 anxiety explain students' achievement in the subject, it has been found from this study sample that the modern algebra1 anxiety rating scale, adapted from 30-itme MARS, had 10 factors contributing to it.

The first factor, F_1, consisted of items 1(taking an examination), 4(thinking about an upcoming test one hour before),5(thinking about an upcoming test 5 min before), 11(taking modern algebra section in degree entrance exam), and 12(taking a quiz). We think that this factor is a part of test anxiety factor as determined by Suinn & Winston in [1]. Descriptive analysis of F_1 showed that students felt very anxious with mean of 3.65 and SD of 1.09. Regression analysis showed that this first factor was positively related to final exam scores with regression coefficient of about 1.18, indicating that it may positively influence students' achievement, but this positive relationship was not statistically significant, $p > 0.05$ and 95% CI of [-2.62, 3.88].

The second factor, F_2, consisted of items 13(picking up textbook to work on homework), 14(being given difficult problems to solve due next class), 29(being given normal subgroup problems to solve), and 30(being given factor group problems to solve). We think that this factor is a part of problem solving anxiety factor, equivalent of numerical anxiety factor reported in [1]. Descriptive analysis of this factor showed that students felt fairly anxious with mean of 2.80 and SD of 1.02. Regression analysis showed that the second factor was negatively related to final exam scores with regression coefficient of about -1.24, indicating that it may negatively influence students' achievement, but this negative relationship was not statistically significant, $p > 0.05$ and 95% CI of [-4.38, 1.89].

The third factor, F_3, consisted of items 16(determining whether an algebraic structure forms a group), 18(defining concepts in group theory), 19(proving theorems in group theory), 20(reading theorems and proofs), and 21(being given conceptual problems to solve). We think that this factor is a part of the definition→theorem→proof factor anxiety which is evident in the presentations of concepts in modern algebra textbooks. Descriptive analysis of this factor showed that students felt fairly anxious in these items, with the mean of 2.86 and SD of 1.03. Also, regression analysis showed that this third factor was positively related to final exam scores with regression coefficient of about -0.64, indicating that it may positively influence students' achievement, but this positive relationship was not statistically significant, $p > 0.05$ and 95% CI of [-4.38, 1.89].

The fourth factor, F_4, consisted of items 27(being asked to prove Lagrange's theorem) and 28(being given problems to solve via Lagrange's theorem). We think that this factors a part of the definition→theorem→proof. anxiety factor, similar to F_3. Descriptive analysis of this factor revealed that students felt fairly anxious in these items, with mean of 3.18 and SD of 1.26. In addition, regression analysis revealed that this factor was negatively related to final exam scores with regression coefficient -0.48, indicating that it may negatively influence students' achievement, but this negative relationship was not statistically significant, $p > 0.05$ and 95% CI of [2.59, 1.62].

The fifth factor, F_5, consisted of items 24(being given symmetric group problems to solve), 25(being given homomorphism and isomorphism problems to solve) and 26(being given coset problems to solve). It appears that these items can be put together as part of problem solving anxiety factor specific to symmetric groups, because in the literature it has been reported that majority of students have difficulty in understanding and dealing with problems related to symmetric groups, finding cosets in a symmetric group as well as dealing with its morphism problems. Descriptive analysis of the average responses to this factor revealed that students felt fairly anxious, with the mean of

