

## Student Opinions about Learning Primary 7th Grade Geometry Subjects with Geometer's Sketchpad

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### ABSTRACT

The purpose of this study is to determine what are the students' opinions about learning the geometry subjects of primary 7th grade with Geometer's Sketchpad dynamic geometry software. In order to determine the students' opinions, computer-assisted teaching method using Geometer's Sketchpad was used. For this purpose, application related to Geometer's Sketchpad software and computer-aided materials were carried out with totally 42 7th grade students. In the study, data on students' opinions about learning the geometry subjects with Geometer's Sketchpad dynamic geometry software was collected by using semi-structured interview form. Descriptive analysis method was used to analyze the qualitative data obtained. The students stated that studying with GSP dynamic geometry software facilitated the learning, made students more active, increased their interest in geometry and desire to succeed; they learned collaboration, group work, and sharing. The negative opinions of the students were formed because of lack of time to study and program's being English.

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### Introduction

Technology has improved very quickly and affect life. In parallel, creative individuals having analytical thinking skill, detecting problems correctly and producing suitable solutions are needed. For this reason, there is general trend and need for everyone to be literate of mathematics, science and technology. Mathematics education should educate individuals who know the meaning of mathematics, have the knowledge of necessary mathematics to adapt the developing world, and are the experts in using technology (Nikolaou, 2000; Ersoy, 2003).

Technology is a valuable tool in the process of learning and teaching mathematics (Kimmins ve Bouldin, 1996). Besides strengthening the students' learning, it strengthens and supports the teaching skills of the teachers (Kimmins & Bouldin, 1996). Students' developing problem solving techniques, perspectives on data and understanding of mathematics can be provided by using technology (Erbaş, 2006). In general, (NCTM, 2000); Technology helps students' learning mathematics. For example, students may examine more samples with calculators and computers than handwriting, thus it becomes easier to reach mathematical conclusions. The computing power of technological devices increases the amount of problems students may solve and also provides the implementation of routine processes quickly and accurately. Technology provides options for teachers to adapt their teaching to the situations of the students having special needs. Easily distracted students may be more willing to focus on computer activities, or students facing lack of organization can get benefits from the arrangements in computer environment. In addition, opportunities

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offered in bringing students with physical disabilities and mathematics face to face have increased with technology.

Geometry is one of the most important areas of mathematics and its basis must be established in primary education. Because the period, in which first critical observations are carried out, intuitions are formed, the concepts and information are acquired, the relations between concepts are established. Geometry has a separate location in mathematics because of the contributions to recognizing the physical world. However, researches showed that in this area constituting an important part of mathematics, students could not develop strong conceptual understandings (Mistretta, 2000).

Computer-Assisted Instruction (CAI) as the most difficult but the most promising one in the use of computers in education, formed from the combination of the principles of self-learning and computer technology and in teaching process, the usage of computer is not as an alternative but as complement to the system and item strengthening the system. In computer-assisted instruction, computer is a teaching method strengthening the motivation and the teaching process used as an environment where learning occurred, that student can get benefit according to his/her own learning speed, forming from the combination of the computer technology and the principles of self-learning. Besides the success of this method in learning-teaching process depends on several variables, in success of the method, providing educational software for the teaching targets and behaviors is very important. In computer-assisted instruction method, computer technology plays an important role in increasing efficiency in education in terms of quality and quantity and engages as an option for traditional teaching methods rather than teaching process.

