



ORIGINAL ARTICLE

Comparing Academic Achievement in Math Course in Music Students and Ordinary Students

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ABSTRACT

Current study aims at comparing academic achievement in math course in music students and ordinary students. To this end, 100 students were selected using multistage sample from third grade of secondary school students from Tehran ordinary and music schools who were studying during 2011 - 2012. TIMSS test was used for data collection to investigate academic achievement in math course. According to the variables under study and type of collected data, indexes of central tendency, dispersion and distribution of scores were used for describing data and variables. Two-way ANOVA and two-way MANOVA were used in statistical analysis. Findings suggest there is significant difference between music school students and ordinary school students in academic achievement in math course. It can be concluded that music students show higher academic achievement compared to ordinary students.

Keywords: academic achievement in math course, ordinary students, music students

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INTRODUCTION

One of the major goals of education is nurturing creative talents such as problem solving ability. Creativity has been always respected in science, art, literature, and other aspects of culture and civilization [1]. Investigating individual differences especially investigating academic achievement is one of the controversial discussions in education and psychology. Math self-concept is one of the variables related to math learning and development. Math self-concept is perceptions of learner about individual mathematical skills and capabilities, mathematical reasoning ability, and enjoying them [2]. In increase model, academic self-concept causes academic progress, while in the skill development model, academic achievement is the cause and the basic determinant is academic achievement [3]. Mathematics is the integral element for success in today world it is a motivation for students to acquire successes in this field and the number of students in this field is growing. Despite of importance of all academic grades, since school is the foundation for shaping scientific character of students and ground for developing positive or negative attitudes toward courses especially math course, thus interest in this course especially in early academic grades should be increased using novel approaches. Authors in math training field argue that living in the complex and advanced world necessitates having creative thinking and dynamic and productive thought. Learning math knowledge can help formation and development of such thinking [4]. Music plays active role in memory development due to its difficulty and developing relationship between various sensory and motor organs of the body, because it coordinates different body organs and improves human skills. The state of playing a song is similar to comprehending a math problem; the meaning and concept is associated to the valid symbols which include all necessary information, however, the real success in this relationship depends on the general ground of education, culture, and history [5]. Previous studies suggest role of music learning and its impact on academic achievement in math course and creativity. Thus, implementing similar studies seems necessary to justify educational authorities to pay attention to music learning as an effective factor for math and creativity progress. Considering above

mentioned facts, current study compares academic achievement in math course and music learning in music students and ordinary students.

THEORETICAL FOUNDATIONS

Academic achievement and its effective factors have always been considered by educational authors and many studies have been dedicated to it. However, at least since 1980 the studies were focused on the interactive effect of motivational and cognitive factors on academic achievement of students in the form of scientific models. In this regard, Corno and Mandinach[6] introduced Cognitive engagement as one of the factors affecting academic achievement of students which also influences the extent and type of their effort in the classroom. Achievement goals are motivational variables affecting self-regulating strategies which focus on the reasons that students attempt to acquire success. Achievement goals are defined as target directions of students, their cognitive representation, and reasons for engagement in behaviors related to the achievement and norms which are used for judgment or evaluation of the performance [7]. Studying factors affecting academic achievement in math course have been considered over last three decades more than ever by the education experts. Findings in various studies indicate academic achievement in math course not only is influenced by knowledge structures and information processing processes, but also it is associated to motivational factors including beliefs, attitudes, values, and anxieties [8]. Some experts in math training field maintain that the living in the complex and advanced world necessitates having creative thinking and dynamic and productive thought and effective learning of math sciences can help formation and development of such thinking [4]. In fact, one of the concerns of educational system and teachers and especially students is test anxiety, academic achievement and creativity of students [9]. In the studies by Erisican, Mc.Chris and Lapointe[13] on academic achievement in math in Canada, Norway, and USA it was found that math self-concept is a strong predictor for academic achievement in math course in three countries. Also, according to the study by Kiamanesh [10]. on Iranian male and female students, math self-concept variable is considered as important factor in predicting math achievement. These studies which were conducted in Iran indicate there is positive relationship between attitude of Iranian male and female students toward math, and their math scores show this variable describe 1.2 and 0.8 percent of math score variance in Iranian female and male students, respectively.

