THE EFFECT OF UTILIZING THE THREE DIMENSIONAL DYNAMIC GEOMETRY SOFTWARE IN GEOMETRY TEACHING ON 12TH GRADE STUDENTS, THEIR ACADEMIC SUCCESS, AND THEIR ATTITUDES TOWARDS GEOMETRY

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ÖZET:

Bu araştırmada, "Prizmalar" konusu örnek olarak seçilerek, geometri öğretiminde üç boyutlu dinamik geometri yazılımı kullanımının, 12. sınıf öğrencilerinin akademik başarılarını ve geometri dersine karşı tutumlarını nasıl etkilediği belirlenmiştir. Araştırma yarı deneysel bir çalışmadır ve son test kontrol gruplu modele dayanmaktadır. Örneklemi bir devlet okulunda 12. sınıfta okuyan 71 öğrenciden oluşmaktadır. Deney grubunda 36 öğrenci ile dinamik geometri yazılımlarından biri olan Cabri 3D kullanılarak, kontrol grubunda 35 öğrenci ile geleneksel yöntemlerle işlenmiştir. Araştırmada nicel veriler toplanmıştır. Veri toplama araçları "Uzay Geometri Başarı Testi", "Geometriye Yönelik Tutum Ölçeği", "Prizmalar Başarı Testi" dir. Veriler TAP ve SPSS 15.0 istatistik paket programları kullanılarak çözümlenmiştir. Bulgular arasında Cabri 3D kullanımının öğrencilerin akademik başarı yönünden deney grubu lehine istatistiksel olarak anlamlı bir fark olduğu belirlenmiştir. Ayrıca Cabri 3D kullanımı ile ders işlenişleri sonunda, deney ve kontrol grubu öğrencilerinin geometriye yönelik tutum düzeyleri arasında istatistiksel olarak anlamlı bir fark yaratmadığı sonucu elde edilmiştir.

Anahtar Kelimeler: Cabri 3D, akademik başarı, tutum

ABSRACT:

This research, with the subject of prisms selected as an example, is intended to determine how utilizing the three dimensional dynamic geometry software affects 12th grade students, their academic success, and their attitudes towards geometry. The research is a semi-experimental study and it is based on the post-test control group model. The sample of the research consists of 71 students at 12th grade in a public school during 2009-2010 academic year. In the experimental group, 36 students took the courses using Cabri 3D, which is a dynamic geometry software (DGS), while in the control group 35 students took the courses through traditional presentation method. This was implemented for five weeks. Quantitative data were collected in the study. The prism subject of the solid objects sun-learning field is selected as samples. Quantitive data were gathered during the research. The data was acquired by the means of "space geometry success test", "attitude towards geometry scale" and "prisms success test ". Quantative data are analyzed by utilizing SPSS 15.0 statistical packaged software. Utilizing Cabri 3D, one of the findings obtained in research, is defined as a statistically significant difference in favour of the experimental group. At the end of the lessons with the use of Cabri 3D, it was seen that there is no statistically significant difference at the experimental and control group students' levels of attitude towards geometry. It is considered that the results gathered from the research shall contribute to the studies to be carried out on the use of Cabri 3D in geometry learning.

Key words: Cabri 3D, academic success, attitude.

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1.INTRODUCTION

Today, technology is developing in the form of hardware and software, renewing itself in various ways in each and every field. The fact that the use of science, technology, and computer is becoming more and more widespread in every field led to new developments especially in education and to an increasing use of computers in schools (Altun & Bektaş, 2010). Within this framework, computer-based learning becomes prominent. According to Stanton, Porter ve Stround (2001), computer-based learning is advantageous in providing active involvement of the student in learning, individualising learning, making learning possible in line with the pace of the student, and having quick results. Some of these advantages are possible through the software used in the computer. Therefore, the importance of teaching software in the use of computers at schools cannot be ignored. Computer software as a teaching tool is the tool that provides the highest level of interaction in the learning environment compared to other tools (Şahin & Yıldırım, 1999, s.25).

The software used in computers for educational purposes are more valuable to the extent that they are interactive and facilitate learning. In this scope, today there is a wide variety of software in terms of quality and quantity. This, in turn, provides the opportunity to enrich the teaching- learning environment. One of these opportunuties in maths teaching is Dynamic Geometry Software (DGS). DGS is the name given to the software developed for geometry which is a sub-branch of maths such as Cabri 2D, Cabri 3D, and Geometer's Sketchpad used frequently in computer-based teaching. These are types of software which provide the opportunity to take geometry to a virtual setting and to have various experiences in computer. These types of software are dynamic due to the fact that they have many flexible features, that every figüre drawn is not constant, and that each feature can be changed as desired. One can make any figure drawn in these settings larger or smaller or can easily change its location and position and make the desired additions to the figure. Also DGS saves geometry from paper- pen process which has a "stable" structure and makes it dynamic on the computer screen, and provides the opportunity for students to make hypotheses, discover theories and relations and test these in the field of geometry teaching (Güven, 2002).

