# The Effect of Using Exercise-based Computer Games during the Process of Learning on Academic Achievement among Education Majors

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**Abstract**

The aim of this study is to define whether using exercise-based games increase the performance of learning. For this reason, two basic questions were tried to be answered in the study. First, is there any difference in learning between the group that was given exercise-based games and the group that was not? Second, is there any difference in learning between the group that used exercise-based games at end of the process of learning and the group that was not applied this but taken the questions of exercises in game material? This research has been conducted within the subject of Testing and Evaluation in the program of Kocaeli University Primary Maths Teacher's College. Experimental design with a pre test-post test control group was used in this study. Experimental process based on game material was used in 120 minutes at the end of a 3-week-teaching period. The reliability values (KR-20) of the two tests were found to be .79 and .71 which were used to evaluate learning level. The study has reached a conclusion that game materials used at the end of learning process have increased the learning levels of teacher candidates. However, the similar learning levels have been observed among students who were taken printed exercises instead of using learning game method to reinforce the traditional learning in the research. This means that in method of applying teaching games in addition to the traditional teaching, there isn't any difference of learning efficiency of students answered the questions based on competition and fun and the group who only answered the questions. This study is expected to contribute defining in which situations games are effective.

**Key Words**

Teaching Process Game, Computer Based Instruction, Teaching Material.

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The game activities which may have an important teaching role, contribute teacher and students in the class. It is claimed that game applications which are well-organized according to the aim, increase the learning process, strengthen retention, supply effective learning with joy in place of boring lessons by increasing motivation (Allessi & Trollip, 2001; Kebritchi & Hirumi, 2008; Lepper & Cordova, 1992; Rieber, Smith & Noah, 1998; Wesson, Wilson & Mandlebaum, 1988). However, as it is reported by Hays (2005), Lim, Nonis, and Hedberg (2006), and Tüzün (2007), it can be said that games are not helpful except improving positive behavior if the games supply only joy, and not effective learning experience.

Nevertheless, in his study, Rowe (2001) points out that some games may be helpful on education and some games may have negative effects. Some researchers claim that instructional games increase the interest or the performance of student towards the lesson (Barak, Engle, Katzir & Fisher, 1988; Renaud & Stolovitch, 1988; Tüzün, Yılmaz-Soylu, Karakuş, İnal & Kızılkaya, 2009; Wishart, 1990). Others point out that games increase only motivation not the level of learning (Bayırtepe & Tüzün, 2007; Brewster, 1996; Klein & Freitag, 1991; Ricci, Salas & Cannon-Bowers, 1996; Rosas et al., 2003).

Hays' (2005) review of 48 empirical research articles on the effectiveness the learning process for the games stressed that the research were not compatible with each other, is often fragmented, filled with ill defined terms, and plagued with methodological flaws. Furthermore, he asserted that some of the advance games were effective in certain situations or subjects, but these results would not be generalized to the other games or instructional programs.

On the other hand, based on some research (e.g., Renaud & Stolovitch, 1988; Serrano & Anderson, 2004; Virvou, Katsionis & Manos, 2005; White, 1984; Wishart, 1990) it is emphasized that games are effective. In related research as experimental methods, it is observed that compared with the learning level in the teaching process between the student groups which take in the game application and non-training groups or used in the comparison of different game applications approaches. Based on these experimental findings, Hays (2005) specified that no evidence indicates that games are the preferred instructional method in all situations.

On the other hand, Kula and Erdem (2005) present similar ideas. In their research, they make it clear that the instructional games which are not carried out with classroom activities have lower effects on success. Just like Kula and Erdem, Leutner (1993) determined that the teacher should give instructional support during the games based on computer.

The games based on teaching values are grouped under different categories based on their characteristics. Games can be categorized as task-based games, logic games, adventure games, struggle games, word games and exercise games (Allessi & Trollip, 2001). In exercise-based games, they are intended to be used in repeating the previously learned skills and knowledge in an interesting environment of game with an educational purpose and thus increase in persistence. The way of education which provides students' progress by answering the questions on a prepared material of board can be given as an example for an exercise-based game.

