



The Impact of Education Based On Multiple Intelligences in Increasing the Willingness to Learn Mathematics among Primary High School Students

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A B S T R A C T

This study aimed to investigate the impact of education based on multiple intelligences in increasing the willingness to learn mathematics among primary high school students in Esfahan district one. This study is practical in nature and data are quantitative and the method of study is descriptive and survey. Besides, it is a quasi-experimental research with a pre-test and post-test design. The statistical population included all primary high school students in Esfahan district one, while 40 of them were chosen randomly through simple random sampling and they were classified randomly as well. The instrument of the study were two questionnaires including an 80-item questionnaire of multiple intelligences by Gardner (2004) and an 18-item questionnaire of Corter (2007)'s willingness to learn mathematics with three subscales, including "willingness to learn math", "math self-esteem" and "intrinsic motivation to learn math". Face validity of the questionnaire was approved and Cronbach's alpha was obtained %76 and %84 respectively for two questionnaires in order to confirm the reliability of the instruments. Results showed that education based on multiple intelligences made a significant achievement in the low group when it was compared with the high group and it reduced the difference between the two groups. The components of willingness to learn math and intrinsic motivation of math in low group increased when it was compared with the high group. Thus, students are more willing to learn math. But in the component of math self-esteem no significant difference was found between the two groups of students in the high and low groups.

Keywords: Multiple Intelligences, Willingness To Learn Mathematics, Love Mathematics, Mathematics Self-Esteem, Intrinsic Motivation To Learn Mathematics.

INTRODUCTION

Today, the rate of science development is increasing per second, therefore, education and teaching methods have been influenced by development in technology, changing tastes and the students' needs and expectations. So today, a teacher should teach the students how to learn and experience not just to transfer information and relations between each other. Therefore, new methods and procedures should be founded on this basis (Backhouse & Oliveira, 2006; Hansen, 2012). Mathematics is a science with abstract and intellectual concepts. In other words, many math concepts are visions of objects that their subjective interpretation is not possible in the real world. The abstract issues in mathematics make it difficult to understand these concepts, so it is hard to teach and learn math and finally it influenced on the students' willingness to learn math. Thus, teaching math requires special teaching methods. Teaching

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methods at first should be practical so that students can create the needed abilities in themselves to understand them. According to the studies, it can be said that there is a strong relationship between the learning and teaching methods (Lee, Park, & Taylan, 2011; Yamaguchi & Okada, 2018).

The intelligence is regarded as one of the significant aspects of human adjustment with "environment" and an important factor in difference of human beings. Intelligence based on its components has been of interest to scholars in this field. Some scholars regard intelligence as a single nature. Some others believe it has numerous components and categories (Hashemi, Bahrami, & Karimi, 2006). According to the traditional views, human intelligence has a simple, integrate and single-factor nature and it rooted in efforts related to the recognition of the main factor for the students' educational success in the early twentieth century (Gardner & Moran, 2006). These efforts led to designing a tool titled Intelligence Quotient (IQ) which is widely used in educational systems. Gardner stated that intelligence has different types, forms and manifestations, and he emphasized on the fact that human beings have different intelligence profile. Therefore, it changed to the source of extensive intellectual and practical movements (theoretical) in some education systems in the world while they were relying on the concept of multiple intelligences in order to create a variety in the educational programs (Ameenee, Tamanaaeefar, & Ameenee, 2010; Pritchard, 2017).

Gardner, the contemporary psychologist, for the first time presented a definition for the intelligence term as the ability to create effective product, or valuable service in a culture, and he challenged the traditional conception of intelligence and categorized eight different types of intelligence. These categories include: Verbal-Linguistic Intelligence, Logical-Mathematical Intelligence, Visual-Spatial Intelligence, Bodily-kinesthetic Intelligence, Musical Intelligence, Interpersonal Intelligence, Intrapersonal Intelligence and Naturalistic Intelligence (Gardner, 2011).

Gardner's theory is not limited to just eight intelligences or eight abilities. He believed that there are probably more than 8 intelligences and in one of his works (1990) he referred to "spiritual" and "existential" intelligences. He meant to acknowledge the abilities of thinking about great questions related to the meaning of life (Slavin, 2019). This theory provides new ways for different people so that they have opportunities to learn through their appropriate ways. Gardner proposed some ways in which during the education process, they pay more attention to people who are able to offer alternatives around in order to realize their educational needs.

