



## **Mathematical problem solving and computers: Investigation of the effect of computer aided instruction in solving lowest common multiple and greatest common factor problems**

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### **Abstract**

This paper aims to determine the effect of computer aided instruction on students' academic performance in solving Lowest Common Multiple and Greatest Common Factor problems and multiplicative structures. The study was held in the second semester of 2008 for five weeks with a total number of 102 sixth grade students. The research was carried out experimentally and a post test control group design method was used in this experimental study. An academic level test was used at the beginning of the study to compare the existing knowledge of experimental and control groups; and a post test and software developed by the researchers about the topic were used as data collection instruments in this study. The means of scores received in academic success test and post test were analyzed using t-test technique. The results of the study show that the use of computer support in teaching and learning Lowest Common Multiple and Greatest Common Factor problems and multiplicative structures in mathematics lesson may increase students academic success.

**Keywords:** Computer aided instruction, math education, Lowest Common Factor (LCM), Greatest Common Factor (GCF)

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## Introduction

The discipline of mathematics plays an important role in the lives of individuals and the importance of mathematics in primary and elementary education cannot be overemphasized. Problem solving is considered one of the most important components of mathematics education. (Jonassen, 2000; Williams, 2003). Verbal problems in the school curriculum has always been their potential role for the development in students of skills in knowing when and how to use their mathematical knowledge for approaching and solving problems in practical situations (DeCorte, Verschaffel, and Greer, 2000). According to Pape (2004), through problem-solving experiences children should learn to think strategically while learning mathematical content. However; as mentioned in the report of National Assessment of Educational Progress (2003) mathematical word problems are considered by students to be difficult at all age levels in elementary and secondary schools.

The reform movement of the past two decades in mathematics education has consistently emphasized problem solving as a focus of school mathematics (NCTM, 1989; cited in Dugdale and etc., 1998). In mathematics teaching, many students encounter difficulties on distinguishing and using knowledge (Orhun, 2002). Although they know mathematical concepts, many students encounter difficulty about using these concepts while solving word problems. Problem solving about the concepts of Lowest Common Multiple (LCM) and Greatest Common Factor (GCM) is one of the topics in elementary mathematics that students have difficulties. Besides problem solving, multiplicative structure is an important process that students should also know in order to find LCM and GCF. However, recent research studies also indicates that elementary school students and even prospective elementary teachers have difficulties recognizing multiplicative relations between whole numbers (Dias, 2005)

The past two decades have seen dramatic growth in the use of technology in mathematics classrooms, diverse and appealing explorations of potential roles for that technology, and sometimes intense debates about the pros and cons of technology in teaching and learning mathematics (Guerrero and etc., 2004). Due to the developments in information and communication technologies, it is possible to use the tools for assisting learning and teaching (The European Commission, 2001).

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Recently, students have been required to show an effective use of computers (Lichtenstein, 1999). NCTM Principles and Standards for School Mathematics (NCTM, 2000, p.24) document proclaimed that,

*Electronic technologies-calculators and computers-are essential tools for teaching, learning, and doing mathematics. They furnish visual images of mathematical ideas, they facilitate organizing and analyzing data, and they compute efficiently and accurately...When technological tools are available, students can focus on decision making, reflection, reasoning, and problem solving.*

## **Methodology**

### *Aim of the Research*

The main purpose of this study is to determine the effect of computer aided instruction on students' academic achievement in solving LCM and GCF problems and multiplicative structures in sixth grade mathematics lesson.

### *Research Question*

Is there a significant difference on academic achievements of the experimental group which received computer aided instruction and the control group which did not in solving LCM and GCF problems?

### *Research Design*

This research was carried out in order to determine the effect of computer aided instruction in teaching LCM and GCF word problems in sixth grade mathematics lesson. In this study experimental post test control group design was used. Two classes of the sixth grades were selected as control group and the other two were selected as experimental group randomly.

Quantitative method is used in order to determine the effect of computer aided teaching in solving LCM and GCF problems.

### *Participants*

This research was held in a Public Primary School in the second term of the academic year of 2007-2008. The reason why this research was held in this school is that there is

adequate technological equipment in classes that is needed to hold a computer assisted instruction.

A total of 102 sixth grade elementary school students took part in this study. 6A and 6D classes were chosen as experimental group by random sampling and 6E and 6F classes were chosen as control group. There were 51 participants in experimental group and 51 participants in control group. In order to ensure the homogeneity of both groups, the number of males and females were compared. The experimental group included 26 females and 25 males while control group included 24 females and 27 males.

The participants in both groups were intended to be similar in terms of their existing knowledge in the selected study topic “LCM and GCF”. According to academic level test scores applied at the beginning of the study, the subjects in both groups have appeared to be equal in terms of their background about the study topic.

#### *Instruments*

Academic Level Test: Pre test was a 40 minute test that contained 25 questions. The questions in the test were taken from a Government Scholarship Examination in Turkey for fifth grade primary school students which was held in 2005 – 2006 academic year.