Everyone interested in geometry in general knows the potential of drawing a figure of an object or making a quick draft of it to lead to various relations that they cannot see (King & Schattschneider, 1997). Because a figure that is drawn inaccurately might cause neglecting special situations, putting forth invalid hypotheses as well as it might cause meaningless results to emerge (Güven, 2002). These indicate that the use of computer software in geometry teaching might be useful.

One of the sub branches of the field of geometry is space geometry. As the studies in space geometry cover three dimensional (3D) geometry activities, the use of visual- spatial skills is more prominent in this field. National Council of Teacher of Mathematics (NCTM) suggests in its report (2000) that geometry teaching should include 3D geometry studies and that students are provided with opportunities to use their spatial skills when solving problems. However, it is not sufficient to use traditional tools like only paper or board, pen, ruler, compass, protractorin traditional classroom setting in space geometry classes. It is difficult for the students to acquire the expected the skills and achieve success in this area through working 3D figures drawn on paper or board. Also, it was put forth through research that it becomes harder for the students to see the relations between geometric objects and that they draw inaccurate outcomes through different perceptions in space geometry classes based on plane geometry (Ben-Chaim, Japan&Houang, 1988; Accascina&Rogora, 2006).

According to a study by Bako (2003), the geometry subject that is the least appealing to 15-year-old students is space geometry. Only 10% of the teachers included in the study expressed that they are successful in teaching space geometry. It was stated that the real reason of the difficulty experiences in teaching this subject is the fact that the students cannot see 3D (Bako, 2003). Taking the principle that the use of visualization in maths teaching can have a positive effect on the students in both cognitive and affective terms as a departure point, the need to use visualization in maths teaching starting from the first stage of primary education is obvious (Tutkun, Öztürk&Demirtaş, 2011). In that sense, students need more meaningful, more convincing, more visual studies

regarding the figures on which they work. This is possible through turning the traditional classroom setting into an experiment setting.

Studies have indicated that applications through computer software, the movements and the turning of figures that the students see on the computer screen have positive effects on dynamic visualization skills that help them do the same procedure in their minds (Harel&Sowder, 1998; Işıksal ve Aşkar, 2003; Köse, 2008). Therefore in recent years the software developed for 3D geometry teaching is prominent. The most prominent among the types of software is Cabri 3D which is a type of DGS. Cabri 3D software provides a virtual settings for students where they can work on geometric figures on computer screen. Figures that cannot be seen or formed in traditional settings can easily be formed in these settings. Many relations and features can easily be seen. Also, the fact that we can define some basic elements of geometry as invariant, and some as variant through Cabri 3D gives us the opportunity to examine the geometric structure dynamically when we move the structure accordingly (Baki, 2001). Also through Cabri 3D software, students can see each element that forms the geometric figures step by step and they can explain various situations (Katona, 2008). Thanks to such visualizations, students can see the figures as they are in various structures which they cannot see on paper such as the edges and face angles.

Laborde (2001) made observations regarding the applications of teaching scenarios which were prepared based on Cabri geometry software on secondary students in a three-year process and tried to analyze and explain the stages of incorporating technology in maths teaching. As a result of his study, he stated that technology is a visual enhancer and expressed that technology plays a significant role in students' effective structuring of mathematical concepts, emphasizing the existence of certain principles in forming the meanings of the tasks asigned in teaching scenarios. In another study, Yıldız (2009) examined the effect of the use of computer-assisted teaching method in the subjects of subject areas and volumes of geometric objects on the attitude and success of students in primary school grade 8. The courses of the students in the experimental group (n=23) of the study involving 46 students were conducted with th teaching software prepared by the researcher using the computer-assisted teaching method for five weeks (20 course hours). The courses of the students in the control group (n=23) were conducted with traditional teaching method in the same period. The results of the study indicated that computer-assisted teaching in the subjects of surface areas and volumes of geometric objects had a positive impact on the attitudes of 8th grade students and their success in maths. Similarly, Tabuk (2003), Tutak (2008) found in their studies that the use of DGS Cabri 3D positively affected the attitudes of students towards geometry. Also the effects of problem solving with computer assistance on the attitudes of students towards maths were analyzed (Funkhouser, 1993). According to the results of the study, computer use developed a positive attitude in the students both towards maths as a discipline and as a maths student.

