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### **THE EFFECT OF GEOMETRY TEACHING WITH CABRI TO LEARNING LEVELS OF FORTH GRADE STUDENTS**

#### **ABSTRACT**

In the study Cabri used for teaching geometry at 4<sup>th</sup> grade. To investigate students' geometry level semi-experimental method used. In the test group, geometry subjects are learned using Cabri. A multiple choice test used to collect data as pre and post test. Answers were assigned as 1 to correct, 0 to wrong answers. Data were analyzed using SPSS. It is found that teaching geometry at 4<sup>th</sup> grade with Cabri has no mean on the students learning on information level compared with the traditional education but it is determined that there is a meaningful difference between the another levels.

**Keywords:** Geometry, Dynamic Geometry Software Cabri, Geometry Learning Level, Primary Education, Learning Level

#### **CABRİ İLE GEOMETRİ ÖĞRETİMİNİN İLKÖĞRETİM 4.SINIF ÖĞRENCİLERİNİN ÖĞRENME DÜZEYLERİNE ETKİSİ**

#### **ÖZET**

Çalışmada, dördüncü sınıf geometri dersi Cabri kullanılarak işlenmiş ve öğrencilerin geometri düzeyleri incelenmek için yarı deneysel yöntem kullanılmıştır. Öğrencilere ön-test ve son-test uygulanmıştır. Çalışma 2007 eğitim öğretim yılında yürütülmüştür. Deney grubunun derleri bilgisayar laboratuvarında Cabri yardımıyla işlenmiştir. Veriler çoktan seçmeli testte yer alan bilgi, kavrama, uygulama ve analiz düzeyindeki sorulara verdikleri doğru cevaplara 1, yanlış ve boş cevaplara 0 puan verilerek elde edilmiştir. Veriler SPSS programıyla analiz edilmiştir. İlköğretim dördüncü sınıf matematik programında yer alan Geometri konularının Cabriyle öğretiminin geleneksel öğretime göre bilgi düzeyindeki öğrenmeler üzerinden fark oluşturmadığı; kavrama, uygulama ve analiz düzeylerindeki öğrenmelerinde anlamlı bir fark oluşturduğu görülmüştür.

**Anahtar Kelimeler:** Geometri Öğretimi, Dinamik Geometri Yazılımı Cabri, Geometri Öğrenme Düzeyi, İlköğretim, Öğrenme Düzeyi



## 1. INTRODUCTION (GİRİŞ)

Being used as an effective device of explaining the environment which we live in assigns important roles also to Geometry for reaching Mathematics' general purposes. One of the general purposes of mathematics is for students to come to appreciate mathematics (Baki and Bell, 1996; Baki, 2006). And it is impossible to reach this purpose by enumerating formulas one after another; without associating Mathematics with our environment; and having students make complicated calculations. It can be reached this purpose by explaining the direct relationship between mathematics and the objects in our environment, and explaining that many facts around us could be understood with mathematics, and finding examples in our environment related with mathematics. If we think that our Earth is surrounded with Geometrical shapes, in classes we can have students perceive that mathematics is powerful device to understand the world, and have them appreciate mathematics by relating mathematics and our environment (Güven, 2006).

Recent research shows that students' transition from concrete operation stage to formal operation happens at the last years of the first level of elementary education. In these years it is very important for students to concretize the knowledge and make the learning meaningful and permanent with the education they had, because learning at those years affect also following years. The most important reason of Geometry to be difficult for the students is the difficulty of gaining formal concepts. Most of the mathematical and geometric concepts are cognitive activity requiring formal concepts; but formal concepts are learned more difficultly than concrete ones (Önder, 2001). The reason many students do not like Geometry and the general failure of this class, is the wrong methods that teachers use. For example, if teacher gives definition immediately in teaching "rectangle" surface, it would be so abstract, incomprehensible for a student at that level (0 level). The National Consulting Committee in America stated improving students' visual awareness and logical thinking ability as one of the goals in Geometry teaching. In the light of these goals, American National Council of Mathematics Teachers (NCMT, 1989) stated that using technology especially computers in an appropriate way will give students a rich environment that they improve their Geometrical understanding and intuitions in it. Many researchers stated that students' discovery of Geometry and problem solving skills can be improved by using dynamic computer programs (Battista, 2001; Hoffer, 1983). There are lots of studies in the literature shows that using computer-supported teaching supplies meaningful and permanent learning.

Computer-supported dynamic environments can turn classes into imaginary laboratories for students to find the relations between figure's parts. That of developed geometrical figures moving in the screens transforms dynamical geometry software (DGS) to virtual laboratories. The most important characteristics of DGS's carrying, moving and changing figures with different transformations (Hazan & Goldenberg, 1997). In traditional school Geometry figures that constructed with paper, pencil, ruler or compasses are stable, and this stableness limits the opportunity of making research on geometry objects. DGS's makes these stable objects moving with their new approach.