In light of the information above, the advantages of computer-assisted instruction are the following. It provides an appropriate classroom instruction by saving time to students in their environment. It gives students the opportunity to control the rate and outcome of learning. Learning the accuracy of the answers immediately brings morale to students. Programs provide a more positive educational environment especially for slow learning students. Since errors will not be in front of the other students they would not be embarrassing. Computer-assisted education is effective for the students having difficulty in learning, from various ethnic groups and with disabilities. The colors, music, and moving graphics used in laboratory activities give realism and selectivity to the subject. The record keeping skill of computer makes it possible to learn individually, and students' progress can be observed by preparing individual instructions. Computers provide a data base increasing in accordance with the development of information. Computers can use all the information belonging to graphics, text, hearing and image. A lot of information can be entered for teacher use. Furthermore, computer gives the individual self learning experience. A variety of instruction methods are used in these learning experiences. Computer provides reliable and appropriate instruction from one student to another without depending on teacher, time, and place. Computer based education increases the effectiveness of instruction. The event is the increase of the student success. Competence is to reach the goals as soon as possible with less cost. Competence is very important in business and industry, and its importance in education is increasing. The emergence of easy to use systems, gave opportunity to some educators to develop their own education programs (EARGED, 2002).

New insights, trial, test and research facilities provided by technology have changed the content and field of mathematics. We see the best examples of this in Chaos Theory, Fractal Geometry, Fuzzy Logic and mathematical modeling in its control systems (Baki, 2001). Technology also brought significant change in ranking the subjects in terms of importance. The importance given to conversion geometry in standards of NCTM's school mathematics published in 1989 is the clearest example of this (NTCM, 1989). Also, statistics, neglected in school mathematics due to paper-pencil calculations' taking long time, got involved in school mathematics with technological developments again (Güven & Karataş, 2003). Dynamic Geometry software such as Cabri Geometry and Geometer's Sketchpad, we have begun to hear those names in geometry teaching, have become a reflection of development of computer technology. Dynamic geometry software (DGS), the reflections of rapid developments in computer technology to geometry classes, has started to enter into primary and high school programs slowly. The expression of dynamic geometry software is the common name of very special geometry software such as Cabri Geometry, Geometer's Sketchpad, and Cinderella developed for geometry. DGS gave students opportunity to hypothesize, explore the theorems and relations, and test these by entering the field of geometry education, rescuing geometry from paper-pen process having a static structure and making it dynamic on computer screen (Güven & Karataş, 2003).

Dynamic geometry software (e.g., Geometer's Sketchpad, Cabri or Geometric Supposer) open structure for mathematics learning-teaching activities, are potentially powerful tools for primary and high school students to investigate. With this software it is possible to examine and detect the features of geometric objects and the relations in two-dimensional space/plane. Cabri one this software can be used not only for plane geometry learning-teaching but also for the other mathematics activities. In addition, not only for BiSa, TI-92 plus advanced HeMa'de Cabri-II software is available and it is possible to create a rich environment for mathematics teaching by using portable personal technology (Ersoy & Baki, 2004). In dynamic environments created by Cabri and similar programs, a student having enough problem solving and searching experience can approach to geometry and mathematical issues new for him/herself more bravely. Teachers can wake their classes with quality geometry problems by using this technology. This awakening both develops students' problem solving skills and has a positive effect on their self-confidence and attitudes towards mathematics (Baki, 2001). The most important and distinctive feature of DGS is that formed shapes can be carried under various transformations, changed and moved (Goldenberg 1999; Hazzan and Goldenberg, 1997). In traditional school geometry, shapes formed with paper-pencil-ruler and compasses are constant and this constancy limits their opportunities to research on the objects. This new approach brought by DGS makes the constant objects mobile on computer screen (Baki et al., 2002).

## Method

### Research Model

In this study, case study method was used. The most important feature of case study is giving opportunity to define special situations examined by focusing on a very special issue or situation to the researcher in detail, and explain cause-and-effect relations between the variables (Cohen et al., 2005; Çepni, 2005). In this kind of studies, the aim is not generalize; but to get a snapshot from the current situation and to reflect the specific situation in detail. Experimental application lasted 8 weeks which means that 32 hours since there are 4 hours mathematics lesson in a week. Before the application, rules obeyed in computer laboratory were identified with the students in research group and were hanged by in the laboratory. In addition, the students are introduced Geometer's Sketchpad software for 4 hours. To do this, Geometer's Sketchpad User's Guide translated by the researcher from English to Turkish was used. The researcher reflected the GSP screen with the projection. The students practiced on their computer by following the samples. First, workspace, called as GSP software's draft (sketch), was shown to the students. Then, select, dot, circle, line, and text tools in the toolbox which is on the left side were explained. "File", "Edit", "Display", Construct", "Transform", "Measure", Graph", "Window" and "Help" menus, above the GSP window, were described briefly by entering into them. Thereof, the students are allowed to draw, tamper the program by doing the activity "snowman" described in the manual. The user manual was copied and distributed to the students. Research group students spent approximately 3 hours in computer laboratory and 1 hour in the classroom in a week. Taking into consideration the fact that students' willing block time 5-10 minutes was used because of not being able to complete the activities in the laboratory.