As can be seen, it will be useful to make use of DGS which should be used in our training institutions and which is recommended to be used (Ministry of National Education, 2011) in the new geometry teaching program. However, socio-economic differences and differences in curricula, learning environments, teacher approaches between our country and other countries can have an influence on the results of using DGS in classes.

1.1. Aim of the Study

The aim of this study is to put forth how the use of three dimensional dynamic geometry software in geometry teaching affects the academic success of 12th grade students and their attitudes towards geometry class.

In this framework sub problems are as follows;

1. Is there a difference between the academic success of students in classes where Cabri 3D program was used and those where it is not used?
2. Is there a difference between the attitudes of students towards geometry where Cabri 3D program was

used and those where it is not used?

3. Is there a significant difference between the students in the experimental group in terms of academic success and attitudes towards geometry according to gender?

The subject of prisms in the program of 12th grade was chosen as an example in order to examine geometry teaching in DGS use.

2. Method

This study is a quantitative study in terms of its aim, design, approaches in data collection and analysis.

Experimental pattern was used in this study. However, groups were not chosen completely randomly. Because the classes in the schools to be selected have already been determined and it is not possible to make changes in classes for research. Therefore, the pattern of the study has been designed as a semi-experimental pattern. In the study, equalized post- test control group model was used.

2.1 Participants

The universe of the study was determined as 12th grade students in the province of Manisa. While determining the working group, stratified, cluster and simple random sampling method has been used among probability based sample choosing methods. The working group consists of 71 students attending classes in the second term of 2009-2010 academic year in an Anatolian High School in the district of Salihli in Manisa. The students in the working group have been defined as experimental and control groups.

Table 1 shows the numbers and gender distributions of the students defined as experimental and control groups in the study.

Table 1 : Distribution of Study Sample according to Classes and Gender

	Class	Female	Male	Total	
EXPERIMENTAL	12 FEN-A 12 TM-A	7 12	9 8	16 20	36
CONTROL	12 FEN-B 12 TM-B	11 10	5 9	16 19	35
TOTAL		40	31		**71**

2.2 Material and Application Process

The application was made with the traditional lecturing of teachers using blackboard in their own classes with the students in the control group. With the experimental group, the course was taught in computer laboratory. The lesson started with information on how to use Cabri 3D software for the students in experimental group and the students were asked to try to work on the program on their own. Each student worked on a computer with Cabri 3D. After the students were given sufficient information regarding how to use the program, the subject was taught with activities and work sheets supported by Cabri 3D, and when needed, the activities were reflected on the screen through a projector.

During the application, the lessons were taught through activities and work sheets prepared by the researchers for the subject of prisms. While preparing these materials, firstly the behaviours pertaining to the subject of

Prisms in the Geometry Program were examined. Afterwards, 12th grade books for Secondary Education Geometry Lesson were revised. Activities and work sheets were prepared taking into account the behaviours.

2.3 Data Collection Tools

The tools that were used to collect data from the participants in the study are given below:

-   "Space Geometry Success Test" to determine the groups with equal level of academic success among 12th grade students,

-   Essay on attitude towards geometry and "Attitude Towards Geometry Scale" in order to determine the attitudes of 12th grade students towards geometry,

-   "Prism Success test" in order to assess 12th grade students' academic success on "Prisms"

2.3.1 Space Geometry Success Test:

The main aim of preparing this success test is to determine whether the knowledge levels of the students in four different classes of the same teacher are equal. Thus, experimental and control groups will have been defined in practice. For this test, 31 questions including questions which were asked in previous years in the university entrance exam at "knowledge, perception, application, analysis, synthesis and evaluation" levels were prepared. The success test that had been prepared was examined by two experts from Dokuz Eylul University Secondary Education Maths Teaching Department and three maths teachers. The necessary arrangements and adjustments were made and the test was finalized according to their views. The success test that was developed was applied to 213 people in total consisting of 12th grade students who learnt the subject for item analysis. The data obtained as a results of the practice were analyzed through TAP program. In the analysis, KR-20 reliability coefficient was found as 0.85.

The item distinguishing power of the questions was examined, 8 items with an item distinguishing index lower than 0.30 were removed from the test. As a result, the number of questions in the test was reduced to 23 after 8 items were removed from the test (Eryiğit, 2010).