Tutak and Birgin (2008) investigated the effects of the computer assisted instruction on students' geometry achievement at fourth grade



geometry course. They found that the computer-assisted instruction had a significant effect on the students' geometry achievement compared to the traditional instruction at fourth grade geometry course. NCTM (2000) state that "technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning." Computers provide visual images of mathematical ideas, facilitate organizing and analyzing data, and compute efficiently and accurately. Students are able to "focus on decision making, reflection, reasoning, and problem solving"

Technology makes instruction more student-centered, encourages cooperative learning, and simulates increased teacher-student interaction" (Almeqdadi, 2000).

Yousef (1997) conducted a study to investigate the effect of using the GSP on the high school students' attitudes towards geometry. One of the results of that study indicated that the scores of the pretest and posttest of the students in the experimental group were significantly different. Another result indicated that there was a significant difference between the control and experimental groups in the gain of the scores from the pretest to the posttest. Lester (1996) conducted a study to investigate the effects of the GSP software on achievement of geometric knowledge of high school geometry students. The results indicated that the mean of posttest scores for the dependent variable (geometric conjectures) of the experimental group was significantly higher than that of the control group.

Tabuk (2003) showed in his study that at elementary school 7th grade "Circle, Spherical and Cylinder" subjects' computer-supported education have positive effects on mathematics success. Baki ve Özpinar (2007) stated that DGS using improved students' success, attitudes and thoughts towards mathematics. Sulak and Allahverdi (2002) found in a study that took elementary school 6th graders as sample, computer-supported education affected students' success level and attitudes in a positive way.

Almeqdadi (2000) investigate the effect of using the Geometer's Sketchpad (GSP) on students' understanding of some of the geometrical concepts. The results of the study indicated that there was a significant difference between the means of the students scores on the posttest with favor to the experimental group. This result showed that the use of the GSP had the effect on students' understanding of the geometrical concepts.

In the conducted studies are seen mostly focused on elementary educations second level and upper grades. But not really encountered the studies that examine the effects of teaching Geometry in elementary school first level using computer-supported teaching to students' learning level of Geometry. Besides, according to Piaget for transition the elementary school first level students who are at the concrete level to formal level, it is necessary to plan and offer environments that uses computer-based instruction (CBI). Because of that it is required to make studies directed to use DGS's in elementary school first levels. So, it is thought that this study will fill a gap in the area.

- **Problem of the Study:** The question, in elementary school 4<sup>th</sup> grade Geometry class is there any effect of teaching via dynamic Geometry program (DGS) Cabri on students' learning level, constitutes this study's research question?



• **Sub Problems:**

- Is there any significant difference between experiment and control groups' last test scores of knowledge step?
- Is there any significant difference between experiment and control groups' last test scores of comprehension step?
- Is there any significant difference between experiment and control groups' last test scores of application step?
- Is there any significant difference between experiment and control groups' last test scores of analysis step?

**2. RESEARCH SIGNIFICANCE (ÇALIŞMANIN ÖNEMİ)**

Connecting with the result of this study, followings were suggested. This study put forward the contribution of computer-supported teaching to students' geometry learning level. Consequently, in the elementary school second level and upper levels geometry classes also, more successful results can be obtained in students' learning level by using dynamic geometry software.

Teachers who apply the activities have important mission for obtaining positive results on computer-supported teaching and the achievement of students' learning level. For that reason, teachers should get in-service training from area experts.

In this study only pre test and post test were applied to the groups. So, in the future studies following test can be used for testing permanence of teaching.

**3. METHOD (YÖNTEM)**

**3.1. Model of the Study (Çalışma Modeli)**

The research was conducted according to a semi-experimental model includes pre and post test control group.

**3.2. Sample (Örnek)**

The study group was consisted of 38 4<sup>th</sup> graders from a town's elementary school's two different branches (4-A and 4-B) in Trabzon province. There are 21 student in experiment group and 17 students in control group.

**3.3. The Structure of Computer-Based Teaching Material  
(Bilgisayar Tabanlı Öğrenme Materyalinin Yapısı)**

Computer-supported teaching activities were developed that uses dynamic geometry program (DGS) Cabri towards teaching elementary school 4<sup>th</sup> grade Geometry subjects. Cabri has a dynamic structure. Cabri gives the opportunity of strolling with the help of mouse on the visual demonstrations of geometrical figures, moving object, measuring, at the same time exploring stable relations in the structure and finding formal mathematical relations in the structure. This learning environment which Cabri offered gives students the opportunity of interacting with computer, exploring and constructing their own knowledge structure. Study sheets were developed to guide students in the application process of computer-supported teaching activities. There is not direct knowledge in the study sheets but there are directives for students as clues related with the activities they will do. During the process of developing computer-supported teaching materials, there area expert educators' and classroom teachers' opinions were received and lastly a pilot study conducted in another school.