**Participants.** The population of this study is all the 7<sup>th</sup> grade students studying in the primary schools having computer laboratory in Yıldırım/Bursa. The sample consists of totally 21 students from 7B (research group) in Şehit Kurmay Binbaşı Ufuk Bülent Yavuz Primary School in Yıldırım having computer laboratories in the second term of 2006-2007 academic year. The distribution of the research group students according to gender are given in Table 1.

**Table 1.** The distribution of the subjects in experimental and control group according to the gender

Gender	Research Group
Female	15
Male	6
Total	21

**The structure and processing of the event.** At the beginning of the lesson in the computer laboratory, the subject to be processed was told to the students. The students turned on their computers and got the GSP drafts from the host to their own computers with network connection. Daily worksheets were distributed to the students about the course topic. The students answered the open-ended questions and filled in the blanks by using GSP software and following the instructions on the worksheet. The students were asked to compose what they are asked, reach conclusions and generalize. The students wrote their findings and generalizations on their worksheets. Then, the students were asked what were the findings and conclusions about the activity and they were written on the board. Thus, the students were able to discuss their findings. After the completed worksheet, the next activity and worksheet are started to be done. A sample from the courses processed is as following: the students are made to open GSP draft prepared about "The sum of the measures of exterior angles in the triangle" on their computers. At the same time, the relevant worksheets were distributed to students. Taking into consideration the questions on the draft and worksheet, the students measured the exterior angles of the triangle with Measure-Angle command, and then they took and dragged any of the corner points of the triangle.

### **Gathering Data**

For research, interview form was used as the data collection tool. The purpose of the study is to determine students' opinions about learning geometry in a computer-aided environment. Within the scope of this aim, the data obtained from interviews with students were evaluated qualitatively by dividing into categories. In review process, sentences which may reflect students' opinions generally were determined and some of these used commonly included the study as samples.

### **Interview Form**

In the study, interview form, one of the qualitative data collection tools, was used. Interview is one of the most common data gathering methods in qualitative research. It reveals individuals' views, experiences, and feelings (Yıldırım and Şimsek, 2004: 113). Thus, the limitations of quantitative data collection instruments have been eliminated. Semi-structured interview technique was used in the study. Interview was carried out to learn the research group subjects' thoughts and feelings about learning geometry with GSP in dynamic geometry environment, computer-assisted instruction and GSP program. Interview questions were investigated by a lecturer at of Dokuz Eylül University. After the necessary corrections the open-ended interview form consisting of 8 questions was prepared. The interview was carried out with the research group students one to one in an empty classroom in approximately 20 minutes. External factors (environment, noise, temperature, ...) was minimized by the researcher. Interviews were recorded with video recorder. Thus, students' responses, gestures and mimics were observed.

### **Findings**

20 students in different levels of thinking were interviewed to determine what changes the students in research group, computer-assisted geometry teaching with Geometer's Sketchpad was applied, observed related to their feelings about progressing the course, attitudes towards geometry subjects, success in the course and relationships with their friends. 1 student in the experimental group did not participate in the interview. Each interview lasted approximately 20 minutes. The questions asked with semi-structured interview technique and the answers were recorded on tape. Then, data obtained from the interview was written down and the data was coded. Categories were formed. The data was organized according to these categories. Presentation of the data was made and interpretation of the findings was put in the order. According to sub-categories, by making direct quotation students' opinions were listed in the table generally and analyzed with frequencies. The research group students' answers given to the question "How would you process the geometry subjects in math classes in past years"? and the results of the analysis are given in Table 2.