In the past, some research been conducted with university students and the effectiveness of the instructional games aiming to practice regarding the learning performance was tested (Klein, 1992; Klein & Freitag, 1991). In the research mentioned, instructional game is compared with a worksheet material given to student. No significant differences were found after the comparisons. Similarly, Ricci and his friends ( 1996) compared the learning levels of three military school students' who have taken part in the instructional game session based on computer, question-answer tests, or texts. The group that has not taken part in the instructional game session but taken the tests and the answer keys were observed as successful as the group that has studied the game material. As a result of this research, it may not be true to make a conclusion that instructional games provide extra support. On the other hand, it may not be possible to generalize the results which were obtained on specific subjects to all populations. In educational faculties, a variety of material and approaches which will be helpful in the students' future careers are introduced in the lessons. In order to make the students accept these approaches, it is very important to carry out the lessons as advised properly. However, it is necessary to define how these applications will affect their learning. In the past, Can and Çağiltay (2006) tried to find out candidates' perceptions on using instructional computer games in class. After the research, they decided that candidates had the positive perception on using computer games in their future careers; but some

of the participants had doubts, especially concerning the issues of classroom management and the educational effectiveness of computer games.

Tannenbaum and Yukl (1992) imply the importance of research about identifying why, when, and in which situations a specific teaching type is effective. When the research done in the past are examined, it is emphasized that instructional games are effective in specific situation or subjects, these results cannot be generalized to other games or teaching programs (Brewster, 1996; Hays, 2005; Uzun, 2009). Moreover, after examining 48 research, Hays (2005) emphasizes that the scientific research about the effectiveness of instructional games are not in the harmony with each other, they are full of conceptual confusions and an important part of the research is methodically wrong.

The aim of this study is to define whether using exercise-based games at end of the process of learning increase the performance of learning. For this reason, two basic questions were tried to be answered in this study. First, is there any difference in learning between the group that was given exercise-based games and the group that was not? Second, is there any difference in learning between the group that used exercise-based games at end of the process of learning and the group that was not applied this but taken the questions of exercises in game material?

## Method

### Research Design

In the study, a pre test-post test control group experimental design was used. In the research to define the effects of educational games and exercise questions, two different groups which were formed at random were compared by means of learning levels as a dependent factor. According to the research design, before the experimental process, a pre-test was applied to the groups to identify their initial learning levels. The content of the Measurement and Evaluation lesson was divided into two parts for three weeks. Both learning units were taught with the traditional teaching method and using the blackboard by the researcher. All students were divided into two groups at random and the game application was applied to the experimental group during 120 minutes. The students who have attended to the presentation of lecturer but have not attended to the game material application were named as a

control group. Whether there is a difference between the group taking instructional games and the group without the games was considered in this experiment process. At the end of this process, learning levels of the students based on the relevant content were measured. At the end of the second three-week-learning period, new experimental and control groups, independent from the previous one from all the registered students of mentioned class were formed at random. At the end of this learning process, the game material related to the new content was applied to the experimental group within 120 minutes. At this part of the research students who have attended to the presentation process but have not attended to the game material application, were given printed questions and answers. It was made clear in this experimental stage that whether there was a difference on the learning level of between the group taken part in the instructional game session and the group that did not take part in this process but took the exercise questions or not.

## The Research Group

The subjects of this study has been the junior students of the 2008-2009 spring season Assessment and Evaluation program, who were taking the elementary mathematics education program in the 1st an 2nd type of instruction. The reason why the Assessment and Evaluation lesson was preferred by the researcher is, the lecture has an independent content as compared with the other subject when considered in condition relation and the content is new for the students. At the research, all the students who were registered in 1st an 2nd type of instruction classes were divided into two groups as experimental and control groups at random. During the 3-week-learning process students who were absent over one week or have not attended the game application were dismissed from the research. Due to this, there were "losts" in experimental and control groups. As a result, the first experimental part of the research was carried out with 66 participants and the second part with 71. The experiment the groups were formed at random in order to compare the experimental situations.

In order to control the equivalence of the randomly made up groups, if there was a meaningful difference between the groups related to pre-test, attendance and the teaching achievement score of Instructional Technologies And Material Design taken in the pre-academic period was analyzed.

T-value of each three measurement of randomly made up groups for the first level of the research wasn't found meaningful related to p> 0,05 level. On this occasion, we can say that there is no difference between the groups related to the new-teaching subject's foreknowledge ($t_{(64)}$= 1,22). On the other hand, we can also say that there is no difference between the groups related to the achievement point of Teaching Technologies and Material Development lesson taken in the pre-academic period ($t_{(64)}$= 0,79) and the attendance level of first experimental level ($t_{(64)}$= 0,09).