2.3.2 Attitude Towards Geometry Scale:

Attitudes are features that are idiosyncratic just like opinions, however they do not change easily so there can be significant differences in their assessment. Attitude scales are scales that are prepared in order to answer a series of sentences/ statements with the purpose of revealing the inner world of the individual. The results of the attitude assessment should reflect whether the intensity of an individual's emotions is for or against the attitude object. In order to assess attitude, mainly Likert- scale is used although various attitude scales were developed such as Likert, Thurstone and Guttman (Karamustafaoğlu, 2003).

Likert scales have certain advantages and disadvantages compared to other scales. Likert scales are easier to develop compared to other attitude scales, however they can be adapted to various attitude objects and situations. Also it provides the opportunity to assess both the direction and the degree of attitude among the dimensions of attitude that can be assessed. However, the fact that different answer statements give the same total points is considered as a disadvantage (Özbay ve Şahin, 2000). While developing attitude scales, attitude sentences with details to include various dimensions of the attitude that is aimed to assess. Generally in order to reduce possible errors, the number of attitude sentences varies from 6 to 24 (Tavşancıl, 2002). In the study, in order to determine the students' attitudes towards geometry, "Attitude Towards Geometry Scale" was developed by the researcher.

Literature review of the relevant field was made firstly in order to develop Attitude Towards Geometry Scale. In order to form the items regarding the attitudes towards geometry, 6 questions were asked in the form of a composition to 40 students at 1st grade who study at Dokuz Eylul University secondary school maths teaching and 40 students who study at an Anatolian High School in order to understand their emotions and ideas regarding geometry. These compositions were examined, and the positive-negative expressions that are directly

related or accepted to be related to the attitudes of the students are gathered. These sentences were rewritten as attitude sentences. While the items were being rewritten, special attention was paid to forming them as items that indicate the behaviors that are desired or undesired instead of sentences that indicate factual situations. In order to prevent the items from being uncertain, special attention was paid to the simplicity of words and the level of the group was taken into account. A pool of items consisting of 42 items was formed out of the sentences taken from the compositions written by the students. Some of the sentences in the pool of items consisted of sentences that indicate negative attitude. The opinion of teachers of Turkish Language and Literature was taken in order to remove incoherencies in these sentences in terms of language and literature. We paid attention to have an equal number of sentences that express positive attitude and those that express negative attitude. In order to prevent the subjects from giving stereotypical answers, the selected 42 items were written in a random order. In the survey consisting of 42 items, 6 closed ended questions were included with the purpose of obtaining personal information from the respondents (Class, age, school, education level of mother, education level of father). In the survey, the subjects were asked to respond to each statement according to five categories of "I certainly do not agree, I do not agree, Normal, I agree, I certainly agree". In order to test the validity and reliability of the draft scale, a pilot study was conducted on 110 students. The final version of the scale consists of 42 items. The data collected from the participants were analyzed using the SPSS 15.0 package program. For example, factor analysis was made for the structural validity of the scale, and Cronbach alpha coefficient was calculated for validity.

Factor analysis is a statistics method that is applied in order to find few, unrelated and conceptually significant new variables through bringing together variables that are closely or intermediately related (Balcı, 2006; Büyüköztürk, 2007). While applying factor analysis, it is important that the size of the sample is large enough to ensure the correlation reliability. In order the determine the sufficiency of data obtained from the sample, Kaiser-Meyer-Olkin (KMO) test is conducted (Tavşancıl, 2002; 50). If Kaiser-Meyer-Olkin value is higher than 0,60, the data can be considered as appropriate for factor analysis (Büyüköztürk, 2007; 126). Therefore first the Kaiser-Meyer-Olkin value of the scale was checked. It was found that the Kaiser-Meyer-Olkin value of the prepared scale is 0.693 and it was decided that the data are appropriate for conducting factor analysis. The first factor was named as "the dimension of negative attitude towards the subject of prisms", the second as "the dimension of positive- negative attitude towards geometry", the third as "the dimension of attitude towards computer programs", the fourth as "the dimension of negative attitude towards computer use in geometry", the fifth as "the dimension of motivation towards geometry". Cronbach Alpha reliability coefficient of the 31-item scale was calculated as 0.870 (Eryiğit, 2010).

