Mayıs 2017 Cilt:25 No:3 Kastamonu Eğitim Dergisi 975-992

The Effects of Using Learning Objects on The Students' Achievement, Motivation and Persistence in Mathematics Teaching

Öğrenme Nesneleri Kullanımının Matematik Öğretiminde Başarı, Motivasyon ve Kalıcılığa Etkisi

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Makale Geliş Tarihi: 15.12.2015 ***Yayına Kabul Tarihi: 23.09.2016***

Abstract

The purpose of this study is to determine whether it has an effect on the level of 7. grade students' academic achievement, motivation and retention which is studied by using objects. The study was on the 43 7. grade students who are studying in Denizhan Boarding Secondary School which is in the Alaca district of Çorum. In the study pretest-posttest experimental design which has control group was used. At the beginning of the study Mathematic Achievement Test and Motivation Survey was applied for two groups as a pretest. Experimental group consist of 21 students were taught circle unit by using learning objects for about 6 weeks, 4 lessons per a week. Control group consist of 22 students were taught according to revised primary school curriculum. After teaching, Mathematics Achievement Test and Motivation Survey was administered as a final test to both groups. In the analysis of the sub problems of the research percentage, mean, Standard deviation, one factor in two-factor ANOVA for repeated measurements tests were used, Data, obtained from Mathematic Achievement Test and Motivation Survey was analyzed by using SPSS 17 statistical program. According to the result of the analysis of the data obtained it has been confirmed that enriched learning environments with learning objects have a positive effect on the students' academic achievement. Also, post-process of the experiment it has a little positive effect on students' motivation. It is important in terms of showing learning objects may be used as an enriching element to teaching at secondary school level and in the classroom environment.

Keywrods:*Learning Objects, Mathematics Education, Motivation, Persistence*

Özet

The purpose of this study is to determine whether it has an effect on the level of 7. grade students' academic achievement, motivation and retention which is studied by using objects. The study was on the 43 7. grade students who are studying in Denizhan Boarding Secondary School which is in the Alaca district of Çorum. *In the study pretest-posttest experimental design which has control group was used. At the beginning of the study Mathematic Achievement Test*

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Anahtar Kelimeler: *Öğrenme Nesneleri, Matematik Öğretimi, Motivasyon, Kalıcılık*

1. Introduction

In the century we live in, innovations and changes rapidly increase; thus, the technologies, enabling the share and spread of these innovations and changes, increase at the same rate. This rapid development of technologies came in all areas of our life. Especially in this era, we face a generation, who can efficiently use technology since very early ages. As a result of this, there has been a rapid change in learning groups as well.

In order to meet this change and make the service of education more effective, information technology is used in education. This caused a rapid growth and great development in educational technologies. The most important one of these changes is the active use of technology in teaching and learning processes. In this way, the use of technology helps the classroom atmosphere gets more fun and increases students' achievement through attracting their attention and increasing their motivation on the classes. As a result of this, distance education models have started to develop, which are carried out independently on time and place. The distance education has no more been limited with printed materials and television because internet and web technologies caused the development of new models. E-learning processes have started with the use of websites and internet technologies.

Another tool enabling the active use of the learning contents created in this media is learning objects. Various definitions of this new concept have been made by many different people. However, the common point of these definitions is that they are small or large sources of information which can be used again and again. The main purpose of the Learning Objects approach can be summarized as; 'developing standards for the design and presentation of electronic sources that can be used in teaching processes, storage of these sources in the databases for easy-access, ordering and categorizing; and increasing the efficiency of these sources.' Especially in mathematics

education, the traditional mathematic teaching methods should be replaced with a new learner-centered mathematics teaching method in which students do researches, form their own knowledge, discover the relations among concepts and create new solutions to the problems they come across. At this point, learning objects may be of help with comprehension and concretization of abstract concepts of the mathematics by the students. The subject "Circle and Circular Region", which has been chosen as the research subject, includes abstract concepts such as Angle, Caliber, Perimeter and Pi, and abstract generalizations such as "Perimeter of circle equals the length of caliber multiplied by pi." Concretization of the subject involving these abstract terms by visualization and expressing it clearly to the students who are at the level of concrete perception is crucial in terms of that they can learn the concepts better, make interpretation on these concepts and use these concepts with their problem solving skills.