The t-test results directed for the average achievement scores of pre-test, lesson attendance and teaching technology-material lesson of the groups constituted for the second experimental phase are presented.

It can be said that there is no significant difference in terms of the level foreknowledge to learn about new subject ($t_{(69)}$=0,18), the level of success of Teaching Technologies and Material Development lesson learned in the previous academic term ($t_{(69)}$=1,18) and the attendance level shown in the second experimental phase ($t_{(69)}$=0,33) between the groups constituted for the second experimental phase.

## Procedure

After the pre-test was given, in both of the experimental levels of the research, conventional teaching for three weeks was experienced. At this mentioned level, the researcher tried to teach the content which was about Measurement and Evaluation lesson by means of blackboard and on the other hand with simple narration and discussion methods. In the instructional process based on the lecturer's narration and consisting three lessons for three weeks, all the participants who were absent for more than one week were taken out of the research. The learning level of each group was analyzed independently from each other.

The teaching material used in research was developed basing on teaching objectives of Measurement and Evaluation course by the researcher. Two exercise based instructional game material for teaching issues in each three weeks were used in research. After determining the constructional characteristic of the game material or the rules considered during the application process, it is passed to developing and choosing exercises that are in the content. The material which was applied in research was experienced on the students who took the same

lesson in the previous year. As a result of this practice, the necessary improvements were made. Besides, it was prepared a list of specification showing the questions that were used according to the subject heading, investigated by a lecturer who gives lessons in that department and received opinion about the construct validity. The instructional game materials used in both experimental group processes have the same features for the purposes of all components except the questions on the exercise of learning unit.

The instructional games used in research were set up with Macromedia Flash MX program. Prepared material provides students to carry on their own group box on the computer screen provided that they give the correct answers to questions. The rules such as one-step progress if all groups give the right answer, three-step progress if one group gives the right answer were applied during the game. There is one color box representing each student group in the material. The first group reaches the 28th box on the material screen wins the game, even though the questions finished, if the final box has not been reached, the winner will be the one who has the most boxes. Developed instructional game material provides students' participation based on the components as knowledge, skill, chance, competition, assistance in small groups.

Prepared material has been applied to experimental group within an extra 120 minute period. In this process, the students not only answered the questions in the game but also they were encouraged to ask when they did not understand the topic. Besides these, explanations were given to complete the missing points. At the beginning of the experimental process, the students at the class were divided into 6 groups which contain 5 or 7 members at random. After the groups have been composed, the rules of the game are told to the students. Then the material has been reflected to the screen and the students have answered the questions that appear on the screen by making a common group decision.

## Data Collecting Tools

In the research, two multiple choice success tests of 15 questions which are devoted to the subjects that are indicated before, have been used to determine the learning levels of the students at the end of the experimental study. For the content and structural validity of the tests,

it has taken expert views of the two lecturers. By selecting the question that have been used in the previous academic terms whose the level of item discrimination are above 0,3 and on the other hand by taking into consideration the structure and context validity, two multiple choice tests were prepared. The reliability coefficient and the values related to the statistics of the achievement test that have been used in this research, have been acquired from the research group. The level of item discrimination of all the questions is above 0,3. The reliability coefficient of the test of 15 questions that is related to the education content that the first experiment includes is calculated as 0,79 (KR-20). The average of item discrimination of the test is 0,48. The reliability coefficient of the test that is used for the second experiment is 0,71 and the average of item discrimination is calculated as 0,41. These tests were used in each experimental process as a pre-test and final-test.

### The Analysis of the Data

The independent variable of the research is practice based instructional game, the dependent variable is the academic achievement grade of the test subject at Measurement and Evaluation Course. After each experiment process based on the points that are obtained from the students' individual measurement in order to test the significance the difference among the groups, t-test for independent groups has been used.