2.3.3 Prisms Success Test:

For this test which was developed in order to assess the academic success of 12th grade students on the subject of "prisms", primarily the related behaviours in the National Education Secondary School Geometry Program and Secondary School Geometry 12th Grade Coursebook were examined. Then, we tried to determine how many questions to write from the stages of "knowledge, perception, application, analysis, synthesis and evaluation" in a way to cover the acquisitions in the sub learning field of "Prisms". 21 questions were prepared according to the determined acquisitions. For scope validity of the test, opinions of 3 experts were taken (1 Lecturer at the Department of Secondary School Maths Teaching, 1 graduate student at the Departments of Maths Teaching at Education Sciences Institute, 1 Maths teacher at secondary education). We decided that the test should consist of 21 questions based on expert opinion. After adjustments, the test consisting of 21 questions was ready to test. The success test which was developed was applied to 227 students studying at 12th grade for item analysis. The data obtained at the end of the application were analyzed with the help of TAP program. In the analysis, KR-20 reliability coefficient was found as 0.799. According to item analysis results that were obtained, no item with an item distinguishing index lower than 0,30 was found (Eryiğit, 2010.

2.4 Data Analysis Methods

In order to check whether the difference between the averages of the two sample groups, dependent t-test is used for cases in which the two average values that are compared are taken from the same samples and independent t-test is used for cases in which the two average values that are compared are taken from different samples (Çepni, 2007). In order to determine whether there is a significant difference between the academic success and attitudes towards geometry between the students in the group where Cabri 3D is used (experimental group) and those in the group where Cabri 3D is not used (control group) in the study, (independent) t-test is used for unrelated samples. One-way analysis of variance is used while testing the significance of the difference between more than two averages (one-factor analysis of variance for unrelated samples). Two types of comparisons can be made between data using the one-factor analysis of variance called Parametric F test. These are comparisons of the averages of samples and the comparisons of the subjects in the sample with each other (Çepni, 2007). This method that is used in experimental studies and reviews requires the subjects or participants to be in only one of two or more experimental conditions and the assessments to be conducted there. This indicates that the obtained assessment sets are unrelated to each other (Büyüköztürk, 2007). Frequency distribution gives the data in numbers and percentages in order to determine the values pertaining to one or more variables or the features of distribution of points. Frequency distribution is used in general description of data collected in experimental studies and reviews (Büyüköztürk, 2007). In this study, frequency distribution has been used in order to examine the responses to the items of students' attitude towards geometry scale.

3. FINDINGS AND COMMENTS

In the selected school, there are four 12th grade classes. It was determined that the 4 classes in this school are equal interms of academic success according to teachers' point of view. Two among these four classes are in the maths and science group whereas the other two are equally-weighted. "Space Geometry Success Test" was applied to the students in order to determine which among these classes chosen as working group would be the experimental group and which would be the control group and in order to confirm their equality in terms of academic success scientifically. According to the results of the success test applied, Table 7 indicating the success averages of classes was formed.

Table 2 : Space Geometry Success Test Class Averages

Class	Average
12 Sci A 12 TM A	13,17
12 Sci B 12 TM B	12,71

Taking into account the class success averages seen in Table 2, these four classes are divided into two groups in a way to have close averages and to have one class from Science&Maths and Equally-weighted groups in each group. Two of the classes were determined as experimental group and two as control group. The relation between the success averages of the groups was checked with t test. T Test results can be found in Table 3.

Table 3 : **Standard Deviations of Averages of Space Geometry Success Test Points and t-test Results**

Class	n	$\overline{X}$	Ss	Sd	t	p	Significance level
Experimental	36	13,17	3,185	69	-1,870	,526	p>0,05 no meaningful difference
Control	35	12,71	2,782				

As seen at Table 3, it was found that there is no statistically significant difference between the academic success of the predetermined groups. The average academic success of the students in the experimental group ($\overline{X}$ =13,17) does not differ from the average academic success of the students in the control group ($\overline{X}$ =12,71). These findings Show that it is appropriate to determine these classes as experimental and control groups.

3.1 Findings and Comments Regarding Academic Success

As can be remembered, the first sub problem in the study is as follows:

"Is there any difference between the academic success of students in classes where Cabri 3D program is used and those where it is not used in geometry classes?" At the end of the application, in order to compare the academic success of students in classes where there is DGS and Cabri 3D is used and those where it is not used, "Prisms Success Test" was applied to the students. The results of the t test conducted fort he data obtained from this test are presented at Table 4.

Table 4 :t-test Results of Prisms Test Success According to Experimental and Control Groups

Class	n	$\overline{X}$	Ss	Sd	t	P	Significance level
Experimental	36	16,69	3,206	69	6,360	,000	p<0,05 significant difference
Control	35	11,00	4,277				

According to t test results seen at Table 4, a statistically significant difference was not found between the "Prisms Success Test" success averages of experimental and control groups in favor of the experimental group (p=,000). It was found that the average success of the students in the experimental group ($\overline{X}$ =16,69) is higher than the average success of the students in the control group ($\overline{X}$ =11,00). The success percentage of the experimental group which was 63% before the application increased to 79% after the application. Thus, it can be said that Cabri 3D use in lessons has a positive effect on the academic success of students. In other words, it can be said that the academic success of the students in the class where Cabri 3D is used is higher than the academic succes of the students in the class where traditional methods are used in teaching.