Most of the researches carried out until now has made descriptions on technical features of the learning objects, metadata standards and system definitions. Empirical researches have remained very few among these researches. Especially in the field of mathematics teaching, there are very few studies researching the effects of learning objects on mathematics education. The reasons above and the effects of learning objects on mathematics education have created a necessity for this research to be carried out. In this paper, we have attempted to define the effects of 'Learning Objects' on achievement, motivation and persistence of teaching in mathematics courses, the overall success of which is quite low in Turkey (Aydin, Sarıer, Uysal, 2012; PISA, 2013).

2. Research Questions

The main problem of this research has been identified as, "What is the effect of the use of Learning Objects on students' achievement, motivation and persistence in teaching "Circles" at 7th grade mathematics lessons?".In order to answer the research problem, the following sub-problems was formed. Within the framework of this general objective, the following questions were tried to be answered:

1. Is there a significant difference between the successes scores of test group students (pre-test, post-test) using Learning Objects and those of the ones in the control group not using learning objects?
2. Is there a significant difference between the motivation scale scores of test group students using Learning Objects and those of the ones in the control group not using learning objects?
3. Is there a significant difference between the persistence test scores of test group students using Learning Objects and those of the ones in the control group not using learning objects?

3. Method

Research Model

In this study, it was aimed to determine the academic success, motivation levels and persistence levels of a learning setting that was enriched with learning objects in the teaching of 'Cycle and Circle' unit within the contents of 7th Grade mathematics course in line with the Teaching Program for Mathematics Course in the Educational year of 2012 -2013. In the research, an experimental design with a one factor pre-test and post-test control group was used.

Working Group

The working group of this study has been carried out on the students of Denizhan Boarding Secondary School in Alaca country of the city of Çorum. The working group of this study consists of 43 students; 21 of which are in the experimental group and the rest of them are in control group.

Data Collection Tool

In this study, students' success tests and persistence tests, which were reviewed in terms of reliability-currency and prepared by the researcher, in order to collect quantitative data. After the pilot study analysis test, KR-20 value was found 0,82 and the standard deviation was found 4,409. In this case, it has been decided that the test was to be used as part of the study with a sufficient level of reliability. We also used the 'Motivation Scale', which was prepared by Keller (2008) and successfully applied by Turel (1995). As a result of analyses, the Cronbach Alpha reliability value is 0.95 and in sub-categories; the measurements are 0.84 for attention, 0.84 for interest, 0,81 for trust and 0,88 for content. In this regard, it can be said that the scale is current and reliable to measure the students' motivation in learning environments.

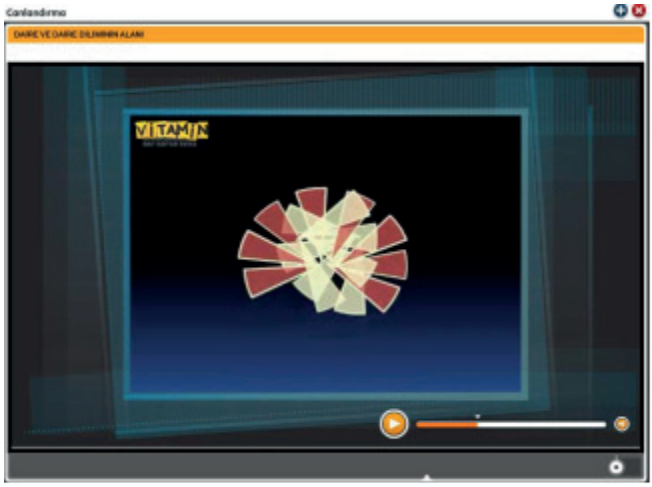
Application Process

The activities related to this research and the application of measurement means were carried out with the students at 7/A and 7/B classes at Denizhan Boarding Secondary School in Alaca, Çorum; for 4 hours of lessons each week during 6 weeks in April and 24 hours of lessons at total during the second term of 2012 - 2013 Educational Year. Analyzing the annual consolidated plan of 7th grades mathematics, it is seen that the unit "Circles" is taught for 16 hours. During the first week of application process, mathematics achievement test and motivation scale were applied to the students in experimental and control groups as a pretest. Then, both of the groups are given information about the application. In order to take all possible precautions before the research, in case of problems such as the students in experimental group feeling special or the students in control group feeling left out; the students were told that the program applied to experimental group would be applied to the students in the control group afterwards.