According to Gardner, multiple intelligences can play an important role in learning and teaching to the students. Being aware of the theory of multiple intelligences has provoked the teachers to find many different ways to help all students. Gardner believed that the basis of multiple intelligences theory is to respect to individuals' differences, the variety of learning methods, methods of assessment and different effects left by the differences (Armstrong, 2009). Multiple intelligences theory has provided an effective model to understand how all people learn regardless of gender, ethnicity, cultural texture or socio-economic status (Baleghizadeh & Shayeghi, 2014; Niroo, Nejhad, & Haghani, 2012; Teele & Teele, 2000).

The theory of multiple intelligences can be used as a model in structural strategies in order to make the students successful. When students are actively involved in the learning process, and they believe that they actively and effectively participate in the learning process, so they are more motivated to learn (Armstrong, 2009).

Today mathematical knowledge is regarded as a tool to understand the international community and its development and it is very important and it should be taken into account by the government planners. Regarding the mathematical studies at the highest levels, developing the cooperation and academic exchanges between mathematic field and other industrial sectors, promoting new education level, making math general can make it reasonable to achieve sustainable development and realize the goals faster (Beaton, 1996).

Basically, math teaching should be accompanied by encouraging the students to explore, preparing them to study, making them accused to logical thinking, persuading them to ask questions, making their mind creative and making willingness to learn math. Since the modern uses of mathematics have gone beyond curriculum framework of this science (number and geometric shapes), the mentioned skills can be taught to the students through effective and new methods of teaching (Chang & Beilock, 2016; Davies, Janus, Duku, & Gaskin, 2016; Topping, Campbell, Douglas, & Smith, 2003).

In Iran, the traditional methods of teaching and learning math are used in most of the schools and some of these methods basically have problems especially if they are used from elementary school which resulted in irreparable problems for the students since teaching math in elementary school is really inappropriate. No new and appropriate method is used to teach mathematic concepts in elementary schools and the students learn math incorrectly which may lead to incorrect understanding of math and the students' unwillingness to learn math in a large group of students in future (Nevgi, Virtanen, & Niemi, 2006).

An important use of intelligence is to consider the individual differences in the curriculum in the classroom by teachers. Teachers should be aware of the students' cognitive levels and they should teach based on them. Good teachers help their students to organize or reorganize their experiences in complicated forms and more appropriate ways (Akpınar, Yıldız, Tatar, & Ergin, 2009). Basically, the issue of human intelligence is involved with all the cognitive processes of human. As Binet (1905) has pointed out: "good understanding, good reasoning, good judging are all main activities of the intelligence." Although there is not much difference in relation to the general nature of intelligence, psychologists have studied and used this concept for many years and in very different ways. One person who recently stepped into this field and he provided a relatively new theory is Howard Gardner (Walters, 1992).

The traditional approach to teach mathematics sufficed to activate the logical-mathematical and verbal-linguistic intelligence of students and the students who benefit from a high logical-mathematical intelligence can learn well (Razmjoo, 2008). The poor performance of education systems in the TIMSS international test led to many studies in this field to determine the reasons for lack of academic achievement, particularly in mathematics (Clarke, 2004; Givvin, Hiebert, Jacobs, Hollingsworth, & Gallimore, 2005; Good & Brophy, 1986). The results of many studies in this field have shown that the improvement of teaching quality has an important role in increasing the academic achievement of students in mathematics (Maleki Avarsin & Mostafa Pour, 2015; Walberg & Haertel, 1992). Since the previous studies have shown that in the

traditional educational system, the only students who can advance are the ones with high logical-mathematical and verbal-linguistic intelligences, the students with different talents are regarded stupid and unintelligent. Thus, it can be assumed that unsuccessful students are low in logical-mathematical and verbal-linguistic intelligences, but it is possible that they are in a high level of other intelligence components (Mohammadian & Baezzat, 2009). Armstrong (2009), in his study found that progression of Maryland School students after one year of using multiple intelligences technique was twenty percent. Within a year, they were taught how to evaluate their strengths and weaknesses in the multiple intelligences and how to use multiple intelligences in learning efficiently.