Post Test: In order to assess the academic achievement of students an achievement test about “LCM and GCF” was developed by the researchers. There were 24 items in the test. The test was examined by four mathematics teachers in an elementary school and one subject field expert to assure the appropriateness of the test to students’ level and four items was taken out of the test.

Software: A computer based course material was designed to be used during the study. The material was designed using Flash 8.0. The program can be used by the teacher as a support material for instruction. Besides this, students can use this program along stone for individual study at home. It includes visually supported explanations of LCM and GCF problems and explanations of multiplicative structure relevant to the unit, the solutions of these problems and adequate feedback to these problems.

The software included visual explanations about the topics Factors, Prime Number, Common Factors, GCF, Multiples, LCM. When the user runs the software, s/he can see these main topics as buttons in the home page (See Figure 1). When s/he clicks on each

button, s/he can see a word problem about the topic. Using the navigation tools, s/he can see step by step solutions to these problems. The most important characteristics of each of these explanations are;

- 1- Students are prompted by questions after each step in the problem in order to help them to think further.
- 2- The concepts in each word problem were given to the students at the end of the explanations so that they can have a deeper understanding.
- 3- The explanations to the word problems were supported with visual aids as much as possible in order to help students to visualize the case in their minds.

Besides these buttons of the main topics, there is also a button named “Exercises” on the top-left corner of the screen. When the user clicks on this button, s/he can find many problems about the topics and solutions to these problems.



**Figure 1.** Screen shot from the home page

### *Procedure*

The study was held for 5 weeks in the second semester of the 2007-2008 academic years. In both experimental and control groups the same mathematics teacher conducted the study. Before the study began, the teacher was given a three hours education about the course software. The researchers were in the classroom during the study in case of any technical problem.

In the experimental group, teacher followed the following steps during the experiment process.

1. At the beginning of each lesson every week, he gave the name of the concept that students will learn.
2. After giving the names, he makes a short discussion with the students about this concept and gives a brief explanation.
3. After this introduction phase, he runs the software on his computer. With the help of a projection, he shows students the word problem about the concept.
4. Students see the solution of the problem step by step. After each step, teacher gives a break and asks questions to students and wait for their answers.
5. Students see the explanation of the concept at the end of each problem.
6. When they learn the concept, teacher solves other problems under the “Exercises” button.
7. The students who have computers at their homes could have a copy of the software on a CD and study at their homes either.

In the control group the instruction was held traditionally. The teacher used direct instruction method. He explained the concepts to the students and solved LCM and GCF and multiplicative structure problems given in the course book. He did not use computer support or any support material in the lesson.

At the end of the experiment, all students in the sample took the post test measuring their understanding LCM and GCF concepts and ability to use these concepts in solving problems.

## **Findings**

In order to answer question presented in this research, the mean and the standard deviation of the scores received in academic level test on the unit “LCM and GCF” were calculated and the difference between the mean levels was tested by the t-test. As can be seen in Table 1, the mean of the academic level test results was 37, 49 for the experimental group and 36,31 for the control group which shows that both groups were equal in terms of their existing knowledge about the topic.

Students took the post test at the end of computer aided instruction phase. In order to compare test scores of both groups, the mean and the standard deviation scores received in

achievement test were calculated. In Table 2, the results of the descriptive statistics indicated that the mean of the posttest results of the control group was 33.33 while it was 51 for the experimental group. Despite the fact that both groups were equal in terms of academic performance at the beginning of the study, results in Table 2 indicates that experimental group which used computer support during the instruction performed significantly higher than control group.

**Table 1.** Students' Academic Level Test Scores

Research Groups	Mean	N	Sd.	T	p
Experimental Group	37,49	51	13,87	0,379	0,706
Control Group	36,31	51	15,97		

**Table 2.** Students' Post Test Scores

Research Groups	Mean	N	Sd.	T	p
Experimental Group	51,07	51	18,50	5,621	0,000
Control Group	33,33	51	14,44		

### Discussion and Conclusion

An LCM and GCF word problem is a study topic in Turkey which students encounter difficulties in understanding. Despite the fact that students know LCM and GCF concepts, they are inadequate in usage of concepts given in these problems and in visualizing these problems in their minds. Teachers also have difficulties in teaching these problems with traditional teaching methods.

There are not many research studies held on this topic (Orhun, 2002; Kakmacı and Yenilmez, 2008; Tatar and etc., 2008). According to the study of Kakmacı and Yenilmez (2008), LCM and GCF problems are one of the topics that students have difficulties or fail in primary mathematics education. Also, Tatar and etc.(2008) mentions that LCM and GCF problems is one of the topics that students find difficult to understand. Although there are many studies that investigates the effect of computer aided instruction on students academic achievements, there are very few research about the use of computer aided

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instruction in teaching and learning LCM and GCF concepts and solving word problems about these concepts. The result of this study indicates that using visually supported computer materials

The aim of this research is to determine the effect of computer aided instruction on students' academic performance on solving LCM and GCF problems. According to the results of this study, it can be inferred that computer based materials which help students in visualizing LCM and GCF problems and in using mathematical language may help increase students' academic performance.

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