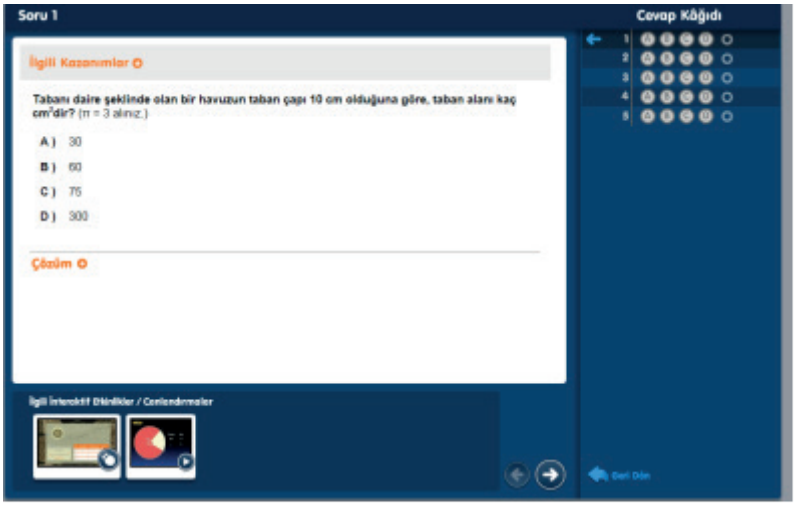
During 2nd, 3rd, 4th and 5th weeks of the application process, the students in the experimental group were taught in an environment with computer, projection machine, printer, sound system and smart board. The teaching process was carried out by consulting the teacher with 50 'Learning Objects' for the subject 'Circles', which were selected based on expert opinions. The teacher, who carries out the practice process, which is one of the most important elements of the research, is given detailed information about the purposes of the process and his missions. During the research, there has been a continuous interaction with the teacher in order to eliminate any possible problem and fulfil any needs. The learning objects with animations and videos were used for lecturing during the introduction phase of teaching. After the introduction to the subject, learning objects consisting of interactive activities were used. Students used some of these activity-based learning objects individually, and they used the rest with the consultation of the teacher with other students in the classroom. Students achieved to get instant feedback and consolidation and they were glad of using learning objects. Students, who failed at the activities, completed their learning with the use of animation and video learning objects about the topic again. In the last part of the lesson, after the subject was fully understood, learning objects including questions and exercises were used. While the students solved some of the question-based learning objects at the smart board, they answered some of the exercise-based learning objects individually.

The list below shows some examples of the learning objects used in the research:

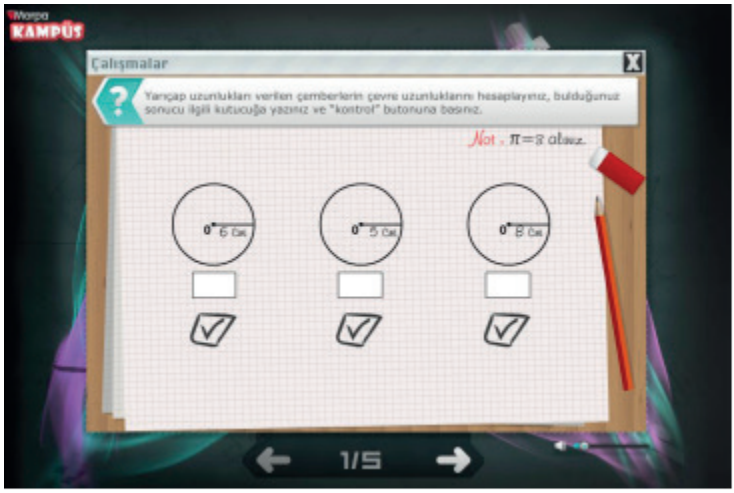
Picture 1. Visual of the Simulation Learning Object about Perimeter of Circle