### **3.4. Experimental Process (Deneysel İşlem)**

Before the application at the stage of designating experiment and control groups, classroom teacher's opinion was received and an achievement test was applied to both groups as pre test. Pre test results showed that there is no significant difference between experiment and control groups in terms of success.

In the experiment group of elementary school 4<sup>th</sup> grade Geometry subjects were taught with computer-supported activities that developed by the researcher. During computer-based teaching activities were made by both groups and in this process the study sheets were handed out for guidance. In the experiment group's lesson process, the teacher undertakes the guide role, students' group studies and their completion were supplied and with the discussions information was shared.

On the other hand in the control group there was no intervention in the teaching process and it was all handled by the classroom teacher. It is determined that in the observations made beforehand and the interviews during application process the teacher used direct instruction and question-answer methods in the control group. Besides, in the control group no extra activities were done except for the ones in the textbook. More than doing activities and using materials in during instruction, it was chosen the way of giving examples of the objects that exist in the classroom and used in the everyday life.

At the end of the applications of experiment and control group, achievement test was applied to both groups as post test.

### **3.5. Data Collection Tools (Veri Toplanma Araçları)**

In this study an achievement test was used as data collection tool which is consist of 20 multiple-choice questions. At the step of developing achievement test, preparing designated table towards the gains of these subjects 28 multiple-choice questions were constituted again toward the gains. While constituting the questions, it was benefited from the 4<sup>th</sup> grade textbook and miscellaneous books. Four mathematics teachers' and three area educators' opinions were received for the content and visual validity of the achievement test. And in light of these opinions 5 questions were extracted from the achievement test and the ultimate form was given. Pilot applications of this ultimate form of the achievement test and making item analysis, test were applied to 80 4<sup>th</sup> graders who saw those subjects before. In the end of pilot application 3 question were extracted that item differential power is below 0.30 (Kalaycı et al, 2005). In its ultimate form, 20 questioned multiple-choice measurement tool's reliability coefficient was found as 0.84. It can be said that this value is enough for achievement tests.

### **3.6. Analyses of Data (Verinin Analizi)**

For each right answer in the achievement test 1 point and for each wrong answer 0 point was given to the students. A student can get maximum 20 points from the achievement test. Because the data was obtained did not show normal distribution, it was evaluated by using Kruskal Wallis H-Test in the SPSS 13.0.



#### 4. RESULTS (SONUÇLAR)

##### 4.1. Findings and Interpretation Relating to the First Sub Problem (Bulgular ve Birinci Alt Problemlerle İlgili Yorum)

At the end of the experimental process, an achievement test was applied to the experiment and control groups as post test and Kruskal Wallis H-Test was applied to the students' post test scores of knowledge step. Obtained results are presented in Table-1.

Table 1. The results of Kruskal Wallis H-test relating to the groups' post test scores of knowledge step  
(Tablo 1. Grupların Kruskal Wallis H-test ilgili bilgi basamağı son test sonuçları)

Groups	N	Sequence mean	sd	$\chi^2$	p	Meaningful difference
Experiment Group	21	24.40	2	11.54	.085	No
Control Group	17	22.15				

When the Table 1 was examined, it was founded that experiment group's sequence mean is 24.40 and control group's is 22.15. It was determined that the difference between experiment and control groups does not have statistical importance [ $p > .05$ ]. Relating with this finding at the end of the experimental process it can be said that groups are equal in terms of knowledge step.

##### 4.2. Findings and Interpretation Relating to the Second Sub Problem (Bulgular ve İkinci Alt Problemlerle İlgili Yorum)

At the end of the experimental process achievement test was applied to the experiment and control groups as post test and Kruskal Wallis H-Test was applied to the students' post test scores of comprehension step. Obtained results are presented in Table 2.

Table 2. The results of Kruskal Wallis H-test relating to the groups' post test scores of comprehension step  
(Tablo 2. Grupların Kruskal Wallis H-test ilgili kavrama basamağı son test sonuçları)

Groups	N	Sequence mean	sd	$\chi^2$	p	Meaningful difference
Experiment Group	21	17.40	2	22.00	.000	D-K
Control Group	17	27.35				

$p < .05$

When the Table 2 was examined it was founded that experiment group's sequence mean is 17.40 and control group's is 27.35. It was determined that the difference between experiment and control groups has statistical importance [ $p < .05$ ]. Relating with this finding at the end of the experimental process it can be said that experiment group's students are more successful than control group students in terms of comprehension step.

