



THE EFFECT OF COMPUTER-ASSISTED INSTRUCTION ON THE ACHIEVEMENT AND ATTITUDES TOWARDS MATHEMATICS OF STUDENTS IN MATHEMATICS EDUCATION

Semra Bayturan
İzmir Province National Education Directorate,
Projects Coordinaton Department
semrabayturan@hotmail.com

Assist. Prof. Dr. Cenk Keşan
Dokuz Eylül University,
Faculty of Education, Turkey
cenk.kesan@deu.edu.tr

ABSTRACT

In this contemporary era, individuals should have great deal of skills with improvements since science and technology take progress rapidly. In this context, different learning methods should be used in schools. One of this methods is “Computer Assisted Instruction” based on the constructivist learning theory. The objective of this study was to investigate the impact of computer-assisted instruction method on students’ achievement and attitudes towards mathematics in secondary mathematics education. The research was designed based on an experimental pre-test post-test model. The research was conducted in 60 ninth grade students from a anatolian high-school during 2009-2010 academic year. The experiment group consists of 30 students and the control group consists of 30 students. The research is implemented by using computer-assisted teaching material that is developed by Flash MX program related with the unit of “Relation, Function and Operation” of the area of learning algebra and took 10 weeks. Computer-assisted instruction and traditional instruction methods were used in the experiment group and the control group respectively. The data were collected by using the Mathematics Test, Mathematics Attitudes Scale. Our results demonstrated that teaching mathematics with a computer assisted instruction method increased student success significantly in mathematics lesson. However, the experimental and control groups did not differ between students’ attitudes towards mathematics.

Keywords: computer-assisted instruction, mathematics achievement, attitude towards mathematics.

INTRODUCTION

If the traditional methods are thought to be insufficient in educating an individual who is supposed to have the contemporary skills, one of the most effective ways is taking advantage of instruction technologies, especially the computers (Altun, Uysal and Ünal, 1999; Yiğit and Akdeniz, 2000). Particularly, reasons like the unproportional change of the students and the teachers’ numbers, complexification of content due to the data quantity, some applications’ importance that show the individual differences direct people to benefit from the computers in education (Alkan, 1998; Uşun, 2000).

There is a clear relationship between the Mathematics and the computer. In fact, this is a symbiotic one. Without Mathematics the computers even exist. But, the existence and process of computer has developed the Mathematics and it has helped us to soar the activation and Mathematics on the paper (Tooke, 2001).

The computer is considered as a basic element in every area that is talked about reforms in teaching Mathematics. The new secondary mathematics education also gives an important place to the computers. In this education, it is emphasized that cognitive tools, which the mathematical notions in teaching-learning mathematics on computers are based on, have an effective position in gaining problem solving and thinking skills due to the softwares (The Ministry of Education [MEB], 2005). But, reflection into education is not as fast as developments in information technologies. It is necessary to present the interactive materials to the students with suitable softwares and activities. Mathematics has been seen as a difficult lesson to understand, apart from the daily life, boring and even ominous. In this situation, it is very important that computers should be used with exploring materials and guidance of teacher as a learning platform.



On the field base, relation and function is one of the most difficult learned topics (Sierpinska, 1992; Mayes, 2001; Albayrak, 2003; Ural, 2006; Elia, Panaoura, Eracleaus & Gagatsis, 2007; Aydın ve Köğçe, 2008). Secondary mathematics lesson is composed of 5 sub-learning field in learning algebra of the 9th grade instruction schedule (MEB, 2005); “Relation, Function and Operation” unit cartesian product, relation, function, operation and operations in functions. There are 14 educational attainments in the schedule about this part and this part composes 28% of total lessons of the 9th grade mathematics.

Insruction should be planned through activities that let the students reveal their foreknowledge, remove notion delusions if there is any, make sense and relate to other notions instead of memorizing (Feyzioğlu, 2006). Relation, function and operation subject is composed of abstract notions and has a rowed structure, so using learner centered material, that embodies these notions, relates them effectively and gives feedback immediately, provides a more beneficial lesson.