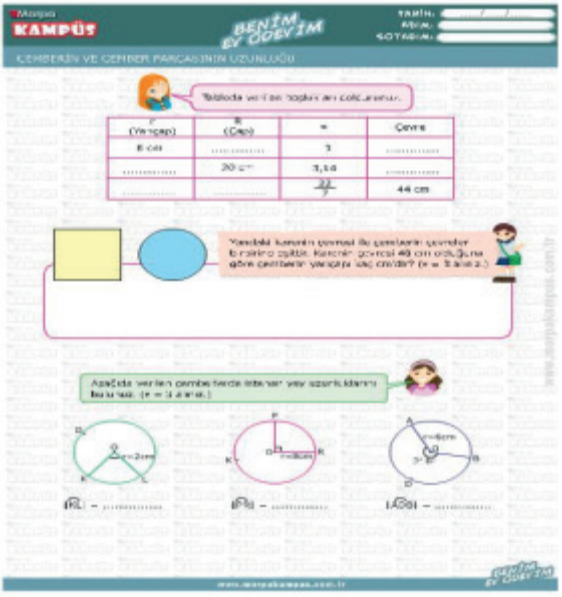
Picture 2. Visual of the Animation Learning Object about Area of Circle and Sector.



Picture 3. Visual of Question-Based Learning Object about Circle and Circular Region



Picture 4. Visual of Activity-Based Learning Object about Peripheral Length of Circle



Picture 5. Visual of Question-Based Learning Object about Circle and Circular Region

During this process, the students in the control group were taught the same subject. Course books were used as learning materials in the classroom for control group.

Students used the paper-pen-based activities in the course books. Applications on the two groups were carried out by the same teacher.

During the 6th week of application process, mathematics achievement test and motivation scale were applied to the students in experimental and control groups as a posttest. Also, after four weeks from the application process, the experimental and control groups were applied a persistence test. All the collected data were shared in the Findings section.

Analysis of Data

The data collected for purposes of research have been analyzed by using statistical techniques in accordance with the features of data with the use of computer-based SPSS-17.0 package program (Statistical Package for the Social Science); the findings has been presented in charts and graphics and the necessary reviews have been made. For this, we benefited from Buyukozturk (2002). Accordingly, in compliance with each sub-problems of this research, we used one way ANOVA test for repetitive measurements on percentage, frequency, arithmetic average and single factor.

4. Results and Discussion

Findings of Academic Success Test

Students' average score in academic achievement pretest-posttest and standard deviation values are given in the table below.

Table 1. Students' Average Score In Academic Achievement Pretest-Posttest And Standard Deviation Values

Tests	Group	N	$\overline{X}$	S	t	p
A. Pretest	Control	22	5,36	2,25	,95	,352
	Experiment	21	5,85	2,12		
	Total	43	5,60	2,18		
A.Posttest	Control	22	9,77	5,55	3,787	,002
	Experiment	21	14,95	3,33		
	Total	43	12,36	4,44		

(*N: Number of Students,* $\overline{X}$ *: Arithmetic mean, S: Standard Deviation)*

While average academic success rate of the students in experimental group, in which 'Learning Objects' is applied, is $\overline{X}$=5.85, this value is measured as $\overline{X}$=14,95 after the experimental process.

While average academic success rate of the students in control group, in which

'Learning Objects' is not applied, is $\overline{x}$=5,36, this value is measured as $\overline{x}$=9,77 after the experimental process.

Accordingly, there has been an increase in the academic success rates of the students in the experimental group, in which Learning Objects is applied.

While there is no significant difference between the pretest academic success rates of experimental group and control group (t = ,95 p = ,352 (p > ,005), there is a significant difference between the posttest academic success rates of experimental group and control group (t=3,787 p = ,002 (p < 005).

This finding can be interpreted that there is a significant difference between the effects of the methods to improve the academic success rate, in which Learning Objects is applied and those in which learning objects are not used. It can be said that, the increase in students' academic success rate in the experimental group is caused by the use of Learning Objects in terms of enabling learner participation, presenting visual aids and concretization of abstract concepts. In other words, teaching with Learning Objects mostly reaches its goals as part of the students' academic success test.

The results of two-way analysis of variance related to whether or not there is a significant difference between the students' academic success rates before and after the experimental process are given in the table below.

Table 2. ANOVA Results of Achievement Test Pretest - Posttest Scores

Source of Variance	SS	Df	MS	F	p
Inter-group	746,814	42			
Group (Experimental/Control)	172,899	1	172,899	12,352	,001
Error	573,915	41	13,998		
In-Groups	1592,227	43			
Measurement (Pretest-Posttest)	979,692	1	979,692	81,218	,000
Group*Measurement	**117,971**	**1**	**117,971**	**9,780**	**,003**
Error	494,564	41	12,063		
Total	2339,041	85			

(SS: Sum of Squares, df: Degrees of Freedom, MS: Mean Squares)

According to this, there is a significant difference between the pretest and posttest achievement test total scores of experimental group and control group, before and after the experiment. [F (1-41)=12,352; p< ,005].