**Table 2.**Students' opinions about processing the geometry subjects in past years

Categories	Categories	Students' Opinions	f	%
Satisfaction	The Use of Equipment	We have never used equipment. "There was only teacher's hand. She/he would draw with chalk".	14	70
		We have not used any tool except for overhead projector.	1	5
		The teacher was drawing the geometric shapes with compass and ruler.	5	25
	Functioning Format	We would process the geometry on the board. The teacher would tell and we would listen and write.	20	100
	Love	I do not like math class much; I would not like geometry subjects in classroom environment.	3	15
Learning	Enjoyable	It was not fun; we were bored because of teacher's telling the formulas; we would just listen and go because of not being fun.	6	30
	Understanding	We could not understand everything well. It was incomprehensible. "We would ask when we did not understand. Ones, did not understand, would say as understood all together."	8	40
	Retention	There is nothing in my mind; I would forget immediately.	2	10
	Interest	Generally, the subjects were not interesting, because if s/he asked that would you believe without seeing or by seeing and keeping? I would not be willing to participate.	8	40

As shown in table 2, in the use of equipment category of satisfaction category, 14 people (%70) stated that no equipment was used, 1 person (%5) stated that once, overhead projection was used, 5 (%25) stated that ruler and compass were used; in functioning format sub-category, 20 people (%100) stated that the course was processed on the board, teacher presented and the students listened, samples and questions were solved; in love sub-category, 3 people (%15) stated that they do not like geometry and mathematics; in enjoyable sub-category, 6 people (%30) stated that they got bored during the course. According to the answers given by students in general, it can be said that, technological equipment was not used in geometry subjects, teacher-centered teaching method was used in geometry and mathematics classes, the students did not find the course enjoyable and like it. In understanding sub-category of learning category, 8 people (%40) stated that they could not understand the subjects; in retention sub-category, 2 people (%10) stated that they did not remember; in interest sub-category, 8 people (%40) stated that the subjects were not attractive. According to the students' answers, it can be said that it was hard to understand the geometry subjects in past years, they could not remember what they learnt and generally the subjects were not interesting. In table 3, the result of the analysis related to the answers of the question "What is your positive opinion about Geometer's Sketchpad dynamic geometry software used during the geometry learning process?" is shown.

As shown in table 3, 6 students (%30) about exploring, 2 students (%10) about retention, 7 students (%35) about understanding, and 4 students (%20) about success stated positive opinion about GSP program in learning category. According to the students' answers, it can be said that the students were able to explore the features of geometric shapes in GSP program and relations among them, they struggled and got persistent information themselves, and they had positive thought due to grasping and understanding better. In dynamic media category, 3 people (%15) about visuals, 15 people (%75) about enjoyable, 6 people (%30) about interest, and 3 people (%15) sharing among friends stated positive opinion. According to the students' answers, it can be said that the students thinks it is enjoyable to study with GSP program, they do not get bored from the activities, visuals of the program motivate them, moving and dragging geometric shapes is interesting, the program is useful with many aspects, and it creates an environment to discuss and share with each other. The students' answers to the questions "What your negative opinions about GSP dynamic geometry program used during the process of geometry learning with computer? What kind of difficulties did you experience while using GSP program in computer? Was shown in table 4.

**Table 3.**The students' positive opinions about GSP dynamic geometry software

Categories	Categories	Students' Opinions	f	%
Learning	Exploring	We can keep and drag point A and explore its features ourselves; we would struggle ourselves mostly.	6	30
	Retention	We launch our own brains with GSP program. We make our brains active and they stick in our mind whether we like or not.	2	10
	Understanding	We would understand better with seeing than processing in the class; we could grasp more with animations.	7	35
	Success	I believe I can solve geometry questions easily in OKS exam. In fact, I started to be more successful in my examinations.	4	20
Dynamic Media	Visuals	It was very nice visually. We could motivate more.	3	15
	Enjoyable	It was very fun, I did not get bored; We could move the geometric shapes ourselves. We could measure the angles. I was very fun while doing these. I liked making snowman; and the animations.	15	75
	Interest	Changing the letters and writings, painting the shapes drew my attention; Moving the geometric shapes was the most interesting.	6	30
	Beneficial	The program has been very useful; It was easy to measure angles. At least, we would measure immediately but not by calculating. We did not have the advantage of changing the shapes.	11	55
	Sharing Among Friends	I would ask my friends when I did not understand; I would discuss with my friend. If we did not know we would click the buttons and get the answers with your help.	3	15