The rowed structure of mathematics shows itself in teaching relation and function notions. Because, here, each notion is structured on an other one. So, this study includes from ordered pair Notion to cartesian product, relation and function and operations in functions.

This study intends to research the computer–assisted instruction’s effect on success and mathematics which is used depending on computer–assisted material that is developed with relation, function and operation topics.

Objectives of Study

The aim of the study is to develop computer–assisted material related to relation, function and operation topics in the 9th grade mathematics instruction schedule and research the effects of computer–assisted instruction methods on success and attitudes of students.

METHODOLOGY

This study is composed of two parts. In the first part, computer software material is developed, in the second part this developed material’s effectiveness is searched by comparing in computer-assisted learning platform.

While comparing, Campbell and Stanley’s (1963) it benefits from experiment group that is classified with pre-test/post-test control group. Before the application the students were seperated objectively into 2 groups; control group and experiment group. First, the prepared scales were applicated as a pre-test on both groups. All the students were applicated with Mathematics Attitudes Scale and Mathematics Achievement Test as a pre-test. In the process, the control group was applicated with “Traditional Instruction Method” , the experiment group was applicated with “Computer–Assisted Instruction”. In the end, pre-tests were given as post-tests and the effects of both methods’ on students attitudes and achievements.

Computer-Assisted Software Material

The material is designed according to Willis’s (1994) Educationl Process Period Model. So, educational software is composed through planning, process, evaluation and correction stages.

While preparing the content schema, all attainments were investigated that are related to relation, function and operation topics in mathematics educational schedule. The levels were decided, their order and introducion conditions were organized according to secondary mathematics schedule.



- ▶ When organizing the topics levels, mathematics books were investigated according to the students' delusions about relation, function and operation.
- ▶ The basic notions are listed.
- ▶ Those notions' definitions on the books were investigated and the best ones were chosen.
- ▶ By relating those notions, their order was planned.

The education software is prepared with the name of *Interactive Mathematics*. The activities were developed and transferred into the computer, and then all the activities were dubbed in a studio. Those dubbed passages were set up on the activities with animations to be synchronized. The users can stop the animations whenever they want and play again. Animations, exercises and evaluation tests can be repeated and listened. The users can get both visual and audial feedbacks for all questions under "What did we learn?" title, even true or false. They can evaluate themselves by seeing their true or false answers with percentages and frequency under each "What did we learn?" title.

In Interactive Mathematics Instructor Package, at the end of each learning part, there is a test with its directions. After each mark a feedback is given but you can not go back before you finish the test, you should go on with the next question. When the test is finished there is a feedback about which questions are true/false, how many points you get and according to the points repetition or conragulation.

Population and Sample

The population of the study is the 9th grade students in Karabağlar in İzmir. The research was carried out with 60 9th grade students from an anatolian high school in Karabağlar in İzmir, in 2009-2010 Education year.

Data Gathering Tools

In this research, Mathematics Attitudes Scale and Mathematics Achievement Tests were used as data gathering tool. To be able to develop the scales and applicate at schools, the necessary permissions were taken from İzmir National Education Directorate.

Mathematics Achievement Test

Secondary school 9-12th grades attainments in mathematics schedule were investigated, according to these attainments 59 questions were prepared. This developed achievement test was applicated on 352 9th grade students in fall term in 2009-2010 education year at determinated schools. At the end, item analysis was done with Finesse programme. In this analysis, Kuder-Richardson 20 (KR-20) reliability co-efficient was found as 0,84. 8 questions were canceled because of their distinction index was less than 0,19, and 11 questions were canceled because their distinction index was between 0,20-0,29. also, the items were investigated according to their difficulty and being marked frequency. Finally, the achievement test had 40 questions by canceling 19 questions. The mathematics test was developed and after 2 months it was applicated 68 9th grade students, KR-20 reliability co-efficient was 0,86. this result shows that the test is reliable.