This finding can be interpreted that the achievement test scores of the students in experimental group and control group can vary according to teaching methods regardless of measurement differences (before and after the experiment).

In terms of the students' success in mathematics, there is a significant difference between average scores of pretest and posttest achievement tests [F (1-41) = 81,218;

p< ,005]. This finding can be interpreted that when the groups are not separated, there is a meaningful change in students' academic success in mathematics lesson depending on the teaching methods.

According to the analysis results in Table-1, there is a significant change in academic success of the students in experimental group and control group, in which different teaching methods are applied, in mathematics lessons before and after the experimental process. This means that the factors of being in different action groups (experimental group and control group) and repetitive measurements have a significant common effect on academic success rates in mathematics lessons [F(1-41)=9,780; p< ,005] This finding means that there is a significant difference between the effects of the methods applied to improve academic success in mathematics for the students learning with learning objects and those learning without learning objects. This means that there is a statistically significant difference between mathematics teaching with learning objects and mathematics teaching without learning objects in terms of achievement test scores.

Findings of Motivation Scale

Students' average score in motivation scale pretest-posttest and standard deviation values are given in the table below.

Table 3. Students' Average Score In Motivation Scale Pretest-Posttest And Standard Deviation Values

Testler	Grup	N	$\overline{X}$	S	t	p
M. Pretest	Control	22	117,68	14,13	-,33	,411
	Experiment	21	122,76	16,80		
	Total	43	111,72	14,51		
M. Posttest	Control	22	107,27	17,92	4,9	,392
	Experiment	21	125,81	16,89		
	Total	43	106,54	22,40		

(N: Number of Students, $\overline{X}$: Arithmetic mean, S: Standard Deviation)

While average motivation scale score of the students in experimental group, in which 'Learning Objects' is applied, is $\overline{X}$=122,76 before the experiment, this value is measured as $\overline{X}$=125,81 after the experimental process.

While average motivation scale score of the students in control group, in which 'Learning Objects' is not applied, is $\overline{X}$=117,68 before the experiment, this value is measured as $\overline{X}$=107,27 after the experimental process.

While there is a slight increase in motivaton scale scores of the students in the experimental group, in which Learning Objects is applied, there is a reduction in the motivation scale scores of the students in the control group.

There is not seen a significant difference between the pretest motivation levels of experimental group and control group (t = -.33 in) high, p=.411 (*chipset top* > .005)] and there is not a significant difference between the posttest motivation levels of the students in experimental and control groups [t = 4.9, p=.392 (p > .005)].

This finding means that there is not a significant difference between the effects of the methods applied to improve motivation levels of the students learning with learning objects and those learning without learning objects. It means motivation levels of the students in experimental group and control group do not vary depending on the tests. In other words, it is thought that teaching with Learning Objects does not have a statistically significant effect on improving students' motivation levels.

The results of two-way analysis of variance related to whether or not there is a significant difference between the students' motivation levels before and after the experimental process are given in the table below.

Table 4. ANOVA Results of Motivation Scale Pretest - Posttest Scores

Source of Variance	SS	Df	MS	F	p
Inter-groups	44959,489	42			
Group (Experimental/Control)	21741,440	1	21741,440	38,393	,000
Error	23218,049	41	566,294		
In-Groups	8867,911	43			
Measurement (Pretest-Posttest)	959,074	1	959,074	5,167	,028
Group*Measurement	**298,702**	**1**	**298,702**	**1,609**	**,212**
Error	7610,135	41	185,613		
Total	53827,4	85			

(SS: Sum of Squares, df: Degrees of Freedom, MS: Mean Squares)

According to this, there is a significant difference between the pretest and posttest motivation scale scores of experimental group and control group, before and after the experiment. [F (1-41)=38,393; p< ,005]. This finding can be interpreted that the motivation scale scores of the students in experimental group and control group can vary according to teaching methods regardless of measurement differences (before and after the experiment).

There is not found a significant difference between the average motivation scale scores of the students before and after the experiment without taking into consideration the group differences. (F (1-41) = 5,167; p > ,005].