3.2 Findings and Comments Regarding Attitudes Towards Geometry

The second sub problem in the study is as follows: "Is there any difference between the attitudes towards geometry among the students in classes where Cabri 3D program is used and those where it is not used?" In order to seek answers for this problem, before and after the application "Attitude Towards Geometry

Scale" was applied to the students. T Test results conducted for the data obtained before the application are given in Table 5.

Table 5: T-Test Results of Attitudes Towards Geometry according to Experimental and Control Groups Before the Experiment

Class	n	$\overline{X}$	Ss	Sd	t	p	Significance level
Experimental	35	116,33	21,211	4,790	1,211	,230	p>0,05 no significant difference
Control	32	110,53	18,601				

As seen in Table 5, t test results indicate that there is no statistically significant difference between the attitude levels of the students in the experimental and control groups (p=0, 230). It is seen from the findings in the Table that the attitudes of the students in the experimental group towards geometry ($\overline{X}$ =116,33) are more positive compared to the attitudes of the students in the control group ($\overline{X}$ =110,53) are more positive. The results of the t test conducted after the application in order to compare the attitudes of experimental and control groups towards geometry are presented in Table 6 together woth the related data.

Table 6 : T-Test Results of Attitudes Towards Geometry according to Experimental and Control Groups After the Experiment

Class	n	$\overline{X}$	Ss	Sd	t	p	Significance level
Experimental	35	120,11	23,09	4,469	,684	,496	No significant difference
Control	35	117,06	13,44				

As seen in Table 6, t test results indicate that there is no statistically significant difference between the attitude levels of students in the experimental and control groups towards geometry (p=0,496). According to the findings in the table, it is seen that the attitudes of students in the experimental group towards geometry are more positive ($\overline{X}$ =120,11) compared to the attitudes of students in the control group towards geometry ($\overline{X}$ =117,06). When attitude points before and after the application are compared, it is seen that there is a slight increase in the attitude levels of students in the experimental and control groups towards geometry.

3.3 Findings and Comments Regarding Differences between Genders

The third sub problem which we seek an answer in the study is "Is there any statistically significant difference between the academic success and attitudes towards geometry of the students in the experimental group according to gender?" In order to seek an answer for this problem, "Prisms Success Scale" was applied to the students at the end of the application and the differences between the students' academic success according to gender were explored. T test was conducted for gender and the t test results of the data obtained after the application are given in Table 7.

Table 7: Prisms Success Test T-test Results of Students in the Experimental Group after the Experiment according to Gender

Experimental	N	$\overline{X}$	Ss	Sd	T	p	Significance level
FEMALE	19	16,11	2,90	,666	-1,172	,249	p>0,05 no significant difference
MALE	17	17,35	3,48				

As seen in Table 7, t test results indicate that there is no statistically significant difference between the academic success of the students in the experimental group after the lesson held with Cabri 3D according to gender (p=0,249). According to the findings in the table, the academic success of female students in the experimental group ($\overline{X}$ =16,11) is lower than the academic success of male students in the experimental group ($\overline{X}$ =17,35).

In order to find out whether the students' attitudes towards geometry differs significantly according to gender, before and after the application "Attitude Towards Geometry Scale" was applied to the students and the differences between attitudes towards geometry according to gender were explored. T test results of the data obtained before the application according to gender are given in Table 8.

Table 8: T-Test Results of the Attitudes of Experimental and Control Groups Towards Geometry Before the Experiment according to Gender

	Gender	n	$\overline{X}$	Ss	Sd	t	p	Significance level
Experiment	**Female**	18	111,62	22,451	4,899	-1,356	,184	p>0,05 no significant difference
	MALE	17	121,40	19,617				
Control	**Female**	17	109,94	16,640	3,992	-0,199	,843	p>0,05 no significant difference
	MALE	14	111,29	21,492				

As seen in Table 8, when we look at the statistical differences between the attitudes of students in experimental and control groups according to gender, t test results indicate that there is no statistically significant difference between the genders of students in the experimental group (p=0,184), and there is no statistically significant difference between the genders of students in the control group either (p=0,843). It is seen in the findings in the table that the attitudes of the female students in the experimental group ($\overline{X}$ =111,62) are lower than the attitudes of the male students in the experimental group ($\overline{X}$ =121,40). The attitudes of female students in the control group towards geometry ($\overline{X}$ =109,94) are lower than the attitudes of male students in the experimental group ($\overline{X}$ =111,29). T Test results of the data obtained after the application according to gender are given in Table 9.