**Table 4.**The students' negative opinions about GSP dynamic geometry program

Categories	Categories	Students' Opinions	f	%
Troubles	Editorial Language	It was a bit hard for me because it was a program in English and I did not know it.	5	25
	Calculating	I could not calculate some, even on the computer.	2	10
	Knowledge of Computer	I had very little difficulty. Because I would not use computer before; In order to use computer the other students need to know how to use computer and keyboard.	3	15
Solutions	Helping Friends	I survived with your and my friends help.	4	20
	Guidance	I did not encounter a lot of difficulties because you leaded us. It was easy since you explained.	3	15
I do not have negative opinion		The program was not hard for me. It was easy; I do not have negative opinion.	10	50

As shown in Table 4, 10 (%50) of the students stated that they do not have any negative opinion about the program. In troubles category, 5 people (%25) editorial language of the program, 2 people (%10) calculating, and 3 people (%15) in terms of knowledge of computer, stated the drawbacks. According to the students' answers, it can be said that very few students had difficulties because the program is in English, calculation was difficult, and they had little knowledge of computer. 4 (%20) of the students from solutions category stated that they overcame the problems thanks to friends' help and 3(%15) thanks to guidance. According to the students' answers, it can be said that the difficulties about GSP program can be overcome

with friends' help and the teacher's guidance. Table 5 shows the analysis results of the students' answers to the questions "Were there any factors disrupting lesson process during computer-assisted instruction?"

**Table 5.** Factors disrupting lesson process during computer-assisted instruction

Categories	Categories	Students' Opinions	f	%
Student	Extracurricular Off-Topic	Some friends not listening the course did not pay attention; they were dealing with the other programs and the internet; but then, you cut the internet completely.	11	55
	Technical Equipment	We had trouble because of the network; The biggest problem was that network was not opened.	4	20
Environment	Sound	There was noise. We would disturb our attention by talking.	5	25
	Time	I think the time was not enough. I wish there had been more time, I wish it was just this subject and we could finish it.	6	30
Seamless		There was no trouble.	4	20
	The Number of Computer	There were enough computers. Because we studied as pairs and it was efficient.	6	30

As shown in table 5, for the factors disturbing the lesson, 11 students (%55) expressed opinion on extracurricular activities. According to the students' answers, it can be said that in computer-assisted instruction, especially some students' using different programs affected the course negatively. In environment category, 4 (%20) about technical equipment, 5 (%25) about sound, and 6 students (%30) stated opinion about time. According to the students' answers, it can be said that in computer-assisted instruction, environmental conditions need to be controlled, and the number and the duration of the lessons were not enough. 4 students (%20) stated that there is not any trouble, and 6 (%30) students stated that there were enough computers. Table 6 shows the analysis results of the students' answers to the question "What do you think about pair work activities done in computer laboratory?"

**Table 6.** Students' opinions about group works during the application

Categories	Categories	Students' Opinions	f	%
Friendship Relations	Solidarity	I have learnt a lot from my friend; Group work was good because we would help each other when we do not understand; We did by more sharing and helping.	17	85
	Idea Sharing	Because human cannot discuss himself whether something is true or not. However, s/he can do when there is someone else. We dragged the angles to grasp, when we did for one it changed and same for the other. It showed the differences.	4	20
Learning	Enjoyable	Bilateral group work was very good. It was very enjoyable.	11	55
	Desire of Success	It might be helpful for lower level students. She/he might want to learn while his/her friend was explaining. She/he might think that his/her friend would tell, she/he learns and increasing the mark; bilateral group work was more useful.	2	10