According to the analysis results in Table-2, there is not a significant change in motivation levels of the students in experimental group and control group, in which

different teaching methods are applied, before and after the experimental process; in other words, the factors of being in different action groups (experimental group and control group) and repetitive measurements do not have a significant common effect on motivation levels [F (1-41)= 1,609; p> ,005]. This finding can be interpreted that there is not a significant difference between the effects of the methods to improve the students' motivation levels, in which Learning Objects is applied and those in which learning objects are not used. In other words, it can be said that use of learning objects does not have a statistically significant effect on improving students' motivation levels.

Findings of Persistence Test

Students' average score in persistence test and posttest and standard deviation values are given in the table below.

Table 5. Students' Average Score in Persistence Test and Posttest and Standard Deviation Values

Testler	Grup	N	$\overline{X}$	S	t	p
A. Posttest	Control	22	9,77	5,55	3,787	,002
	Experiment	21	14,95	3,33		
	Total	43	12,36	4,44		
Persistence T.	Control	22	4,50	2,2	11,5	,000
	Experiment	21	11,14	1,5		
	Total	43	7,82	1.85		

(N: Number of Students, $\overline{X}$: Arithmetic mean, S: Standard Deviation)

While the average score of posttest achievement test of the students in experimental group, in which Learning Objects is applied, is $\overline{X}$=14,95; persistence test score, which was applied 5 weeks later, was found $\overline{X}$=11,14. While the average score of posttest achievement test of the students in control group, in which Learning Objects is not applied, was $\overline{X}$=9,77; persistence test score was found $\overline{X}$=4,50.

According to this, while there is a slight decrease in persistence test scores in comparison with the achievement test scores of the students in the experimental group, in which Learning Objects is applied, there is a little more decrease in the persistence test scores in comparison with the achievement test scores of the students in the control group.

There is a significant difference determined between persistence test scores of experimental group and control group [t = 11,5, p= .000 (p < .005)].

This finding can be interpreted that there is a significant difference between the effects of the methods to improve the persistence levels of students learning with Learning Objects and those learning without learning objects. It means persistence

levels of the students in experimental group and control group can vary depending on the tests. In other words, we can say that teaching with Learning Objects makes a good contribution to provide persistence by using visual and auditory themes in order to improve students' persistence levels.

The results of two-way analysis of variance related to whether or not there is a significant change in the students' persistence levels according to posttest achievement test scores are given in the table below.

Table 6. ANOVA Results of Success Levels Posttest - Persistence Scores

Source of Variance	SS	Df	MS	F	p
Inter-groups	920,14	42			
Group (Experimental/Control)	814,576	1	814,576	316,373	,000
Error	105,564	41	2,575		
In-Groups	535,306	43			
Measurement (Posttest-Persistence)	362,097	1	3362,097	88,298	,000
Group*Measurement	**5,074**	**1**	**5,074**	**1,237**	**,272**
Error	168,135	41	4,101		
Total	1455,446	85			

(SS: Sum of Squares, df: Degrees of Freedom, MS: Mean Squares)

There is a significant difference between the posttest scores and total persistence scores of experimental group and control group [F (1-41)=316,373; p< ,005]. This finding shows that there is a significant difference between the posttest scores and persistence test scores of the students in experimental and control groups. In terms of the students' success in mathematics, there is a significant difference between posttest scores and persistence test scores [F(1-41) = 88,298; p< ,005]. This finding can be interpreted that, without taking the group difference into consideration, there is a meaningful change in the persistence of students' academic success in mathematics lesson depending on the teaching methods.

According to the results of the analysis in the table, we can see that there is not a considerable difference between academic success rates in posttest and persistence test for the students in experimental and control groups, in which two different teaching methods are applied. This means that the factors of being in different action groups (experimental group and control group) and repetitive measurements have different common effects on academic success rates in mathematics lessons [F(1-41)=1,237; p< ,005]. This finding means that, the effects of the methods, which were applied to improve academic success in mathematics for the students learning with learning objects and those learning without learning objects, do not indicate a considerable variation on persistence. This means that there is not a statistically significant variation on the groups between mathematics teaching with learning objects and mathematics teaching without learning objects in terms of persistence test scores.