Lee et al. (2011), believed that willingness to learn math may be the result of a process consisting of multiple factors affecting the level of interest, intrinsic motivation and self-esteem which increase mathematics learning that leads to the students' educational achievement. In this regard, the students' scores in math were used as a component of willingness in order to examine math teaching by using multiple intelligences in experimental and control groups. In the traditional method, teacher focus on activating logical-mathematical and verbal-linguistic intelligences which enable the students who benefit from a high logical-mathematical intelligence to learn more. However, there is only 25% of students how benefit from this intelligence in a high level, while by designing some activities related to other intelligences, other students can be helped to learn math (Akpınar et al., 2009). Therefore, this study aimed to prove the hypothesis that the education based on multiple intelligences increase the willingness to learn mathematics among primary high school students in Esfahan district one.

METHODOLOGY

This research is practical in nature and the data are quantitative and the research method is empirical (experimental) and the design of study is pre-test and post-test and the purpose of the study is comparison. The statistical population included third grade high school students in Esfahan district one, but since it is an experimental research with a pre-test and post-test design, a total of 40 students were selected by random cluster sampling. Therefore, among active primary high schools in Esfahan one school was chosen randomly and then among third grade classes, one class was chosen randomly. Then, a pre-test was taken from the students and after that they were taught based on the theory of multiple intelligence and later a post-test was held. To measure each of eight-factor components of intelligence, an 80-item questionnaire of multiple intelligences by Gardner (2003), was used and to measure students' willingness to learn math, an 18-item questionnaire by Carter, Hawkins, and Natesan (2008), was used. Corter's questionnaire consists of three subscales, including "willingness in math", "math self-esteem" and "intrinsic motivation to learn mathematics". Besides, the students' scores in pre-test and post-test were used as educational achievement score and a sign of increasing students' willingness to learn math. Validity of the questionnaire was face validity and Corenbach alpha was used to measure the reliability of the questionnaires as the reliability of Gardener's multiple intelligences questionnaire was measured 76% and Corter's willingness to learn math was measured 82%.

Before education course, the questionnaire of identifying multiple intelligence profile was distributed as Martin (1998) stated that 25% of students benefit from high level of logical-mathematical intelligence and they are classified in the high group, and 25% of students have low level of logical-mathematical intelligence and they are classified in the low group. In the first session, the students who were unaware of the content of education course were asked to complete the questionnaire of willingness to learn math and then they were given a test about vectors and coordinates as a pre-test. Afterwards, regarding Gardner's theory of multiple intelligences, they were taught vectors and coordinates during three 70-minute sessions and they were asked to complete the questionnaire of willingness to learn math once more. After completion of the course to assess student learning vector and coordinate, they were post-tested to determine how much they learnt. Following the distribution of multiple intelligence questionnaire to identify the profile of intelligence and especially logical - mathematical intelligence in each of the students and identifying high and low groups, the calculations were done and the mean scores of the two groups were determined from 100 which have been shown in the following figure. As it can be seen, the mean score of mathematical-logical intelligence in the low group was about half of the high group. In this research, to test the hypotheses, paired t-test and independent t-test were used. Data analysis was performed by using SPSS.

RESULTS

To investigate the impact of education based on multiple intelligences in both high and low group of logical-mathematical intelligence, the mean scores of pre-test and post-test groups were compared with each other. The results have been shown in Table 1. As it can be seen, the mean difference in the pre-test is significant while in the post-test this difference significantly decreased.

According to Table 1, it can be stated that education based on multiple intelligences results in significant academic achievement of the low group compared with the high group and it reduced the difference between the two groups. Thus, t-test for two independent groups also showed no significant difference between the two groups in mean scores of post-test. However, in the pre-test, the mean scores were significantly different in both groups.

