

A comparison of the effectiveness of game-based and traditional teaching on learning and retention of first grade math concepts

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ABSTRACT

The purpose of the present research was to compare the effectiveness of game-based and traditional teaching in learning and retention of first grade math concepts. The population of the research consisted of all the female students of Khorramabad Province. The participants were selected using cluster sampling and were randomly divided into an experimental and a control group (31 participants in each group). The participants in the experimental group were taught according to game-based teaching and the participants in the control group underwent traditional teaching. The learning test and the retention test were conducted one week and three weeks after teaching each method. Data description was done using mean and standard deviation and data comparison was done using independent t-test and effect size (ES). The results showed that the experimental group had higher scores in learning tests (except for the concept of correspondence) and retention tests (concepts of left and right, correspondence, equality, less than and greater than signs, and addition and subtraction) ($p \leq 0.05$). It can thus be concluded that using educational games in teaching of first grade math concepts can be remarkably helpful and efficient.

Keywords: Math concepts, game-based teaching, traditional teaching

INTRODUCTION

Childhood is characterized by its close link to games. The concept, process, and benefits of games have always been considered by researchers. According to Buytendijk, games exist because of childhood [4]. Games provide children with opportunities to be creative and increase their abstract thinking; they serve as basis for optimal development of physical, social, emotional, and cognitive aspects in children [7]. By playing games, children have the chance to create a world where they dominate and can thus overcome their anxieties [10]. Games enable children to practice the skills required for facing future challenges; they can be regarded as a part of the educational environment that

enable adaptation with school environment and help children learn, develop their emotional and social abilities, and improve their problem solving and abstract thinking [6]. There are teachers and educational policymakers with extreme ideas who believe that games waste the time that can be devoted to more learning. From this viewpoint, games have no clear educational achievements [12]. Research has shown that reduced time of games and physical activities in schools are often justified by increased time devoted to reading skills and mathematics [7]. Math is one of the main courses that are taught from first grade elementary school. Not only does it play a significant role in different academic stages, but it also helps children develop analytic skills, problem solving abilities, and critical thinking. However, the research over the past few decades has shown that children have often had negative attitude toward and poor performance in math. Although there is no consensus among researchers regarding the reasons for such a negative outcome [14], shortcomings in syllabi, materials and contents, and educational methods, inappropriate course books, inefficient and inexperienced teachers, and lack of motivation in learners are some of the factors that have been highlighted along with gender and ethnic factors as the reasons for negative attitude toward math course, especially in Third World countries [14]. UNESCO published a book in 2003 regarding learning math concepts through games during the first three grades of school and, instead of viewing games and learning as opposing forces, it mentions games as a desirable means for enriching the educational climate of schools [14]. The review of Johnson et al. (1998) of 168 studies between 1924 and 1997 showed that cooperative learning improves learning, self-esteem, and the quality of interpersonal relationships as compared to individual or competitive learning. The review of Singer et al. (2006) of 37 studies indicates that, compared to individual learning, cooperative learning not only improves the attitude of students, but it also enhances their retention [17]. However, investigation of elementary math books and teaching methods shows that game has rarely been incorporated into this course and teachers seldom use games for teaching math concepts. Despite the numerous advantages of games in developing the physical, mental, emotional, and social abilities of children, it has been shown that the time dedicated to games has considerably decreased in recent years, in both schools and kindergartens—conditions in which the time of games has been compromised by course programs [7 & 12]. The present research tries to study and compare the effectiveness on two teaching methods (game-based and traditional) on learning and retention of first grade math concepts.

MATERIALS AND METHODS

The present research is experimental with a pretest-posttest design. The population of the research consisted of all the first grade female students of Khorramabad City who were studying at the period 2008-2009. The participants were selected using multi-stage random cluster sampling. First, one school was randomly selected from the schools of Khorramabad and then two grade 1 classrooms were randomly selected. Finally, the teaching method of each classroom was assigned by chance. The experimental group started learning math through games and the control group underwent the traditional teaching method. Each classroom included 31 students. To administer the teaching program, first a session was held with the parents of students in the experimental group where the aims of the research were elaborated and it was guaranteed that supplementary classes (6 traditional sessions) would be held at the end of the research period. During three sessions before the onset of the research, the teacher of the experimental group was familiarized with game-based teaching methods and a specific syllabus was created for each math session. This syllabus included the learning and behavioral purposes, the games required for teaching the concepts, and the teaching and learning activities within the time of each session (45 minutes). Beside the math course book, the teaching materials included a hula hoop, a rope, a light large ball, a light small ball, a basket, and number cards. The games used for teaching math concepts included numbers game, grabbing the handkerchief, one-way street, songs, and so forth; for instance, one-way street game was used to teach directions. It must be noted that the research environment was equal for both groups. Assuming that the first grade students had not officially learned any math concept, the learning and retention tests were conducted one and three weeks after teaching each concept. The tests were conducted simultaneously and with the same content for both groups. The tests were designed by the teacher and were based on the concepts of first grade math book (2008-2009). The face and content validity of the tests were confirmed by experienced teachers and mathematicians. The data was analyzed using descriptive statistics (mean, standard deviation, etc.), independent t-test (between-group comparisons), and effect size (ES). The statistical operations were done in SPSS 15 and Effect Size Calculator at the 0.05 significance level.