Mathematics Attitude Scale

In this research "Mathematics Attitude Scale" was used, developed by Nazlı Çiçek and Erktin (2002). In this attitude scale, there are 20 items that have positive and negative provisions about "Benefits of mathematics", "Perceived Mathematics Achievement Level" and "Interests in mathematics". All items have 5 choices and these choices are scaled from "never" to "always". Also, to prevent a routine answering, 8 items have negative sentences and the others have positive sentences. For grading, the negatives were reversed. Before used in the research, the attitude scale was applicated on 211 students in İzmir, 125 9th grade and 86 10th grade students. finally, in all scale Cronbach alpha reliability co-



efficient was 0,91; “Benefits of mathematics” was 0,77; “Perceived Mathematics Achievement Level” was 0,87; “Interests toward mathematics lessons” was 0,84.

Data Analysis

Some data was analyzed with Finesse, some data was analyzed with SPSS 13.0 package. In analysis period, frequency, percentage, standart deviation value; in paired comparions unconnected exemples, t tests were used. Control and experiment groups’ differencies between groups according to variables were tested $p < 0,05$ significance level. After the analysis, some charts were given and each data was commented seperately.

FINDINGS

These results were found from obtained data.

Table 1. The results of control and experiment groups’ pre-test points of mathematics achievement test

Goups	N	X	sd	cd	t	p
Experiment	30	2,100	1,729	58	1,320	0,192
Control	30	1,566	1,381			

As we see in Table 1, there isn’t a clear difference between the control and experiment groups’ Mathematics Achievement Test pre-test points statistically ($t=1,320$; $p > 0,05$). In experiment group students’ Mathematics Achievement Test pre-test average is $X = 2,100$; in control group students’ average is $X = 1,566$. There isn’t any difference between the groups before the test. According to this fact, it can be said that before the application the control end experiment group students are similar to each other about the topic.

The students, who were educated with Computer-assisted instruction and traditional educational methods in “Relation, function and operation” learning platform, were investigated if their post-test mathematics achievement test points were different. The facts of the control and experiment groups’ post-test achievement points are shown in Table-2.

Table 2. The results of control and experiment groups’ post-test points of mathematics achievement test

Groups	N	X	sd	cd	t	p
Experiment	30	20,766	4,553	58	5,105	0,000*
Control	30	14,466	4,994			

* $P < 0,05$

As we see in Table 2, between the control and experiment groups’ students’ mathematics achievement test post-test points are statistically different ($t=5,105$; $p < 0,05$). In the experiment group’s students’ achievements ($X = 20,766$) are higher than the control group’s students ($X = 14,466$). This difference is on behalf of the experiment group. This fact shows that the Computer-assisted instruction method and traditional education methods have a clear different effect on the students’ mathematics achievements. This result leads that experiment group’s students with computer-assisted instruction methods increase their achievement level and show a higher performance more than the control group students.

The students’ attitudes towards mathematics were investigated before and after the application about “Relation, function and operation” learning in control groups which had the traditional education methods and the experiment group which had computer-assisted instruction.



Table 3. The results of control and experiment groups' students' pre-test points of mathematics attitudes

Dimensions	Groups	N	X	sd	cd	t	p
Benefits of Mathematics	Experiment	30	20,933	4,378	58	-0,879	0,383
	Control	30	21,800	3,166			
Perceived Mathematics Achievement Level	Experiment	30	21,666	4,685	58	0,336	0,738
	Control	30	21,266	4,540			
Interests toward math lessons	Experiment	30	31,633	6,094	58	0,233	0,816
	Control	30	31,233	7,137			
General	Experiment	30	74,233	12,981	58	-0,020	0,984
	Control	30	74,300	12,911			

When we look at Table 3, it can be seen that there aren't any significant differences statistically between the control and experiment groups' attitudes towards mathematics pre-test points in the general scale and "Benefits of mathematics" ($t=-0,879$; $p>0,05$), "Perceived Mathematics Achievement Level" ($t=0,336$; $p>0,05$), and "Interests toward mathematics lessons" ($t=0,233$; $p>0,05$) sub-traits. It can be seen that in the general scale and all sub-dimensions, both the control and experiment groups' students' points are close to each other. This fact shows that before the application the students' attitudes of mathematics in the control end experiment groups are similar.