Table 1. Comparison of pre-test and post-test mean scores in two low and high groups

Groups	Pre-test	Post-test	Mean	Std. deviation of pre-test	Std. deviation of post-test
High group	13.34	14.1	28.01	2.58	3.93
Low group	11.01	13.4	38.99	1.66	2.72
The difference between two groups	1.21	0.92	10	0.7	2.33

Table2. T table results in two dependent group

Test	t-test to compare the mean scores				
	t	Df	p	Mean difference	Std. deviation difference
Pre-test	2.399	18	0.027	2.33	0.971
Post-test	0.463	18	0.649	0.700	1.510

According to the above table, there is a significant difference between the mean scores of

two high and low groups in the pre-test. On the other hand, there is no significant difference between the mean scores of two high and low groups in the post-test. Accordingly, due to deletion of significant difference between the mean scores of two groups and after education course, the first hypothesis of the study is confirmed and the hypothesis is the impact of education based on Gardner's multiple intelligences theory on educational achievement of students with high and low levels of logical-mathematical intelligence is different. Regarding the increase in post-test mean scores of the low group compared with the high group, it is concluded that the effectiveness of education based on Gardner's multiple intelligences theory increases math achievement of students with low logical-mathematical intelligence, and these students showed more willingness to learn math.

Table 3. Comparison of pre-test and post-test mean scores in two low and high groups in math willingness

Test	Component	Group	Mean	Std. deviation	Mean of std. deviation
Pre-test	Willingness to learn math	High	70.31	3.27	1.03
		Low	10	1.89	0.60
Post-test	Willingness to learn math	High	10.4	4.09	1.29
		Low	60.2	2.98	0.94

Table4. T table results in two dependant group

Test	Component	t-test to compare the mean scores				
		t	Df	p	Mean difference	Std. deviation difference
Pre-test	Willingness to learn math	2.178	18	0.043	2.7	1.414
Post-test	Willingness to learn math	1.068	18	0.3	1.5	0.562

According to the above table, there is a significant difference between the mean scores of two high and low groups in the pre-test. On the other hand, there is no significant difference between the mean scores of two high and low groups in the post-test. Accordingly, due to deletion of significant difference between the mean scores of two groups and after education course, the second hypothesis of the study is confirmed while the hypothesis is the impact of education based on Gardner's multiple intelligences theory on math willingness of students with high and low levels of logical-mathematical intelligence is different. Regarding the increase in post-test mean scores of the low group compared with the high group, it is concluded that the effectiveness of education based on Gardner's multiple intelligences theory increases math willingness of students with low logical-mathematical intelligence, and these students showed more willingness to learn math.

Table 5. Comparison of pre-test and post-test mean scores in two low and high groups in math self-esteem

Test	Component	Group	Mean	Standard deviation	Mean of std. deviation
Pre-test	Math self-esteem	High	30.12	4.32	1.37
		Low	40.12	3.06	0.97
Post-test	Math self-esteem	High	50.4	4.97	1.57
		Low	80.2	5.30	1.68

Table6. T table results in two dependent group in math self-esteem

Test	Component	t-test to compare the mean scores				
		t	Df	p	Mean difference	Std. deviation difference
Pre-test	Math self-esteem	0.018	18	0.986	-0.1	1.134
Post-test	Math self-esteem	1.306	18	0.208	1.7	0.460

According to the above table, in the self-esteem component; there is no significant difference between the mean scores of two high and low groups in the pre-test. Thus, the third hypothesis of the study is denied so the impact of education based on Gardner's multiple intelligences theory on math self-esteem of students with high and low levels of logical-mathematical intelligence is not significantly different.

Table 7. Comparison of pre-test and post-test mean scores in two low and high groups in intrinsic motivation

Test	Component	Group	Mean	Std. deviation	Mean of std. deviation
Pre-test	Intrinsic motivation	High	50.4	2.17	0.69
		Low	20.9	3.43	1.08
Post-test	Intrinsic motivation	High	4	4.76	1.51
		Low	5	2.94	0.93

Table8. T table results in two dependent group in intrinsic motivation

Test	Component	t-test to compare the mean scores				
		t	Df	p	Mean difference	Std. deviation difference
Pre-test	intrinsic motivation	4.132	18	0.001	5.3	0.641
Post-test	intrinsic motivation math	0.636	18	0.533	-1	0.787

According to the above table there is a significant difference between the mean scores of two high and low groups in the pre-test. On the other hand, there is no significant difference between the mean scores of two high and low groups in the post-test. Accordingly, due to deletion of significant difference between the mean scores of two groups and after education course, the fourth hypothesis of the study is confirmed while the hypothesis is the impact of education based on Gardner's multiple intelligences theory on intrinsic motivation of students with high and low levels of logical-mathematical intelligence is different. Regarding the increase in post-test mean scores of the low group compared with the high group, it is concluded that the effectiveness of education based on Gardner's multiple intelligences theory increases intrinsic motivation of students with low logical-mathematical intelligence, and these students showed more willingness to learn math.

