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Comparing High School Students of Mathematics, Experiential, and Humanity Courses in Terms of Engagement in Mathematics Dimensions of Masjed Soleiman City, Iran

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ABSTRACT: The objective of the present study is to compare high school girl and boy students of mathematics, experiential, and humanity courses in terms of "Engagement in Mathematics" dimension in Masjed Sleiman city (interest, achievement orientation, frustration, anxiety, diligence, attentiveness, time spent, surface strategy, deep strategy, and reliance). The statistical sample of the study was all grade two and grade three high school students of Masjed Soleiman in the school year of 2014-15. Total of 326 students (169 boys and 157 girls- 127 experiential, 100 mathematics and 99 humanity) has been assigned for this study. The scale of student engagement in Mathematics was used to gather the data. The method of analysis was MANOVA. The results showed that girls and boys students in different courses in terms of "Engagement in Mathematics" were different. There were differences between boys and girls in terms of deep strategy, achievement orientation, diligence and time spent. Mathematics students were significantly different with humanity and experiential students in terms of interest, anxiety, frustration, time spent, and diligence. There were also differences in time spent in the interaction between courses and gender.

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INTRODUCTION

Important researches under the title of "Engagement" exist related to behavior, emotion, and cognition of students and understandability and test making in the related literature investigation (for example, Lam et al., 2003; Fredericks et al., 2004). Chapman (quoted in Fathi Ashtiyani et al., 2011) has used schooling (educational) engagement as a construct to introduce students' tendency to participate in daily school activities, participating in classes, doing homework, and following teacher's instruction in the classroom. Numerous studies have indicated the multi-dimension entity of schooling engagement and have counted three dimensions for it as bahvioral, cognitive, and affective. Lam et al. (2003) have mentioned the construct of engagement in relation to mathematics subject in high school. Engagement dimensions include surface strategy, deep strategy, reliance, interest, anxiety, achievement orientation, frustration, attentiveness, and time spent. Students may display their engagement by using surface and deep strategies. Some students are engaged by memorizing facts and different mathematical rules while others engage themselves with the understanding of basic rules. Some rely on following teacher's instructions while others try to acquire outputs of the optimum learning. Students who have a tendency for achievement orientation get pleasure from obtaining optimum results in mathematics. They do not like mathematics in particular. This concept of the strategy of achievement orientation is closer to learning.

According to this concept, students tend to optimize their time-spending and diligence only to get higher scores. Their motivation and diligence lead them just to obtain better scores. Feeling of anxiety put them under pressure when they learn mathematics and when specially they are taking mathematic tests. This anxiety affects their learning of mathematics and influences their behavior when they face nervous problems. This feeling of high involvement is because they want to be good at that subject. Some students show the feeling that they are tired of mathematics and do not like to learn anything new related to mathematics. For students with frustration the only objective is spending time. Focusing on some complicated mental processes is said to include concentration or involvement with the objective, holding (retaining/keeping) or tolerating and just waiting for a long time, encoding special stimuli and changing focusing from one objective to another one (Seidman, 2006). Noticing (Focusing) is significant for cognitive performance, mind and behavior because even little carelessness influences learning a lot. Lam, et al. study indicates that students' engagement in mathematics has several dimensions. The objective of this study is to survey the dimensions of mathematical engagement in relation to variables of gender, educational course, and the interaction between these two variables.

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MATERIAL AND METHODS

The present study is of descriptive-causal comparative type and has used MANOVA to analyze its data. The statistical sample of the study was all grade two and grade three high school students of Masjed Soleiman in the school year of 2014-15. The sample included 326 students (169 boys and 157 girls- 127 experiential, 100 mathematics, and 99 humanity). The scale of Students Engagement in Mathematics was used to gather the data. Lam et al. (2003) designed the scale of mathematics engagement as having 75 items and 10 dimensions including surface strategy, deep strategy, reliance, interest, achievement orientation, anxiety, frustration, focusing, diligence, and time spent. The respondents reported their response of correctness or incorrectness for each item based on a 5-degree Likert continuum. In this continuum, 1 is for "complete disagreement" and 5 is for "complete agreement". The designers calculated Cronbach's alpha for all subscales from 0.79 to 0.90. They verified its validity through the analysis of verifying factor and calculating the correlation among its subscales. In this study, Cronbach's alpha was calculated from 0.63 to 0.90 for the used subscales and 0.85 for all the questionnaires The analysis results of the verifying factor indicated that all the scale items except item 8 had sufficient factorial load (higher than 0.3).