## Results

The main question of the research is that "What is the effect of the computer based instructional games on the students' academic achievement? The independent variable of the research is instructional games whereas the dependent variable is academic achievement points. Since the experimental process has been repeated twice, results that are acquired as to each grade have been presented separately. At the first step, the question that is supposed to be answered is "after the learning process, are there any differences in terms of learning level between these two groups that one of them is exposed to game application, the other one that has not been exposed to such a kind of application?" At the end of the first three week education, instructional game material has been experimented to a group, the group has only attended to traditional classroom exercises. In order to determine the effect of instructional

game material on academic success test, have been compared. There is a meaningful difference in average points of the students' learning levels that have attended to the second group in consequence of t-test at the end of the first empiric operation ($t_{(64)}$=2,14, p<0.05). In order to determine the standard deviation, the arithmetic mean values were considered. As the mean value of the students taking part in the training game activities is (X=12,39) more than the others (X=11,16), it was decided that the training games facilitate the students' learning ability. As a result, besides the traditional training methods by training game activities students have a chance to learn more basic concepts and knowledge.

At the second step of the research the question looked for being answered was are there any differences at the learning level between the group taken game application and the group wasn't taken but applied the exercise. Similar to the first step, in order to determine the effect of the training game activities on the academic success, the points of the two groups were compared. There is no significant difference of learning levels and related mark average as a result of t-test which was taken after the second experimental process between the two groups ($t_{(69)}$=0,43, p>0,05). In other words, if the students take exercises, participating or not participating in the training game activities don't affect students' learning degree.

## Discussion

Game at this study was not an alternative to lecturer's application of presenting the lecture. It was used to retain lecture learner at the end of teaching process. For that reason the instructional games in the research are used to practice the lectures which were taught after traditional education. When we think about the general features of the materials used in the instructional game, we can mention that it creates eagerness in learning as well as it helps the learners work in teams. The teaching person has helped the learners to use the educational materials and corrected the mistakes and given feedbacks to them.

The study has reached a conclusion on game materials used at the end of learning process have increased the learning level of teacher candidates. However the equal learning levels have been observed on students who were taken printed exercises instead of using learning game method

to reinforce the traditional learning in the research. This means that in method of applying teaching games in addition to the traditional teaching, there is not any difference of learning efficiency of students answered the questions based on competition and fun and the group who only answered the questions.

Many previous studies proved that instructional games give more motivation to the learners and they can be more interested in the subjects (Bakar, Tüzün & Çağıltay, 2008; Costabile, Angeli, Roselli, Lanzilotti & Plantamura, 2003; Çankaya, & Karamete, 2008; Malouf, 1987-1988; Karakuş et al., 2008; Klein & Freitag, 1991; Ricci et al., 1996). But on the other hand there are some theories that this motivation and interest does not affect the learning level very much (Klein & Freitag, 1991; Ricci et al., 1996).

According to the research conducted, the factors like providing feedback during the game, group work, interaction, deciding altogether may not contribute to the level of learning. The possible factors that can be resulted in mentioned situation are pinpointed below.

First of all, instructional game application is used for every experimental process in 120 minutes. In another research, the use of this implementation may cause to different results if it is applied one more time. On the other hand, the additional time (120 minutes) could make students be tired cognitively much more than needed; therefore, the time span spent in each session can be decreased and the content of activity which is planned to be applied can be distributed to different sessions. Besides that case, during the implementation, the lack of interaction between students can be another factor that affects the process. The groups of students are formed randomly for the purpose of having different kinds of students or heterogeneity in other saying. The students in groups may have some difficulties in interaction with others due to their characteristic features. In purpose of enabling much more effective interaction between students, they can be allowed to form their own group members and this application can be used in another study. Besides all of the points mentioned, the teaching material that is used in the investigation may have as much effect as in a teaching approach or a material. In the past similar to this, in some studies it is determined that there is no meaningful difference of learning level between the students who were applied game applications and the students who studied with repetation, exercise, worksheet or books (Klein, 1992;

Klein & Freitag, 1991; Koran & McLaughlin, 1990; Ronen & Eliahu, 2000; Whitehill & McDonald, 1993; Wiebe & Martin, 1994). There is a need for well designed applications for games that contributes to learning level referring to the aim, so the studies can be conducted on the variables that focuses on giving feedback, correction, missing parts and the interaction among students in learning by thinking of design and approaches. On the other hand, the investigation as a dependent variable bases on just one measure, 'learning level' in other words. The learning level in the research is studied by depending upon the remembering of some principals, concepts related with the topic and the degree of meaningful learning that students managed to reach. In another research, different cognitive learning level; different cognitive skills like problem solving and critical thinking or emotional learning like motivation and attitude topics can be studied.

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