In mathematics lesson, it was investigated that if the students', who were applicated with traditional instruction methods or computer –assisted instruction in learning "Relation, function and operation", attitudes of mathematics post test results' differences are clear or not. So, the control end experiment groups' attitudes of mathematics post-test results are compared with t test. The results are on Table-4.

Table 4. The results of control and experiment groups' students' post-test points of mathematics attitudes

Dimensions	Groups	N	X	sd	cd	t	p
Benefits of Mathematics	Experiment	30	21,233	3,490	58	0,346	0,730
	Control	30	20,933	3,215			
Perceived Mathematics	Experiment	30	21,800	4,254	58	0,030	0,976



Achievement Level	Control	30	21,766	4,469			
Interests toward math lessons	Experiment	30	33,400	5,103	58	0,763	0,449
	Control	30	32,133	7,528			
General	Experiment	30	76,433	11,388	58	0,499	0,620
	Control	30	74,833	13,378			

According to the Table 4, there aren't any clear differences statistically in general scales ($t=0,499$; $p>0,05$) and "Benefits of mathematics" ($t=0,346$; $p>0,05$), "Perceived Mathematics Achievement Level" ($t=0,030$; $p>0,05$) and "Interests toward mathematics lessons" ($t=0,763$; $p>0,05$) sub-dimensions between the control and experiment groups' students' attitudes of mathematics post-test points. But, at the end of the application, in all dimensions and general scale the experiment group students' attitudes of mathematics ($X=76,433$) are more positive than the control group students' ($X=74,833$).

RESULT AND DISCUSSION

A significant difference was found at the end of the application on behalf of the experiment group between the mathematics achievements of the control group who had traditional instruction methods and the experiment group who had computer-assisted instruction. But, a significant difference was not found between their attitudes of mathematics.

This situation shows that, computer-assisted instruction method is more effective on the students' mathematics achievements than the traditional instruction methods, but it is not effective on their attitudes of mathematics.

In books and articles, we can see a lot of researches that compare achievements of groups who are applied the traditional instruction or the computer-assisted instruction method on different fields. In most of the researches there were found significant differences about achievements on behalf of the computer-assisted instruction applied group (Akinsola & Animasahun, 2007; Budak, 2000; Gürbüz, 2007; Özmen, 2008; Tienken & Wilson, 2007).

On the other hand, in some researches, there weren't found any differences about achievements between the computer-assisted instruction applied group or the traditional instruction applied group (Alacapınar, 2003; Rosales, 2005; Tienken ve Maher, 2008).

When the books and the articles are investigated, we can see a lot of different studies from primary school to university about the computer-assisted instruction and attitudes towards the lesson. If these studies results are evaluated, it can be found that in one group the computer-assisted instruction materials provide positive attitudes towards the lesson (Akçay and other., 2003; Aktümen and Kaçar, 2008; Kutluca, 2009); and in another group the computer-assisted instruction materials do not provide any or provide (Kulik & Kulik, 1987; Ganguli, 1990; Buran, 2005; Klein, 2005; Sarıçayır, 2007); a little (Çepni and other., 2006) positive effects on the attitudes.

When we look at the studies generally, at primary schools the students' attitudes have been changed but at secondary school or university, in other words, the higher instruction level, the attitudes have



not been changed much. Hence, Baykul (1990) investigated the students' attitudes' changes towards mathematics and science lessons from the 5th grades and all the seniors at high schools. In this research, it was seen that the students' attitudes towards mathematics and science lessons are changing in a negative way through the 5th grades and the seniors, in the last years of their schools. It can be said that the more they have experiences with mathematics and science lessons, the more they feel negative attitudes towards the lessons. The literature supports this study because the students are in secondary level.

From the point of the computer-assisted instruction method's effect on the students' mathematics achievements, in education platform the materials which are well-designed and appeal to their sense organs will increase their interests and so the lessons can be taught more effectively. In this sense, in education platforms, especially in the subjects like algebra which the students can face in abstract and upper learning levels, should be enriched with computer-assisted materials that use animations and simulations.

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