As shown in Table 6, for group work in friendship relations category, 17 (%85) on solidarity, and 4 students (%20) stated opinion on idea sharing. In general, it is seen that bilateral group work provides a discussion environment and cooperation. In learning category, 11(%55) on enjoyable, and 2 people (%10) stated opinion on desire of success. According to the students' answers, it is seen that the group work is enjoyable and some students take their friends as an example and want to be successful. Therefore, it can be said that in computer-aided geometry teaching, bilateral group work while studying with GSP has increased the social interaction and sharing. Table 7 shows the analysis results of the students' answers to the

questions "Is there any difference in your perspectives towards geometry after Geometer's Sketchpad? How?"

**Table 7.**The differences in students' opinions on geometry after GSP

Categories	Categories	Students' Opinions	f	%
Learning	Success	My mark has changed so much. My mark increased from 40 to 90. It affected not only this course but the others, too; Permanent formulas stuck in our minds for OKS. I believe I will pass the joint exam, too.	4	20
	Attitude Towards The Course	I was afraid of mathematics. I began to like it after this program; generally, human would fear when you say geometry. Shapes were drawn and there were formulas. However, it was easy here because it was with the explanations; I was afraid before, because of thinking that I could not do. It changed in later times; it was easy.	8	40
	Increasing Of Interest In The Course	I was not reluctant but I became eager with GSP; I was not interested while the teacher was presenting the course traditionally. However, we processed the course with computers in the laboratory. Because of this, the course drew my attention; my interest in mathematics increased; geometry became enjoyable.	6	30
	Understanding	I grasped the subjects more easily; you can understand everything; I used to have difficulties in drawing pictures. Our teacher just made us draw. This time, however, we do it, keep and drag it ourselves, we found the area ourselves.	6	30
Satisfaction	Trusting Him/Herself	Our self-confidence is growing. We believe we can do when self-confidence increase; My desire to be successful increased after GSP.	6	30
	Enjoyment Of The Course	I never liked geometry. I did not like it because I could not do, but I like now; I began to like more after the computer lesson; I never liked before. I did not pay attention to the lesson. However, since it is enjoyable the program is very good, I liked because of being fun, instructive and permanent.	9	45

As shown in table 7, in learning category, 4 (%20) on success, 8 (%40) on attitude towards the course, 6 (%30) on Increasing of interest in the course, and 6 students (%30) stated opinion on understanding. The students stated that they was afraid of geometry and geometric shapes, they were not willing for the course, the course did not draw their attention, they had difficulties in understanding geometric subjects; however, after GSP, they began to like geometry, geometry became more interesting and enjoyable, they understood better because of dragging the shapes and it was easy to draw the shapes, they believed to be more successful. In satisfaction category, 6 (%30) on trusting him/herself, and 9 students (%45) stated opinion on enjoyment of the course. The students stated that after GSP, they started to trust themselves, they wanted to ask for speak much more; they struggled at least even if they could not, and they started to like geometry. In the light of this, it can be said that learning with GSP increased their interest towards geometry, made them like and find geometry, provide them to understand the subjects better when compared with the traditional method. Table 8 shows the analysis results of the students' answers to the question "What differences do you realize between computer-aided geometry teaching and learning in traditional class environment?" Table 8 shows the analysis results of the students' answers to the questions "What is your opinion about worksheets given while studying on computer? How did you feel while completing the worksheets?"

As shown in Table 8, in learning category, 6 (%30) on exploring, 5 (%25) on strengthening, 11(%55) on understanding, 7 (%35) on interest, 11 (%55) on enjoyable, and 7 students (%35) stated opinion on retention. In sharing among friends category, 2 people (%10) said that worksheet provided them to help each other. According to the students' answers, it can be said that worksheets given while studying with GSP increased their side of exploring, questioning, and being creative, strengthened their information, made them



understand better gain more permanent information, and it was attractive, enjoyable and fun like puzzle. In addition, the students shared information with each other while studying with worksheets.

