The Effect Of 3D Virtual Learning Environments On Mathematic Success: Second Life Sample

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ABSTRACT
The usage of three dimensional (3D) virtual worlds in Mathematics Education not only eliminates the dependance of education on K-12 schools but also enables the subjects to be more concrete. The objective of this study is to create a mathematics laboratory by using the virtual classroom qualities of 3D worlds. In this lab, abstract mathematics subjects are concretised by the materials developed. This state makes the learning of secondary school students, who still think concretely, easier and more consistent.

In our country, Turkey, studies on three dimensional virtual worlds exist in Management, Sociology, Fine Arts, Architecture, Science and Technology. In terms of teaching, there are only studies in the field of Foreign Language. No studies are available about its contribution in Mathematics Education yet.

For the objective of this study, an experiment group of 28 people was chosen from Fatih Secondary School third grade students. The teaching of Mathematics to this group was supported by Second Life. At the beginning and at the end of the study, an achievement test was applied. With this study, the positive effect of three dimensional virtual worlds on Mathematics education was observed together with the change of student success in Mathematics courses, and it was found significant at a level of .01.

Keywords: Second Life, Mathematic Teaching, 3D Virtual Learning Environments, 3D Virtual Worlds

INTRODUCTION
In this century, graduated individuals are expected to define the problems they encounter, solve them and contribute to the society in which they live. Therefore, the current education system adopts a student-based and structural learning understanding through which students form knowledge. In the frame of this understanding, context and methods of the education need to be re-organized in a way to gain critical thinking, scientific thinking, relational thinking, reasoning and creative thinking skills. Providing students with learning opportunities suitable to their skills and expectations and raising manpower equipped with the qualities required in our age is only possible through a technology-based structure within the education system. Educationg individuals and ensuring that their creative thoughts emerge is only possible with a contemporary education perception (Özden, 1997; Alkan, 2005).

In light of these ideas, technology has started to take its place in the learning-teaching process. During this period, computer technologies have also begun to be used in material development in order to provide more effective education as used in consulting and asessment-evaluation services. The rapid improvement of science and technology is bound to affect computer technologies used in the education process, and it also provides possibilities to overcome the limitations that can occur in computer-based learning environments. Presently, a transition has started from internet-based learning to 3D, multiple user, online virtual learning environments.These 3D online environments allow multiple users to do activities and communicate with other users with the help of a virtual self (avatar) that represents them in the same environment at the same time. These environments provide a powerful visual interface structure that evokes the sense of reality in social communication, which becomes an alternative for them by eliminating the drawbacks of other Internet-based systems. These environments eliminate the distance concept as it can bring the users together in remote places. In addition, according to Barkand and Kush (2009), virtual learning environments are described as: instant messaging, discussion boards, e-mails, blogs and podcasts (Dickey, 2005; Dede et al., 2004; Mennecke et al., 2011).

The methods and the techniques used in the learning-teaching process in our country are inefficient, especially in the courses with abstract subjects like Mathematics. According to Piaget, cognitive development of individuals is completed in four phases, and these are: Sensorimotor Stage, Preoperational Stage, Concrete Operational and Formal Operational Stage. Concrete operational stage: It applies to individuals' in the age range 7-11, and this age

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range corresponds to the span between the primary school third grade and secondary school third grade. In this stage, an individual can achieve basic operational series with the condition that every step is clearly explained. Additionally, an individual improves the concepts of the substance amount of the objects, reversibility and conservation of length and weight. The next stage, Formal Operational Stage, applies to the age 11 and above, and this corresponds to the secondary school fourth grade and above in educational life. In this period, an individual improves the skills of hypotetico-deductive reasoning, identification and control of variables, imagining, comprehending abstract events and concepts by interpreting them (Gültekin, 2005; Özmen, 2004).

The lecturers in virtual learning environments provide convenience to the education leaders on the matters below:

- Observing the students' contribution to discussion.
- Preserving all the activities and conversation history, written or visual, to get feedback and an evaluation.
- Transferring discussions to the students to be able to set an example about critical thinking skills.
- Asking questions and adding interpretations in order to direct the critical thinking.
- Putting forth an expert view when necessary.

More importantly, the lecturers in virtual learning environments have the opportunity to watch and evaluate the discussions made offline (Duffy, Dueber & Hawley, 1998).