CONCLUSION

Regarding the importance of teaching and its fundamental role in achieving educational objectives in theoretical and practical fields and with the emphasis on the effective teaching, the present study aimed to examine Gardner (1990), theory, in which it was stated that the traditional method just enable teachers to activate the verbal-linguistic and logical-mathematical intelligences of students. Besides, This study aimed to investigate the impact of education based on multiple intelligences in increasing the willingness to learn mathematics among primary high school students in Esfahan district one.

To investigate the impact of education based on multiple intelligences in both high and low groups of logical-mathematical intelligence, the mean scores of pre-test and post-test groups were compared. The results showed that the difference between two groups in pre-test was significant, but the difference between two groups significantly decreased in post-test. The t test for two independent groups also confirmed no significant difference between the two

groups in the means of post-test. Accordingly, due to deletion of significant difference between the mean scores of two groups and after education course, the first hypothesis of the study is confirmed while the hypothesis is the impact of education based on Gardner's multiple intelligences theory on math willingness of students with high and low levels of logical-mathematical intelligence is different. Regarding the increase in post-test mean scores of the low group compared with the high group, it is concluded that the effectiveness of education based on Gardner's multiple intelligences theory increases math willingness of students with low logical-mathematical intelligence, and these students showed more willingness to learn math. In this way, the results can be explained by Pasha Sharifi (2005), who concluded that these students no more are called stupid and unintelligent. The results of this study are consistent with Gardner's findings when he denied many people's opinions that the logical-mathematical intelligence is more substantial and urgent than the other intelligences, and they believe just mathematical logic is the key to solve the problems. In fact, there are many logic such as math, language, visual and so on which have different strengths and limitations, while each of them acts according to its own rules. Therefore, the strongest mathematical logic in these areas cannot solve their issues. As there are numerous methods in reasoning and solving math problems and since people take advantage of different intelligences, it is not surprising that the students with low logical-mathematical intelligence revive and use other means of mathematical reasoning arose from intelligence multiple, and they solve problems with students who benefit from high logical-mathematical intelligence.

Other findings of this study considered the willingness to learn math in pre-test and post-test. Thus, there is a significant difference between mean scores in two high and low groups in pre-test, while no difference was found in post-test. Accordingly, due to deletion of significant difference between the mean scores of two groups and after education course, the second hypothesis of the study is confirmed while the hypothesis is the impact of education based on Gardner's multiple intelligences theory on math willingness of students with high and low levels of logical-mathematical intelligence is different. Basically, all internal and external motivating factors that encourage the students to learn math meaningfully, can be defined as willingness to learn math. These factors can even be a function of time and conditions and educational resources. Gardner and Moran (2006), believed that boredom and apathy towards mathematics may root in the students' first confrontation with math in elementary schools. However, textbooks are often intensive and passive and also limitation in time of mathematic class make teachers worried about the program and it does not give the possibility to work more with students. However, in conditions that both textbook and teacher are good and teacher knows the "art" of being a good teacher, the personal efforts of students also can eliminate some of the negative factors. When teachers benefit from teaching methods related to the multiple intelligences, then the students get involved with learning which can create interest in students to learn math.

Thus, it was found that after utilizing this method, the results of post-test showed that the students' academic achievement and academic interest have been desirable. On the other hand, according to the significant difference between both groups in willingness to learn mathematics and increase in mean scores of the low group, it should be stated that this type of teaching mathematics compensates shortcomings arising from lower logical-mathematical

intelligence in this group. Meanwhile, some researchers found that teachers who used teaching methods based on multiple intelligences were more satisfied with the obtained results and they described mathematics learning motivation with higher quality and depth.