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Table 9: T-Test Results of the Attitudes of Experimental and Control Groups Towards Geometry After the Experiment according to Gender

	Gender	n	$\overline{X}$	Ss	Sd	t	p	Significance level
Experiment	**Female**	18	111,89	23,867	5,626	-2,301	,028	P<0,05 Significant difference
	Male	17	128,82	19,275				
Control	**Female**	17	116,70	11,652	2,43	-0,211	,834	p>0,05 no significant difference
	Male	15	117,69	16,650				

As seen in Table 9, when we look at the statistical differences between the attitudes of students in experimental and control groups according to gender after the lesson with Cabri 3D and the lesson with traditional methods, t test results indicate that there is a statistically significant difference between the genders of students in the experimental group in favor of male students (p=0,028), and there is no statistically significant difference between the genders of students in the control group (p=0,834). It is seen in the findings in the table that the attitudes of the female students in the experimental group ($\overline{X}$ =111,89) are quite lower than the attitudes of the male students in the experimental group ($\overline{X}$ =128,82). The attitudes of female students in the control group towards geometry ($\overline{X}$ =116,70) are lower than the attitudes of male students in the experimental group ($\overline{X}$ =117,69). T Test results of the data obtained after the application according to gender are given in Table 9.

When we look at the attitudes of experimental group students towards geometry before and after the experiment, a very slight change is observed in the attitudes of female students towards geometry, however a more prominent change is observed in the attitudes of male students towards geometry after the experiment (see Table 7, Table 8). When we look at the control group students' attitudes towards geometry before and after the experiment, we see that there is a positive change in the attitudes of male and female students towards geometry (see Table 8, Table 9).

7. Conclusions and Suggestions

This study was conducted to explore the effects of Cabri 3D use in geometry teaching on the academic success and attitudes towards geometry of 12th grade students. Using data collection tools before and after the experimental study conducted for this purpose, we tried to assess the academic success and attitudes towards geometry among the students who participated in the study and the relations between the data obtained were evaluated.

In the study, a significant difference was found between the academic success of the students in the classes where Cabri 3D is used and those where it is not used in the subject of prisms. This finding is parallel to the results obtained in the study of Bones (2002) which he conducted to find out how computer-assisted teaching affects the students' success in finding the volumes of rigid bodies. Bones (2002) showed that computer-assisted teaching enhances the students' success in finding the volumes of rigid bodies. One of the students' commented as follows: "I think it is easier to use the program than to listen to the lesson". This study indicated that

technology use affects student attitudes positively and that the students can solve problems easily. Likewise, the results of the present study indicate that Cabri 3D use enhances students' success. Although in Bones' study the students' attitudes are positively affected, in this study it became clear that Cabri 3D use does not affect the students' attitudes towards geometry. This information is considered as insufficient to claim that Cabri 3D software enhances students' success. In our opinion, more studies are needed to state whether Cabri 3D software use is the real reason of obtaining this finding.

When we explored the effect of the use of Cabri 3D software, which is a new type of DGS, on the attitudes of students towards geometry; a significant difference was not observed before the application between the attitude levels of students towards geometry. Likewise, after the application a statistically significant difference was not observed between the attitude levels of students in the groups towards geometry. It was found that there is a slight increase in the attitude levels of student groups where Cabri 3D is used and not used towards geometry. Similar results were also obtained by other researchers although they are not completely the same. While Tutak (2008) found that Cabri use had a positive effect on students' attitudes towards geometry, Aksu (2005), as a result of the experimental study conducted with primary school students, found that active learning method had an influence in enhancing student success, achieving permanent learning, developing positive attitudes towards maths, and improving geometry understanding levels. Following this information, it can be said that Cabri 3D has a positive effect on the attitudes of students towards the subject area.

When the differences between the academic success of the students in the group where Cabri 3D is used in prisms success test is examined according to gender, it was found that the academic success of male students is a little higher than that of female students. As there are not many quantitative studies regarding Cabri 3D use, this finding was not compared to those in other studies.

In the study, the differences between attitudes towards geometry among experimental and control groups before and after the experiment were examined based on gender and it was revealed through data obtained both before and after the experiment that male students are more inclined towards geometry than female students.

The fact that the study was conducted in the lab of the school caused the students to leave the setting which they are used to and move to another setting. It is assumed that the U type seating arrangement is the reason of some problems encountered. The fact that the teacher in the class was the researcher whom the students had just met might have influenced the study as an undesired variable. In order to remove this variable, geometry classes should be held in computer labs using DGS at times. Thus, it is assumed that undesired variables and problems encountered can be disposed of.