REVIEW OF LITERATURE

Sobhaninejad and Abedi [11] studied relationship between self-regulating learning strategies and academic achievement motivation and academic performance of Isfahan high school students in math course. To this end, 180 high school students were selected using stratified sampling and proportionate to the sample size from the population of math students of high schools in Isfahan. Findings suggest significant relationship between self-regulating learning strategies and academic achievement motivation and academic performance of students in math course.

A study examined relationship between creativity and academic achievement in math course. The descriptive – correlation research method was applied. Sampling was done using cluster sampling and Torrance Creativity Questionnaire was used as research tool including 60 items. Kendall's tau was used for data analysis and research hypothesis was not supported. That is, creative students do not always obtain high scores in math course and its correlation is inverse [12].

Relationship between mathematical creativity, numerical talent and academic achievement in math was studied in a study. Mathematical creativity scientifically was considered as the ability to provide numerous, different and applicable answers. When the student was faced to a math problem in written, diagrammatic, or chart form, his creativity in problem solving was evaluated using author-made tools. Low correlation was found between scales of mathematical creativity, numerical talent, and academic achievement in math course, creativity, and problem solving. Correlation between talent and low academic achievement is more than relationship between creativity and academic achievement. In three schools, girls showed higher scores in creativity than boys [13].

In a study, it was assumed that problem solving related to Arabic logo games increases academic achievement in intelligent children. Thus, their creativity was measured based on Torrance creative thinking test and evaluation of math skills. Evaluation of the previous studies on factors affecting increased creativity indicates positive effects in most studies. One of applications for this study is that use of computer can increase creativity in intelligent students and if their goal for a work is specific, especially in ideas related to math, their creativity levels would be increased [14].

In the study by Lyons et al., parallel structural modeling was considered for testing one-dimensional theoretical models so that two aspects of math ability are measured simultaneously. There is good evidence for validity of conceptualizing two types of math ability. 1. Math ability, 2. Creativity. Each of

which is in four-aspect hierarchy. This study was conducted within 10 and 11 years (sample size = 1090). IQ scores indicate general academic ability which is predictive of the academic ability, not creativity. Math skills and creative thinking is predictor of creativity, but it is not a predictor of academic or mathematical ability. These findings led to a new approach for understanding mathematical abilities and provided reliable and valid psychometric instruments. Based on these two new tools, teachers can make difference between the individual structural methods and academic curriculum to act based on student needs.

RESEARCH THEORETICAL MODEL

Current work aims at comparing academic achievement in math course in music students and ordinary students. Thus, proposed academic achievement model is observed in Fig 1.

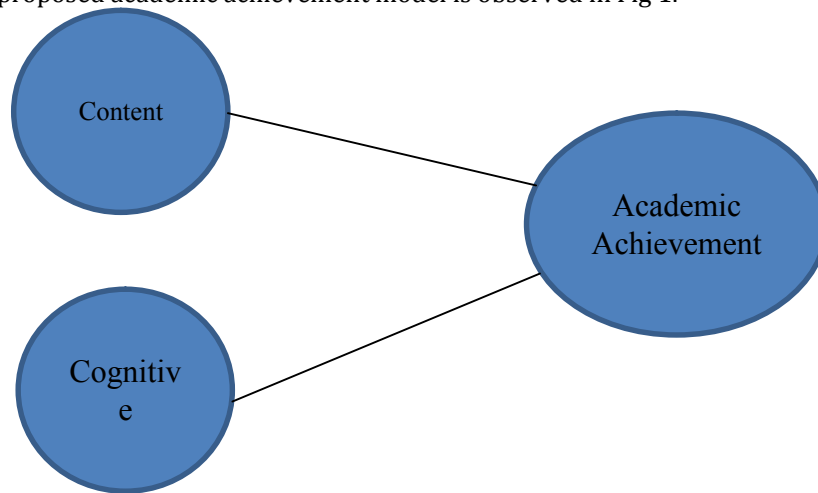


Fig 1. Research proposed model

Thus, research hypotheses include:

1. There is difference between TIMSS scores (achievement in Mathematics) in two groups of students from the music school and ordinary schools.
2. There is difference between TIMSS scores (achievement in Mathematics) in male and female students.
3. There is interaction between type of school and gender in describing TIMSS scores (achievement in Mathematics) in the students.
4. There is correlation between TIMSS scores (achievement in Mathematics) and math scores (first and last semesters) in students from music school and ordinary schools.
5. There is correlation between TIMSS scores (achievement in Mathematics) and math scores (first and last semesters) in male and female students.

STATISTICAL POPULATION, SAMPLE SIZE, AND SAMPLING METHOD

Statistical population includes third grade secondary school students in ordinary schools and music school in Tehran who studied during 2011 – 2012. Using sample size formula, it was calculated and estimated based on theoretical standard deviation and real difference in population and sample mean with 5 percent error level.

Considering possible loss of objects, a total of 100 third grade secondary school students were selected as the sample size, of these, 50 were from ordinary schools and 45 were from music school. 50 were females and 45 were males in terms of gender. In this study, a multi-stage sampling technique was used.

MEASUREMENT TOOLS

Following tools were selected for data collection:

1. Math mean grade
2. TIMSS test, for academic achievement in mathematics

Framework of TIMSS 2007 math questions is totally based on TIMSS 2007 evaluation framework. Basic structure of math framework is defined in content and cognitive aspects. These two aspects from TIMSS 2003 were left intact. TIMSS test is based on four-option items so that variety in performance and weaknesses and strengths of students in different academic areas of math and science can be investigated and compared. In all items regardless of the item form, statistical indexes include the number of students in each of participant countries, level of difficulty (percent of students who provided proper answer), and coefficient of determination (two-point correlation between success on the question and total score).

Regarding multiple choice questions, statistical indexes include percent of students who selected one choice. Also, percent of students who lost the item or did not reach it and two-point correlation between answer of each choice and total score is considered. Regarding answer making questionnaires with scale 1, 2, 3 scores, statistical index include coefficient of difficulty and coefficient of determination of each score.

CALCULATING RELIABILITY AND VALIDITY OF TIMSS ITEMS

In order to estimate reliability and validity of TIMSS items based on psychometric indexes, field test in the participant countries is conducted. Following determining level of difficulty and coefficient of determination for MCQs and answer making questions, statistical report (Almanac) is published in terms of the countries and it is provided for the member states. Following analysis of psychometric indexes, items which are not qualified in terms of reliability and validity are excluded and other items are replaced. Thus, statistical indexes related to reliability and validity of TIMSS items (2007, 1995, 199, 2003) are calculated not only for Iran, but also for all participant countries. All documentations related to item reliability and validity is published in technical and detailed reports of International Study Center (ISC) of Boston University and Data Processing Center (DPC) of Homburg, Germany. Implementing the first replication state of TIMSS entitled Re-implementation of Third International Mathematics and Science Study (TIMSS) (TIMSS 99) was started immediately after publishing TIMSS findings [10]. In this research, each answer-making question is scored as true (one unit score) and false (zero unit of score). Also, for increasing reliability level, math mean grade is also calculated.

DATA ANALYSIS

In this research, proportionate to the variables under study and type of data collected, indexes of central tendency, dispersion and distribution of scores were used, results of which are given in Tables 1 and 2. Considering nature of measurement scale and research hypotheses, two-way ANOVA and two-way MANOVA was used for data analysis in statistical analysis stage.