RESULTS

In this section of the study, the descriptive statistics of the study variables are presented. Table 1 presents statistic indices like mean and standard deviation of the subjects.

Also, MANOVA procedure was used for the analysis of the study data. Table 2 summarized the results of MANOVA for the comparison of variables means for the girl and boy students of mathematics, experiential, and humanity courses.

According to Table 2, it can be concluded that there is a difference among girl and boy students of mathematics, experiential, and humanity courses in mathematical engagement at least for one dimension.

Table 3 presents the testing effects among the girl and boy students of mathematics, experiential, and humanity courses in mathematical engagement. According to this table, there is a difference between girl and boy students in terms of deep strategy, achievement orientation, diligence and time spent. There is also, a difference among mathematics, experiential, and humanity students in terms of surface strategy, deep strategy, interest, anxiety, frustration, diligence, and time spent. Moreover, there is a difference in time spent in the interaction among groups of subjects, as diagram 1 presents.

Scheffe test was used in order to determine the significance of the difference among paired groups. The results of this section are presented in Table 4.

As seen in Table 4, based on Scheff's test, humanity students use surface strategies more than experiential and mathematics students.

Deep strategies are used more in mathematics students than experiential students. Interest, anxiety, frustration, time spent, and diligence are significantly different ($p<0.05$) in mathematics students compared to experiential and humanity students which means that mathematics students have more interest, time spent and diligence and less anxiety and frustration than experiential and humanity students.

Table 1. Mean and standard deviation of the dimensions of mathematics engagement for girl and boy students of mathematics, experiential, and humanity courses.

Variables	Statistical indices									
	Female		Male		Mathematics		Experiential		Humanity	
	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD
Surface strategy	19.59	6.27	18.81	5.73	18.40	6.04	18.42	5.95	21	5.67
Deep strategy	23.60	5.05	24.75	5.18	25.22	4.77	23.40	5.23	24.19	5.27
Reliance	26.81	5.10	26.52	5.37	26.23	5.17	27.12	5.44	26.51	5.04
Interest	21.61	6.51	21.02	6.79	24.42	6.37	20.26	6.37	19.49	6.26
Achievement orientation	26.29	3.82	25.38	4.58	26.04	4.06	26.12	4.25	25.20	4.39
Frustration	12.30	3.82	12.72	6.13	9.62	5.52	13.48	6.24	14.20	6
Anxiety	16.67	5.75	16.07	5.79	14.28	5.36	17.42	5.70	17.10	5.74
Attentiveness	22.65	5.35	22.06	5.96	23.33	5.53	21.72	5.62	22.14	5.79
Diligence	23.32	5.73	21.46	6.25	24.11	5.71	21.70	6.08	21.41	6.08
Time spent	8.46	3.38	9.77	6.31	13.89	5.13	8.53	3.23	5.11	2.82

Table 2. Summary of the MANOVA results for the comparison of variables means for the girl and boy students of mathematics, experiential, and humanity courses.

Effect	Value	F	Hypothesis df	Error df	Sig.
Pillai trace	0.12	2.03	20	624	0.005
Wilk lambda	0.88	2.06	20	622	0.004
Hotelling trace	0.14	2.10	20	620	0.004
Roy largest root	0.12	3.75	10	312	0.000

Table 3. Results of testing effects among the girl and boy students of mathematics, experiential, and humanity courses in mathematical engagement.

Source variables	df	Mean square	F	Sig.
Sex*course Surface strategy	2	2.52	0.07	0.93
Deep strategy	2	26.59	1.03	0.36
Reliance	2	15.98	0.58	0.56
Interest	2	31.11	0.77	0.46
Achievement orientation	2	3.91	0.22	0.80
Anxiety	2	47.57	1.51	0.22
Frustration	2	92.97	2.64	0.07
Attentiveness	2	48.28	1.52	0.22
Diligence	2	66.32	1.91	0.15
Time spent	2	97.61	7.13	0.001