**Table 8.** The students' opinions about worksheets given at the time of application

Categories	Categories	Students' Opinions	f	%
Learning	Exploring	There was the question "What conclusion did you reach?" in worksheet. We wrote our thought and conclusions. It encouraged us.	6	30
	Strengthening	It strengthened the things we saw on the computer screen; worksheets strengthened the information we got from the computer.	5	25
	Understanding	It helped us to understand the subject. We learnt actually, but we grasped better with worksheet.	11	55
	Interest	You feel that you are cared when get the worksheet. Thus, the lesson became more interesting; decorations were the most interesting; there were pictures, and shapes.	7	35
	Enjoyable	It was very fun like solving puzzle. I liked being asked questions, finding us and answering with you again; it was fun to complete the worksheets.	11	55
	Retention	We both saw on the computer and completed the worksheets. Thus, I think we got permanent information.	7	35
Sharing Among Friends		We shared our thoughts with each other; Some of them were very difficult, and I shared some with my friends.	2	10

### Conclusion, Discussion and Implications

These results revealed at the end of the interviews with students. In primary schools, generally presentations and question and answer method is used. Teachers do not use any equipment to draw geometric shapes except for compass and ruler. %70 of the students stated that no equipment was used in the class. It shows that technological equipment was used in geometry classes and a teacher centered instruction was applied. This result is supported by Bedir's (2005) study. The students stated that they could explore the relations among the shapes and their features, understood better, the visuals of the program motivated them, moving and dragging the geometric shapes is interesting, and they became more creative while doing these. DGS gave students opportunity to hypothesize, explore the theorems and relations, and test these by entering the field of geometry education, rescuing geometry from paper-pen process having a static structure and making it dynamic on computer screen. %25 of the students stated that they had difficulties since the program was in English, but they made it by the help of teacher guidance and friends. The students thought that the time was not enough since they found the formulas and generalized themselves. All of the 7<sup>th</sup> grade geometry subjects were not processed; it was limited only with Angles and Polygons units in the study. The students mentioned the sound, extracurricular activities and technical equipment affecting the course negatively. The students found worksheets given in dynamic geometry environment and group work activities beneficial. They stated that their perspectives changed positively after GSP. Their interest in geometry increased, they started to trust themselves at geometry. In Güven and Karataş's (2003) study "Learning Geometry with Dynamic Geometry Software: Students' Opinion, it was reached to the result that the students' opinions on mathematics in general and geometry in specific changed positively and they found dynamic geometry environment useful. In addition, it was determined that the activities made students gain mathematical trust. The students stated that they are more active in the computer laboratory when compared with the traditional class environment, they learnt by exploring with GSP, they always dealt with particular geometric shapes but they dragged and changed the shapes and measured the angles and side lengths, they drew the shapes easily. The results of Üstün and Ubuz's (2004) and Bedir's (2005) study support our findings. It was emerged in Aktümen and Kaçar's study that computer-assisted instruction method was more effective than traditional teaching method and the students learn with computer-assisted instruction developed positive attitude towards mathematics teaching.

The recommendations developed according to the results gained from this study for math teachers, computer teachers, teacher training institutions, and ones who wants to study about this subject are as

following: The activities took time because the students reached generalizations themselves by exploring, building their own knowledge, struggling. Today, when the constructivist approach was adopted, the number of math classes should be increased for geometry teaching. The use of dynamic geometry software such as GSP should be supported and developed in primary, upper secondary, and higher education. The number of computer lessons should be increased in teacher training universities and the courses about affective use of dynamic geometry software in geometry teaching for math teachers should be added to the curriculum. The teachers should know how to use computer in order to get advantage from this program. Because it is important that the students' being in social interaction with computers in dynamic geometry environment, it should be given high level of importance that students should make group discussions and then class discussions with the teacher's guidance. Before using educational programs such as dynamic geometry software, it should be introduced and the students should be given opportunity to make recognition. Class sizes should be decreased in order to conduct computer-assisted instruction well.

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