Table 1: Summary of descriptive indexes of students' scores (music group = 50, and ordinary group = 45) in TIMSS test and math scores

Group	Variable	Mean	SD	Skewness	Elongation	k-s	P
Music	TIMSS	22.40	3.33	-0.476	0.546	0.930	0.353
	Math score in first semester	17.54	2.60	-1.220	0.961	1.222	0.101
	Math score in last semester	17.16	2.90	-1.081	0.524	1.370*	0.047
Ordinary	TIMSS	18.64	5.27	-0.111	-0.940	0.774	0.586
	Math score in first semester	16.35	3.38	-0.565	-0.995	1.067	0.205
	Math score in last semester	15.73	3.71	-0.934	0.524	0.921	0.364

P < 0.05*

According to above information, distribution of students' scores (in music and ordinary groups) in TIMSS test and math scores and different descriptive indexes including mean, SD, indexes of skewness and elongation and results of Kolmogorov – Smirnov normality test (except math score in last semester of music students $p < 0.05$) indicate that distribution of sample group scores in measured variables tend to normal distribution.

Table 2: Summary of descriptive indexes of students' scores (female group = 50, and male group = 45) in TIMSS test and math scores

Group	Variable	Mean	SD	Skewness	Elongation	k-s	P
Female	TIMSS	21.50	4.63	-0.903	-0.043	1.322	0.061
	Math score in first semester	17.35	2.94	-0.990	-0.281	1.466*	0.027
	Math score in last semester	17.42	2.59	-0.692	-0.775	1.272	0.079
Male	TIMSS	19.64	4.69	-0.377	0.134	0.752	0.624
	Math score in first semester	16.56	3.13	-0.832	-0.214	0.919	0.367
	Math score in last semester	15.44	3.83	-0.899	0.072	0.952	0.326

P < 0.05*

According to above information, distribution of students' scores (in music and ordinary groups) in TIMSS test and math scores and different descriptive indexes including mean, SD, indexes of skewness and elongation and results of Kolmogorov – Smirnov normality test (except math component in first semester $p < 0.05$) indicate that distribution of sample group scores in measured variables tend to normal distribution.

RESEARCH FINDINGS

Considering research hypotheses, the number of dependent variables and type of data was obtained and two-way ANOVA and two-way MANOVA were used. Detailed explanation of statistical calculations based on the hypotheses is given below. Table 3 gives Lyon's equality of error variance test and Table 4 gives multivariate tests and finally Table 5 provides a summary of Pearson correlation coefficient between variables.

Table 3: Summary of Lyon's equality of error variance test

Variable	F	Df1	Df2	Sig. Probability
TIMSS	0.627	3	91	0.599

Given F statistics and their significance probability, assumption of variance consistency is supported in TIMSS scores.

Table 4: Summary of multivariate tests

Source of Change	Sum of squares	Degree of freedom	Mean of squares	F	P	Chi-Ita
School	3837.009	1	3837.009	24.532	0.000	0.212
Gender	553.471	1	553.471	3.539	0.063	0.037
School * Gender	276.821	1	276.821	1.770	0.187	0.019
Error	14233.240	91	156.409			
Sum	1806369.00	95				

Consider F statistics with degree of freedom 91 and 1, null hypothesis can be rejected only regarding school type variable ($p < 0.01$). In other words, there is significant difference between mean score of TIMSS test simultaneously in music and ordinary school students, and students of music school and ordinary school can be distinguished based on TIMSS test score. The size of difference effect is relatively average concerning Chi-Ita (0.212). Overall, Chi-Ita (0.212) suggests relatively average relationship between type of school and TIMSS test score. Thus, there is enough evidence to support H1.

F statistics on the main effect of gender variable and interactive effect of school type and gender suggest lack of statistical significance. Hence, there is not enough evidence to support H2 and H3.

Table 5: Summary of Pearson correlation coefficient results (N = 95)

Variable	TIMSS Score
First semester math scores	0.540**
Last semester math scores	0.648**

** $p < 0.01$

Above table shows correlation coefficients between variables in the whole subjects. Results suggest there is positive significant correlation between first and last semester math scores and TIMSS score ($p < 0.01$). Thus, there is enough evidence to support H4 and H5.