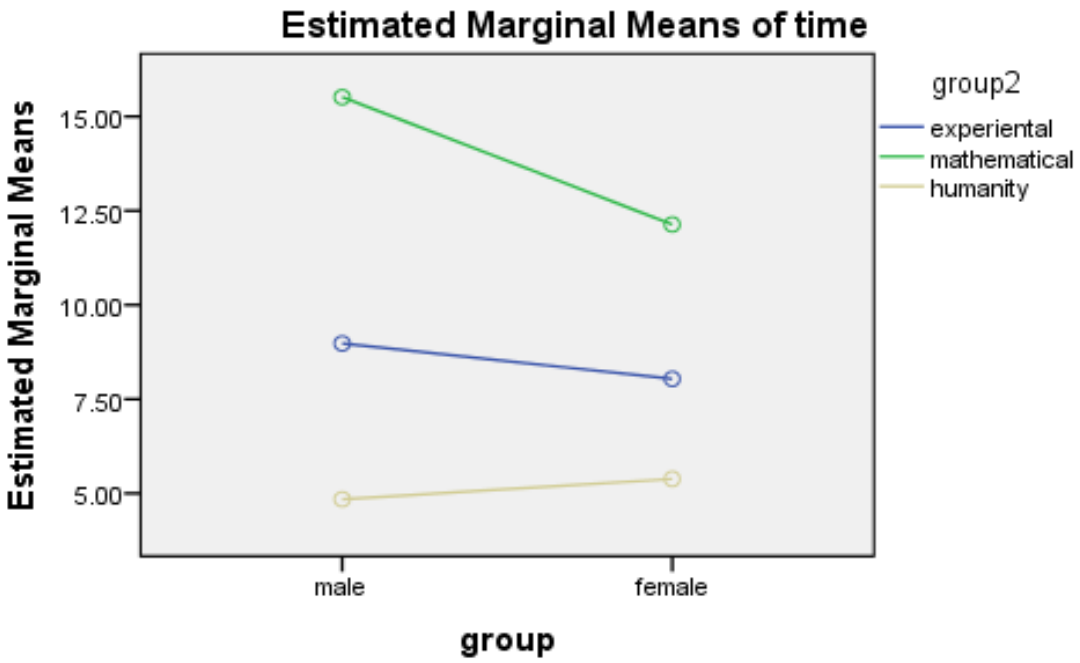

Diagram 1. Estimated marginal means of Time spent

Table 4. Results of Scheff's test for the comparison of means for students of mathematics, experiential, and humanity courses in mathematical engagement.

Multiple Comparisons							
Scheffe							
Dependent Variable	**(I) Group2**	**(J) Group2**	**Mean Difference (I-J)**	**SE**	**Sig.**	**95% Confidence Interval**	
						Lower Bound	**Upper Bound**
Surface strategy	Experiential	Math	.0630	.79025	.997	-1.8804	2.0064
		Humanity	-2.5780*	.79248	.005	-4.5269	-.6291
	Math	Experiential	-.0630	.79025	.997	-2.0064	1.8804
		Humanity	-2.6410*	.83804	.008	-4.7019	-.5801
	Humanity	Experiential	2.5780*	.79248	.005	.6291	4.5269
		Math	2.6410*	.83804	.008	.5801	4.7019
Deep strategy	Experiential	Math	-1.8185*	.67892	.029	-3.4882	-.1489
		Humanity	-.7931	.68083	.508	-2.4674	.8813
	Math	Experiential	1.8185*	.67892	.029	.1489	3.4882
		Humanity	1.0255	.71997	.364	-.7451	2.7961
	Humanity	Experiential	.7931	.68083	.508	-.8813	2.4674
		Math	-1.0255	.71997	.364	-2.7961	.7451
Interest	Experiential	Math	-4.1557*	.84794	.000	-6.2410	-2.0704
		Humanity	.7744	.85034	.661	-1.3168	2.8656
	Math	Experiential	4.1557*	.84794	.000	2.0704	6.2410
		Humanity	4.9301*	.89922	.000	2.7187	7.1415
	Humanity	Experiential	-.7744	.85034	.661	-2.8656	1.3168
		Math	-4.9301*	.89922	.000	-7.1415	-2.7187
Anxiety	Experiential	Math	3.1400*	.74960	.000	1.2965	4.9834
		Humanity	.3122	.75172	.917	-1.5364	2.1609
	Math	Experiential	-3.1400*	.74960	.000	-4.9834	-1.2965
		Humanity	-2.8277*	.79493	.002	-4.7827	-.8728
	Humanity	Experiential	-.3122	.75172	.917	-2.1609	1.5364
		Math	2.8277*	.79493	.002	.8728	4.7827
Frustration	Experiential	Math	3.8562*	.79311	.000	1.9058	5.8066
		Humanity	-.7238	.79534	.661	-2.6798	1.2321
	Math	Experiential	-3.8562*	.79311	.000	-5.8066	-1.9058
		Humanity	-4.5800*	.84106	.000	-6.6484	-2.5116
	Humanity	Experiential	.7238	.79534	.661	-1.2321	2.6798
		Math	4.5800*	.84106	.000	2.5116	6.6484
Diligence	Experiential	Math	-2.4103*	.78756	.010	-4.3471	-.4734
		Humanity	.2885	.78979	.935	-1.6538	2.2307
	Math	Experiential	2.4103*	.78756	.010	.4734	4.3471
		Humanity	2.6987*	.83519	.006	.6448	4.7526
	Humanity	Experiential	-.2885	.78979	.935	-2.2307	1.6538
		Math	-2.6987*	.83519	.006	-4.7526	-.6448
Time spent	Experiential	Math	-5.3573*	.49462	.000	-6.5737	-4.1409
		Humanity	3.4239*	.49602	.000	2.2040	4.6437
	Math	Experiential	5.3573*	.49462	.000	4.1409	6.5737
		Humanity	8.7812*	.52453	.000	7.4912	10.0711
	Humanity	Experiential	-3.4239*	.49602	.000	-4.6437	-2.2040
		Math	-8.7812*	.52453	.000	-10.0711	-7.4912