2.98 and SD of 1.07. Furthermore, regression analysis showed that this factor was positively related with final exam scores with regression coefficient of about 1.33, indicating that it may positively influence students' achievement, but this positive relationship was not statistically significant, $p > 0.05$ and 95%CI of [-1.46, 4.12].
The sixth factor, F_6, consisted of items 8(taking a number of modern algebra classes), 10(studying for modern algebra test), and 15(getting ready to study for modern algebra test). It seems that these items may be a part of the test anxiety factor in modern algebra1, similar to F_1. Descriptive analysis of the factor showed that students felt slightly anxious in these items, with the mean of 2.68 and SD of 1.09. Furthermore, regression analysis showed that this factor was negatively related to final exam scores with regression coefficient of about -2.41, indicating that it may negatively influence students' achievement, but it was not statistically significant, $p > 0.05$ and 95%CI of [-5.11, 0.28].
The seventh factor, F_7, consisted of items 17(finding subgroups on paper) and 23(watching someone solving modern algebra problems via calculator). It seems that these items are also a part of problem solving anxiety factor. Descriptive analysis of the averaged responses to these items revealed that students felt slightly anxious, with the mean of 2.23 and SD of 1.09. In addition, regression analysis revealed that this factor was negatively related with final exam scores with regression coefficient -1.98, indicating that it may negatively influence students' achievement, but this negative relationship was not statistically significant, $p > 0.05$ and 95%CI of [-4.48, 0.51].
The eighth factor, F_8, consisted of items 6(waiting to get modern algbebra1 test returned in which you expected to do well.) and 7(seeing your final exam grade posted on announcement wall). Descriptive analysis of the averaged responses of these items revealed that students felt very anxious, with the mean of 3.81 and SD of 1.13. Furthermore, regression analysis revealed that this factor was positively related with final exam scores with regression coefficient 0.57, indicating that it may positively influence students' achievement, but it was not statistically significant, $p > 0.05$ and 95%CI of [-1.97, 3.11].
The ninth factor, F_9, consisted of items 2(thinking about an upcoming modern algebra1 test one week before) and 3(thinking about an upcoming modern algebra1 test one day before). It appears that these items are related to text anxiety factor. In addition, regression analysis revealed that this factor was negatively related with final exam scores with regression coefficient -0.15, indicating that it may negatively influence students' achievement, but it was not statistically significant, $p > 0.05$ and 95%CI of [-2.55, 2.24].
Finally, the tenth factor, F_{10}, consisted of items 9(being given a "pop" quiz in modern algebra1) and 22(defining group theory concepts while someone watching you). It seems that these items are also part of text anxiety factor, similar to F_1, F_2, F_6, and F_9. Furthermore, regression analysis revealed that this factor was positively related with final exam scores with regression coefficient 1.18, indicating that it may positively influence students' achievement, but it was not statistically significant, $p > 0.05$ and 95%CI of [-1.43, 3.78].
A closer look at above discussion reveals the following. First, modern algebra1 anxiety rating scale developed in present study may not have 10 factors, but instead it may have three main factors, those may be test anxiety, problem solving anxiety, and definition→ theorem→ proof anxiety factors. We also found that the test anxiety factor (f_1) consisted of items 1-7, 11, 12, 20, 22, 23; problems solving anxiety (f_2) consisted of items 19, 21, 25-30; and the last factor (f_3) consisted of items 8-10, 13-18,24. In addition, f1 and f2 were positively related to students' final exam scores, but none of them were statistically significant; however, f3 was negatively related to students' final exam scores, and this negative relationship was statistically significant, indicating that the more students had higher level of this third anxiety factor, the less they scored in the final exam. This finding in our study is similar to Woodard's study in [4], Betz's study in [12], and Ma study in [10], all of whom also found a negative relationship between math anxiety and math achievement. However, we cannot firmly conclude these results from the present study, since we already saw there are 10 factors, and latter arrived at three possible anxiety factors. Also, half of the 10 factors in the initial regression analysis and two factors in the latter regression analysis were positively correlated to students' final exam scores in modern algebra1. This is in contradiction with the results of the previous literature which had empirically shown that math anxiety factors generally negatively influence students' academic achievement. We believe that this positive relationship may be due to the fact that the sample students in our study may not have rated their actual modern algebra anxiety level on the given scale, or it may be due to the fact that these anxiety factors may actually positively influence students' achievement in modern algebra1. Thus, more researches should be conducted to determine the actual number of factors of modern algebra1 anxiety rating scale and its direction of relationship with students' achievement.

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