Certain suggestions are made based on the results acquired:

- Teachers should be trained primarily on basic technology skills, and then on DGS use. These training sessions should not be held only for once, instead they should be expanded to the whole process, they should be long-term and followed afterwards. They can be held as seminars or in-service training.

- Teachers should be supported regarding the provision of materials and sources with which they can use Cabri 3D software. Teachers should cooperate in finding, preparing and sharing materials specific to the subject area. For instance, a pool of materials can be formed for each lesson. However, this should not mean an extra load for some teachers. In order to prevent possible problems, responsible and related officials should determine how the performances of teachers preparing the sources will be evaluated and according to which conditions the task should be shared.

- Physical conditions should be improved in schools for the use of DGS Cabri 3D use.

- Cabri 3D, like other technological tools, is not a tool that should be used in all lessons or during the whole lesson. It is assumed that it would not be right to quit traditional board use completely. Cabri 3D software should be successfully included in the setting in cases where its use will yield positive results.

- The problems encountered in Cabri 3D use should be known and taken into account both by producers and teachers who will be users of the program and it is useful to take the necessary measures as soon as possible.

- In future studies, we suggest that Cabri 3D use in geometry teaching is for a longer term. We assume that analyses to be conducted with data collected after the students get used to using computer-assisted DGS are also needed.

- In studies to be conducted regarding Cabri 3D use, results to be obtained through qualitative data besides quantitative data are required.

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SUMMARY

Today, the changes and developments in technology bring innovations to education like any other field. One of these innovations is Dynamic Geometry Software (DGS). It is clear that DGS which is frequently used in computer-assissted teaching will enrich the teaching- learning environment. Because DGS provides an experimental setting for geometry teaching, students will experience trial and error and see the relations. This is more prominent in space geometry which is a sub branch of geometry. In space geometry classes based on plane geometry, it was put forth through research that it gets harder for students to see the relations between geometric objects and reach inaccurate results due to misperceptions (Ben-Chaim, Japan&Houang, 1988; Accascina&Rogora, 2006). Therefore especially in space geometry lessons, software that facilitates seeing and learning is needed.

The aim of this study in this framework is to put forth how three dimensional geometry software use in geometry teaching affects 12th grade students' academic success and attitudes towards geometry. The subject of prisms in the geometry teaching 12th grade program was chosen as an example in DGS use.

It is a semi-experimental study and it is based on post- test control group model. The sample consists of 71 students studying at 12th grade in a public school. In the experimental group, the lessons were held using Cabri 3D which is a type of dynamic geometry software with 36 students, and in the control groups through traditional methods with 35 students. In the study, two science&maths and two equally-weighted classes were included. The application took 5 weeks. In the experimental group, the lessons were held with Cabri 3D software for 5 weeks through worksheets and activities. Quantitative data were collected in the study. Data collection tools are "Space Geometry Success Test", "Attitude towards Geometry Scale", "Prisms Success Test". The classes were divided as experimental and control groups without a significant difference between average success through "Space Geometry Success Test". Through "Attitude towards Geometry Scale", it was explored whether there is any difference between the attitudes of experimental and control groups towards geometry before and after the application. Through "Prisms Success Test", it was checked whether there is a significant difference between the academic success at the end of the application. In the study, among data analysis methods, (independent) t-test was used to check whether there is a significant difference between the academic success in geometry class and attitudes towards geometry among the students in experimental and control groups for unrelated samples. Frequency distribution was used to examine the answers for students' attitude towards geometry scale. The data were analyzed using TAP and SPSS 15.0 statistical package programs.

At the end of the "Prisms Success Test" applied to students to compare the academic success of students in classes where Cabri 3D is used and those where it is not used, it was found that Cabri 3D use leads to s tatistically significant difference in favor of the experimental group in terms of academic success (p=0,000). Also, it is found in the "Attitude towards Geometry Scale" applied to the groups before the application that there is no statistically significant difference between the attitude levels of the students in experimental and control groups towards geometry (p=0,230). When the same scale is applied after class, it was found again that there is

no statistically significant difference between the attitude levels of students in the experimental and control groups towards geometry (p=0,496).

As a conclusion, it was found in this study, like Bones (2002) in the study regarding computer-assisted teaching in finding the volumes of rigid bodies, that computer-assisted teaching enhances the academic success of students. Whereas Tutak (2008) found that Cabri use positively affects students' attitudes towards geometry, this study claims that there is no significant difference between the attitudes of students towards geometry before and after the application.