Based on observed means; The error term is Mean Square (Error) = 13.687; *The mean difference is significant at the .05 level.

The present study was conducted in order to compare girl and boy students of mathematics, experiential, and humanity courses in terms of the dimensions of Mathematics Engagement (including surface strategy, deep strategy, reliance, interest, achievement orientation, anxiety, frustration, focusing,

diligence, and time spent dimensions). The results of MANOVA indicated that there are differences among girl and boy students of mathematics, experiential, humanity in terms of time spent meaning that boy students of mathematics spend longer time to do their homework. Other findings of this study showed that girls and boys differed in terms of deep strategy and time spent in a way that the mean of deep strategy and time spent for boys was higher than girls and that the mean of achievement orientation and diligence was higher for girls than boys. Also, there are differences among mathematics, experiential, and humanity students regarding surface and deep strategies, interest, anxiety, frustration, diligence, and time spent in a way that humanity students spend more time than experiential and mathematics students for memorization of formulas rather than deeply understanding them and mathematical problems.

Mathematics students use deep strategies more than experiential students. Interest and diligence are more and anxiety and frustration are less in mathematics students compared to the other two groups. Time spent is also different for different courses. It is longer for mathematics students than experiential students and longer for experiential students compared to humanity students. Past researches have shown that some variables related to mathematics students are different between girl and boy students in other courses. For example, Pajar and Suirdon (quoted in Husni, 2006) conducted a research with 1047 subjects on mathematics anxiety of different educational levels. The results showed that woman students had less mathematics anxiety compared to girl students of guidance school and all boys at all levels. High school girl students also had more mathematics stress than boy students in guidance school. For girl and boy students in guidance school there was no significant difference regarding mathematics stress. These result correlate with previous researches in that the difference between girls and boys in mathematics emerges after guidance school. In Iran, Mohammad Jani et al. (2014) conducted a research on the effect of mathematics anxiety on 300 girl and boy subjects and showed that from among factors of mathematics anxiety only learning anxiety could predict mathematical achievement and there was no difference between girls and boys regarding this factor. Also, findings of Noori et al. (2011) showed that there was a difference among different courses of high school in terms of mathematics anxiety. The findings of this study confirmed differences regarding Mathematics Engagement among different courses and between girls and boys.

CONCLUSION

The findings offer necessary variables (deep strategy, interest, time spent and diligence) to obtain mathematics engagement with high quality and investigates the pathology of educational behavior of girls and boys in mathematics, experiential, and humanity courses. More researches are needed to investigate the relationship between mathematics engagement and mathematical achievement and determining the importance of these dimensions on mathematical achievement. Since the present study is just a comparative one and does not prove any causal relationship, more experimental studies should be conducted to support the findings of this study regarding the effect of different dimensions of mathematical engagement and its interaction with different courses and genders.

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