DISCUSSION AND CONCLUSION

Results obtained in H1 indicates there is significant difference between mean score of TIMSS simultaneously in music students and ordinary students, and music school students and ordinary school students can be distinguished based on TIMSS test score. Thus, there is enough evidence for accepting H1, which is consistent with findings by domestic studies such as Ghasemtabar et al and Sobhaninejad [11] indicating presence of significant difference between TIMSS scores of music students and ordinary students. It is also consistent with findings by foreign studies by Gardener, Harris [18], and Subhi [14]. However, it is not consistent with findings by Lyons (2006) showing creativity cannot predict academic ability or mathematical ability. Thus, it can be stated music intelligence is considered as one the main components of intelligence which describes importance of music in learning and training and generally in human life. Training music can play considerable role in increasing counting and calculation skills. As shown in the studies, there is relationship between learning strategies and academic achievement motivation and academic performance. Also, training music can facilitate learning and it can be a motivation for academic achievement. Overall, it can be stated music influence on learning math skills in undeniable.

Results obtained in H2 indicate there is no significant difference between means of TIMSS test in male and female students and male and female students cannot be distinguished based on TIMSS test score. Thus, there is not enough evidence to support H2. Findings in domestic and foreign works do not report gender differences in this regard. It can be said considering findings; boys and girls have identical expectations for success in math and probably show similar performance. Overall, gender stereotypes related to the math curriculum for boys have been modified and there is no difference in mathematical

problem solving and interest in math between the sexes and both sexes tend to learn and progress in math and show the same tendency.

Findings on H3 indicate there is not significant interaction between means of school type and gender in describing variance of TIMSS test scores and type of school or gender cannot predict achievement in math course. Thus, there is not enough evidence to support H3, which is consistent by findings in domestic works such as Golestan *et al* [16]. representing lack of influence of gender and school on achievement in math course. It is also consistent with findings in foreign works such as Lyons *et al.* (2006). However, it is not consistent with findings by Rahnama *et al.* (2009) and Jensen (1973) and Ling (2006). Thus, it can be concluded age and gender are regarded as weak predictors of academic achievement in math course in schools and university. Even it was found in scales of math creativity, creativity numerical talent, math academic achievement, creativity and problem solving in university, and studies showed even math ability and creative thinking are predictors of creativity in both sexes. Type of school cannot describe achievement in math course, since academic achievement is mostly dependent on motivation of students and teaching quality of teachers.

Findings related to H4 show there is positive significant correlation between mean scores of math in first and last semesters and TIMSS score which is consistent with findings by Bahar *et al.* [17] and Naderi [19] showing relationship between math motivation and achievement in math course. However, previous evidence for supporting H4 is not enough. Thus, it can be stated math self-concept is regarded an important factor in predicting achievement in math course. Both creativity in math course and academic achievement in this course increases at all levels and educational grades simultaneously. However, few studies have been conducted in this regards and mostly existing studies did not consider demographic variables as moderator variable.

Results for H5 indicate there is positive significant correlation between mean scores of math in first and last semesters and TIMSS score in male and female students. Hence, there is enough evidence to support this hypothesis which is consistent with findings by Islami and Rahnama [20] showing relationship between math motivation and achievement in math course in girls and boys. It is also consistent with findings in foreign works such as Jensen (1973) and Naderi (2010). However, it is not consistent with findings by Kourvand [15]. As mentioned, gender difference is not observed in tendency to math course. Also, no gender difference is observed in achievement in math course in girls and boys. Based on their mean scores in first and last semester, achievement in math course can be observed in both girls and boys.

RECOMMENDATIONS

- This research can be conducted in other academic grades.
- Family, economic, social, etc. variables can be controlled as much as possible in the future works.
- Future works can consider importance and situation of music in curriculum of students.
- Future studies can inform teachers and instructors to promote music training and its impact on learning math and creativity in students.

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