##### 4.3. Findings and Interpretation Relating to the Third Sub Problem (Bulgular ve Üçüncü Alt Problemlerle İlgili Yorum)

At the end of the experimental process achievement test was applied to the experiment and control groups as post test and Kruskal



Wallis H-Test was applied to the students' post test scores of application step. Obtained results are presented in Table 3.

Table 3. The results of Kruskal Wallis H-test relating to the groups' post test scores of application step  
(Tablo 3. Grupların Kruskal Wallis H-test ilgili uygulama basamağı son test sonuçları)

Groups	N	Sequence mean	sd	$\chi^2$	p	Meaningful difference
Experiment Group	21	27.24	2	26.30	.000	D-K
Control Group	17	14.56				

p<.05

In the Table-3 it seems that experiment group's sequence mean is 27.24 and control group's is 14.56. It was determined that the difference between experiment and control groups has a statistical importance of p<.05. Relating with this finding at the end of the experimental process it can be said that experiment group's students are more successful than control group students in terms of application step.

#### 4.4. Findings and Interpretation Relating to the Fourth Sub Problem (Bulgular ve Dördüncü Alt Problemle İlgili Yorum)

At the end of the experimental process achievement test was applied to the experiment and control groups as post test and Kruskal Wallis H-Test was applied to the students' post test scores of analysis step. Obtained results are presented in Table-4.

Table 4. The results of Kruskal Wallis H-test relating to the groups' post test scores of analysis step  
(Tablo 4. Grupların Kruskal Wallis H-test ilgili analiz basamağı son test sonuçları)

Groups	N	Sequence mean	sd	$\chi^2$	p	Meaningful difference
Experiment Group	21	28.00	2	23.69	.000	D-K
Control Group	17	15.03				

p<.05

In the Table 4 it seems that experiment group's sequence mean is 28.00 and control group's is 15.03. It was determined that the difference between experiment and control groups has a statistical importance of p<.05. Relating with this finding at the end of the experimental process it can be said that experiment group's students are more successful than control group students in terms of analysis step.

#### 5. DISCUSSION AND RESULT (TARTIŞMA VE SONUÇ)

At the end of this study it was found out that the computer-supported teaching which was applied to the experiment group in the teaching of elementary school 4<sup>th</sup> grade Geometry subjects is more effective than the traditional teaching which was applied to the control group for the students' learning level of Geometry. It was determined that at the comprehension, application, and analysis steps experiment group students were more successful than the control group students while could not find any significant difference between them



at the knowledge step. This result can be explained with the computer-supported teaching activities that were processed in the experiment group. Because in contrast with the control group students, experiment group students found the opportunity of participating the computer-supported teaching activities actively, with the help of dynamic geometry program Cabri making some experiments on the computer with students, and testing their own knowledge. In addition to this, computer-supported teaching environment in the experiment group was supported with group study and study sheets. In these computer-supported teaching environments the opportunity of telling their opinions comfortably, discussing the results they found with their friends, and constructing their knowledge was given to the students. As a matter of fact, a meaningful learning, as Piaget stated, comes true with individual's active participation to education process and share his/her knowledge in social environment.

In the conclusion of this study, dynamic geometry program Cabri can be shown as an important reason of increasing experimental group students' geometry achievement. Because this dynamic geometry program gives students the opportunity of moving the geometric figures which was given to them, constructing new figures, making observations and constructing their own knowledge. Besides, this software made geometry more enjoyable for students, because of supplying visual of geometric figures. In this study DGS Cabri increased the students' learning level in other words their achievement. But as opposed to this, in Takunyacı and Akgün's study (2007) it was found that there is no significant difference between the effects of computer-supported teaching which was made with a program developed by a private firm for teaching elementary school 8th grade Geometry subject "surface measurements and volumes" unit, and face to face teaching on students' achievement. This situation was attributed to inefficiency and inadequacy of the lesson program which was used for CBI in the research.

The obtained result from this study which is computer-supported teaching increases students' achievement more than traditional teaching, overlaps with Tabuk's (2003) "Circle, Spherical and Cylinder" and Bedir's (2005) "angles and triangles" subjects in which it is stressed that computer supported teaching at geometry increase students achievement levels (Assaf, 1986).

On the other hand, the results obtained from this study has parallel points with the results of the studies that was conducted by Tutak and Birgin (2008), Moore (2002), Bedir and his colleagues (2005), Işıksal and Aşkar (2005) in which they all stated that computer-supported teaching increases students' achievement various subject within mathematics.

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