RESULTS AND DISCUSSIONS

The descriptive statistics and the results of independent t-test are presented in Table 1. The results show that there is a significant difference between the two groups in learning the concept of left and right ($p < 0.05$). The comparison

of test scores shows that the game-based learning group obtained higher scores in this concept. There is also a significant difference between the two groups in retention of the concept of left and right ($p < 0.05$), with the game-based learning group scoring higher than the traditional learning group. Based on the findings, there is no significant difference between the two groups in learning the concept of one-to-one correspondence, but a significant difference was observed in the retention of this concept. Comparing the mean retention scores shows that the game-based learning group obtained a higher score than the traditional learning group and the value of Cohen's d is greater than 0.8, suggesting that the effect size is high. It was also revealed that there is a significant difference between the two groups in learning the concepts of equality and inequality ($p < 0.05$). Comparison of the means indicates the higher score of the game-based learning group. A significant difference was observed between the two groups in retention of the concepts of equality and inequality, with the game-based learning group scoring higher in the retention test. The results show that there is a significant difference between the two groups in learning the concepts of addition and subtraction ($p < 0.05$), and the game-based learning group has a higher mean score than the traditional learning group. Moreover, the results indicate that there is a significant difference between the two groups in retention of the concepts of addition and subtraction ($p < 0.05$), with the game-based learning group scoring higher than the traditional learning group.

Table 1 – Comparison of the learning and retention scores of the game-based and the traditional learning group ($\bar{X} \pm SD$)

Statistics Variables	Traditional ($N = 31$)	Game-Based ($N = 31$)	t	P-value
Direction (Learning)	17.5 ± 1.1	18.5 ± 0.6	4.2	0.000
Direction (Retention)	16.7 ± 1.6	17.9 ± 1.0	3.3	0.001
One-to-One Correspondence (Learning)	18.4 ± 1.4	19.5 ± 0.7	1.6	0.114
One-to-One Correspondence (Retention)	19.3 ± 1.0	19.7 ± 0.6	0.4	0.000
Equality and Inequality (Learning)	18.6 ± 1.4	19.3 ± 0.9	2.2	0.027
Equality and Inequality (Retention)	18.4 ± 2.0	19.3 ± 0.9	2.2	0.029
Addition and Subtraction (Learning)	18.9 ± 1.3	19.6 ± 0.7	2.9	0.005
Addition and Subtraction (Retention)	18.5 ± 1.8	19.5 ± 0.8	2.4	0.016

CONCLUSION

The results of the present research showed that, in comparison to traditional teaching, game-based teaching improves learning and retention of such math concepts as light and left, equality and inequality, and addition and subtraction. In terms of the concept of one-to-one correspondence, a significant difference was observed only in the retention scores of the two groups. The theoretical basis and empirical evidence that support the advantage of game-based learning are as follows:

Game-based learning can be considered as an active learning method. Active learning is a method of instruction in which learners actively participate in the learning process [17]. In the present research, the students participated in the designated games for each math concept and then started to work on the exercises of the course book. Therefore, it can be argued that games turn learning into a direct experience and create conditions where the learner is constantly required to make decisions. Games enable students to witness the outcome of their actions. While playing, children can use the data from their errors during the game to create a pattern that will allow them to solve next problems more easily. The feedback children receive during the game quickly and objectively informs them of their performance.

Moreover, since one of the requirements for effective learning is motivation in the learners, and since studies have shown that lack of motivation is one of the main reasons for poor performance of students in math, incorporating games and recreational activities into math course can be a way of piquing the interest of students. Games bring children satisfaction, excitement, and escape from tension and anxiety. Studies have shown that fully structural, teacher-centered methods of instruction put much emphasis on theoretical issues, undermine the motivation and self-confidence of students and damage their learning. Chang et al. (2006) and Singer et al. (2006) argued that children's attitudes of curiosity, motivation, and sense of mastery are the key to success in the elementary grades [16]. It can thus be concluded that learning increases when the process is accompanied by joy and amusement. The findings of the present research are consistent with the results of Kagan and Lowenstein (2004) who argued against the polarization of learning and game. Kagan and Lowenstein state that combining systematic instruction methods and game-based learning can increase the effectiveness of the curriculum [13]. In most educational games, students form groups and cooperate for achieving a common goal. Therefore, game-based teaching is not only an active learning

method, but also a cooperative and community-based method. Cooperative learning refers to methods of instruction where students work in groups to complete tasks collectively toward academic goals [17]. The present research had certain limitations as well. The research was carried out on female students, and further studies can compare the effectiveness of game-based teaching on learning and retention of math concepts in male and female students. Another limitation of the research was the lack of access to standard tests for first grade math course and the use of tests that were designed by the teacher. Each of these limitations reduces the generalizability of the results and necessitates caution in their interpretation. In sum, considering the results of the research, it can be argued that using educational games in teaching first grade math concepts is remarkably effective as compared to the traditional teaching methods.

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