Upon examining the mathematics curriculum of the schools educator can see that, by the second grade of secondary school, an abstract subject like algebraic expressions has been taught to the students. The students are in concrete the operational stage at this age, so comprehension of abstract subjects like this is made impossible by the methods and techniques used while teaching. Furthermore, for example presentation of a cube, a three dimensional object, on a two dimensional board creates a separate paradox. The low number of the materials designed to present the abstract subjects to the student in concrete operational stage does not allow each student to use them and the users are also limited by internet Access, materials at the school. In this context three dimensional online virtual learning environments are needed. The materials formed in three dimensional interfaces provided by these environments not only concretize the subject but also provide the opportunity to use them in required place and time. Besides the cost and the time spent for copying these materials for students being close to zero, it also serves the educational policy of cost saving (economy). (Küçükahmet, 2006; Ergün ve Özdaş, 1997).

THE STUDY

With this research, Second Life environment, which is a three dimensional online virtual world is aimed to reveal the effects of student attitudes toward mathematics courses and design activities which will enable the third grade students of secondary school to see the 3D objects in mathematics courses in a concrete way, access the information outside of the school, and provide them with an education through games. Furthermore it gives the chance to observe the effects of this method on academic success and the cognitive levels of the students.

The problem statement forming the base of the study is: "What is the effect of supporting teaching principles with the activities prepared in Second Life environment on Secondary School third grade students' academic success?"

Accordingly, the hypotheses of the study were defined as follows:

1. A statistically significant difference exists between the academic success pre-test and post-test scores of the SL learning group.
2. A statistically significant difference exists between the academic success pre-test and post-test scores (the score of answers given to the objective of the application) of the SL learning group in favor of post-test.

The premises and the limitations of the study can be lined up as follows:

1. It has been presumed that the information taken from various sources and institutions reflects the truth and that the uncontrollable variants of the study affect each student in the same way.
2. This study is delimited with a working group of 28 third grade students from Uskudar District Fatih Secondary School and a research period of three weeks research period.
3. The application process applies to the secondary school third grade Mathematics subject of "Cartesian Coordinate System."
4. The improvement in the academic success of the students has been assessed by the written exams which are prepared by the course teacher.

In this research the effect of a mathematics course taught with Mastery learning and supported by Second Life on

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student success is examined. Written exams prepared by the researcher are used for data collection. Tha data collected from the research is analyzed with non-parametric statistical methods as the group number is less than 30. In order to compare the pre-test and post-test total scores of the experimental group, the Wilcoxon signed rank test is used, which is considered to be appropriate to use in relational measurings (Büyüköztürk, 2003). The quantity analysis of the study is made with the help of SPSS 21 for MacOS X package program.

FINDINGS

In this part, the findings obtained by the quantity data of academic achievement tests were presented in accordance with the research hypothesis and problem.

Findings of the First Hypothesis

The first hypothesis of the study is: "A statistically significant difference exists between the academic success pre-test and post-test scores of the SL learning group."

Wilcoxon signed rank test results, as to whether the scores taken from the academic achievement tests before and after the application show a significant difference or not, are given in Table 1.

Table 1: Wilcoxon Signed Rank Test Results of Pre-Experimental and Post-Experimental Academic Achievement Test Scores

Second Life Education After - Before	n	Mean Rank	Sum of Rank	z	p
Negative Ranks	8	16.19	129.50		
Positive Ranks	20	13.83	276.50		
Ties	0			-1.674	.094
Total	28				

*Based on negative ranks

According to the test results in Table 1, it is noted that there is no significant difference between the answers given to the achievement test before and after the 3D material application developed in Second Life environment. ($z=1.67$, $p>.05$).

When the mean rank is taken into account, the scores are in favor of the pre-test, that is to say, the general success obtained from the examination before the application is greater then after. The result can be seen as normal considering the facts that the achievement test is not just for the related objective but covering all the courses of the semester and that it has been applied four months later than the pre-test. This state stands for the vision that pre-test and post-test scores of general success does not show a significant difference.

Findings of the Second Hypothesis

The second hypothesis of the study is: "A statistically significant difference exists between the academic success pre-test and post-test scores (the score of answers given to the objective of the application) of the SL learning group in favor of post-test."