But another finding of this study showed that in math self-esteem component, no significant difference was found between the two groups in pre-test and post-test. So the third hypothesis of the study is denied as in math self-esteem component, no significant difference was found between the high and low levels of logical-mathematical intelligence. The issue of self-esteem affects and is affected by cognitive processes, attitudes, needs, interests and aspirations of the people. Academic interest in mathematics is also affected by students' self-esteem. According to many researchers' observations, some learners fail in education without any physiological reason and mental disability and after doing some studies they found that this mental failure is internal not external. Basically, Mathematics self-esteem can be defined as a value that one learner consider in himself for learning mathematics. Studies have shown that the students' awareness of themselves originated from their past experiences of success and failure in learning math. It emphasized the role of education based on the theory of multiple intelligences on mathematics learning which increases math self-esteem in students.

The other finding of this study is related to intrinsic motivation which is significantly different in pre-test between two high and low groups, while no significant difference was found in post-test. Accordingly, due to deletion of significant difference between the mean scores of two groups and after education course, the fourth hypothesis of the study is confirmed the hypothesis is the impact of education based on Gardner's multiple intelligences theory on intrinsic motivation of students with high and low levels of logical-mathematical intelligence is different. So people with intrinsic motivation feel more competent in themselves and they don't allow other to affect their behaviors. This group of students determines their behaviors and because of their incompetence which they feel, they believe that their behavior can affect their environment. This group of students who are introverted in motivation assume that the success and failure in school is because of their right or wrong behavior. It should be noted that the teachers' behavior is a factor affecting students' intrinsic motivation.

According to Corter (2007) the methods that some teachers use in teaching and creating intrinsic motivation to increase the students' willingness to learn math is very important. He believed that some teachers benefit from motivational styles of harness and control to create intrinsic motivation in students. However, some other teachers try to create intrinsic motivation in students by supporting their interests and making self-esteem in them. Gardner (2006) believed that motivational style of teacher in creating intrinsic motivation has a positive and significant impact on students. It is surprising that in field of intrinsic motivation for learning mathematics, the highest difference of mean was in pre-test of two groups regarding education based on multiple intelligences theory. There are some studies which are in line with the result of present study. For example Köksal and Yel (2007), can be pointed out. The researchers showed that by increasing the intrinsic value of students, their sense of competence in solving mathematical problems increase as well. Also, students who are motivated to learn more are able to achieve more. Based on this method, they found that students with high self-esteem were able to recall more details. Motivational and emotional results make their learning easier and better. This issue caused that more assuring information be used in processing

information.

In general, the following suggestions can be considered to explain the results of this study well.

1. Schools should know each student's intellectual profile and present it to teachers to encourage them to use the superior intelligences of students and to strengthen their weaker intelligences in teaching.

2. Since the education system highly focuses on traditional methods of teaching and teachers have been affected by this view, so it is the teachers who have to show creativity in applying methods of teaching and assessment and etc. regarding multiple intelligences and this issue necessitates the collaboration between officials and teachers.

3. Since teachers are mostly interested in teaching math through traditional methods, it is suggested to officials to make the teachers familiar with methods of teaching which are related to multiple intelligence and to held educational courses in workshop and practical activities in order to make the teachers familiar with this method scientifically and practically.

4. The educational groups in Education department should develop textbooks with teaching models based on the theory of multiple intelligences in various subjects.

5. Festivals to introduce the best models of teaching should be held, to encourage, promote, engage and deepen active teaching-learning methods, including the use of multiple intelligences.

6. Based on the obtained results, the education based on multiple intelligences in higher cognitive levels has been more effective, so teachers should strengthen the teaching methods which are related to reinforcing high levels.

7. Some exhibitions of students' achievement and the used intelligence in creating it should be held and the titles and the names of the owners of the works should be presented in order to promote the theory of multiple intelligences for visitors and students.

8. The signs or pictures of celebrities should be used in one or more prominent display of multiple intelligences in the school grounds in order to appreciate the abilities of students in all aspects in form of their intelligences types.

9. Various centers should be established in schools based on each of the intelligences to attract the students and encourage them toward educational activities for all students with intellectual profile.

10. The students' assignments and projects should be determined and also the establishment of reward and punishment system according to aspects of intelligence of each student by school teachers and educators.

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