5. Conclusion

It is seen that there is not a significant difference when the average achievement pretest score of the students in the experimental group, who are taught with Learning Objects, is compared to average pretest score of the students in control group, who are taught without Learning Objects. According to this result, it is clearly seen that the behaviors of the students in both experimental and control groups are very similar and two groups are equal to each other before the experimental process. After the subject is taught, there was seen an expected increase in both groups. However, there was a significant difference between the academic success posttest results of the students in the experimental group, who were taught with learning objects, and the academic success posttest results of the students in the control group, who were taught without learning objects. It can be stated that the average of academic success posttest results of the students in the experimental group is higher than the average of academic success posttest results of the students in the control group. It can be said that the reason of this difference is that the Learning Objects had a positive effect on the experimental group students and contributed to their problem solving skills so that they could comprehend the subject better.

When the literature is analyzed, it is observed that the researches, in which different ways of Learning Objects are applied, achieved successful results. In the research carried out by Akpinar and Simsek (2007), it is determined that as a result of the teachers designing and using Learning Objects in the classroom, they are very effective on students' learning. In the research by Doymus and his friends (2006), the subject 'Electricty' at the 6th grade Science and Technology class was taught to experimental group with animations and to control group with traditional teaching methods. As a result, the students in the experimental group were more successfull than those in the control group.

In the study carried out by Turel (2008), as a result of the teaching process at the 7th grade Science and Technology class enriched by Learning Objects, it is seen that the students in the experimental group are more successful than the students in the control group. Finally, the result of this research is parallel to the findings of other similar studies in the literature. The measurement before the research has shown no difference between the motivation levels of the students in both groups. After the experiment, there has been a slight increase in the motivation levels of the students in the experimental group who were taught with learning objects. The reason of this increase is that the students get actively involved in the learning process and study the concepts with 2D or 3D visuals; thus, this concretization increased their motivation levels and led to the increase in their academic success levels. In the control group, there has been no increase in the students' motivation; moreover, there has been a decrease in their motivation levels because they couldn't concretize the abstract concepts and got bored. There are studies supporting these findings in the literature. In this study, it is found that there is an increase in the satisfaction of the individuals in the learning

environments where learning objects are used (Salas and Ellis, 2006). Turel (2008), in one of his studies, stated that there is an increase in the motivation levels of the students who are taught in an environment enriched with learning objects. Cetin and his friends, in a study they carried out in 2006, found out that computer technologies have positive effects in increasing students' interest in the lesson, easing their learning and increasing their motivation.

Ozerbas (2003) found in his study that Computer Assisted Colligative Teaching is more effective in increasing students' motivation. In his study in 2005, Ozdener determined a significant difference between the average achievement level of the students in experimental groups, who are taught with simulation softwares, and the students in control group, who are taught with demonstration method. The interviews with the students and observations showed that such educational materials contribute to students' motivation. Considering the permanence test results of the students, it is clearly seen that there is a decrease in both groups because the students may forget some of their knowledge due to lapse of time. However, we can say that the decrease in the experimental group is much less than the decrease in the control group because the use of Learning Objects enabled concretization of the abstract concepts and contributed to the visual spatial intelligence of the students in the experimental group. We can deduce that the use of Learning Objects, thanks to the visual and audial themes, is effective in ensuring the permanence. There are studies supporting these findings in the literature. Dasdemir (2012) stated that the use of animation in Science and Technology class has a positive effect on persistence. Yılmaz (2012) stated that there is a statistically significant difference on behalf of experimental group in teaching social sciences with concept maps. The recommendations in the light of the results of this research are as below:

1. Since the teacher, carrying out the teaching process, does not have background knowledge on Learning Objects, it is thought that the Ministry of National Education (MEB) should organize inservice training programs about preparing and using Learning Objects among the in-service training activities for teachers.

2. It will be more efficient that the learning objects in accordance with the course content, which can be easily used by the teachers, are designed by the Ministry; and object warehouses are established, where the teachers can choose from a number of options according to their needs.

3. There is a material shortage because 'Learning Object' is a new concept in education. Learning Object warehouses could be enlarged and more materials for more courses could be prepared. This database should be kept up-to-date, and the use of these materials should be provided for many teachers and students from all around Turkey.

4. This research has been conducted at 7th grade at secondary school. For more accurate generalizations and accelerating the pass to practice, it can be recommended that the Learning Object teaching process should be carried out at different learning grades and in a longer period of time, such as a term; and high level thinking skills of students, such as creative thinking, should be researched.

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