Wilcoxon signed rank test results, as to whether the scores taken from the academic achievement test questions covering the related objectives before and after the application show a significant difference or not, are given in Table 2.

Table 2: Wilcoxon Signed Rank Test Results of Pre-Experimental and Post-Experimental Academic Achievement Test Scores Concerning the Objectives of the Application

Second Life Education After - Before	n	Mean Ranks	Sum of Ranks	z	p
Negative Ranks	6	7.00	42.00		
Positive Ranks	15	12.60	189.00		
Ties	7			-2.561	.01
Total	28				

* Based on negative ranks

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According to the test results in Table 2, it is noted that there is a .05 significance level between the answers given to the achievement test questions covering the related objectives before and after the application with Mathematics Robot developed in Second Life environment (z=2.56, p=.05).

The mean ranks in Table 2 show that the scores of the answers given after the application are greater. In other words, the difference is in favor of positive ranks, namely post-test scores. After these results, it can be stated that the learning application with 3D materials developed in Second Life environment has a positive effect on the learning level of the related objective by the Second Life learning group.

CONCLUSIONS

In this research, Second Life environment, which is a three dimensional online virtual world, is aimed to reveal the effects of student attitudes toward mathematics courses and design activities which will enable the third grade students of secondary school to see the 3D objects in mathematics courses in a concrete way, access the information outside of the school, and provide them with an education through games. In addition, SL allows researchers to observe the effects of this method on academic success and the cognitive levels of the students.

Researchers in different studies express that before carrying out the activities in three dimensional virtual learning environment, it is necessary to define the content and the objectives related to the content. (Hodge et al., 2009; Molka-Danielsen & Deutschmann, 2009). The selection of the materials must be appropriate for the content in order to make complex tasks easy to learn, and the interaction of the participants with the materials is emphasized. (Gillen, Ferguson, Peachey, & Twining, 2012; Moore & Rocklin, 1998; Salomon, 1993). Therefore the researcher has chosen Cartesian Coordinate System, a subject of third grade, and the objective "The student is able to explain and use the two dimensional cartesian coordinate system".. Later on, 3D material, suitable for the content and the objective, was developed in second life environment. It is noted that there is no significant difference between the answers given to the achievement test before and after the 3D material application developed in Second Life environment (Table 1).

When the mean rank is taken into account in Table 1, the scores are in favor of pre-test, that is to say, the general success obtained from the examination before the application is higher. The result can be seen as normal considering the facts that the achievement test is not just for the related objective but covering all the courses of the semester and that it has been applied four months later than the pre-test. This phase stands for the vision that pre-test and post-test scores of general success does not show a significant difference.

By looking at the second hypothesis, the following result can be reached: a significant difference can be formed in the general academic success of the students in the research on the condition that the study is applied throughout the semester.

On the other hand, it is noted that there is a significant level of difference between the answers given to the achievement test questions covering the related objectives before and after the application developed in Second Life environment (Table 2). Considering the mean rank in Table 2, positive ranks are higher, namely in favor of the post-test scores. This phase can be interpreted as 3D materials developed in Second Life environment provide a better understanding of the subject and have a positive effect on their academic success.

Research has shown virtual environments provide a possitive impact on learning. Sert (2009), defines game based learning environments as: the environment that learning is carried out through games to ensure the learning process to be more fun and highly motivational. In the study by Salmon et al. (2010) due to the environment designs made by the participants, it is found out that they are more entertained and have a higher motivation for studying in the environment. In another study, researchers state that student-student interaction in virtual environments is very important for the formation of social learning (Beldarrain, 2006; Kongmee et al., 2011).

When the findings of the research are examined, thanks to the three dimensional Mathematics Robot developed in the SL environment, it can be seen that affective qualities are improved: (a)students' interests toward Mathematics increased, (b) they started to like Mathematics, (c) they would like to reserve more time for Mathematics, and (d) they would like to have advanced level information about Mathematics. Besides an increase of academic success regarding the objectives, a cognitive quality, has been noted. It can be stated within the light of this finding that the increase in the sympathy and the motivation toward mathematics mobilized the academic success in a desired course. Furthermore, increasing students interaction enables social learning by having an independent environment from the school, encouraging them to ask questions to each other, and sharing more things..

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