

## Student Opinions on the Use of Geogebra Software in Mathematics Teaching

**Yeliz CELEN**

*Amasya University, Faculty of Education, Chair of Educational Programs and Instruction, yeliz.celen@meb.gov.tr, TURKEY*  
ORCID: <https://orcid.org/0000-0002-7991-4790>

### ABSTRACT

Mathematics as a discipline requires abstract operations under many sub-learning areas is considered hard by students to learn. In this respect, it has become indispensable to make mathematics teaching processes fun and to structure teaching procedures by using different teaching methods, techniques or materials. In this context, the purpose of the study is to determine the teachers' views of 7th grade students about the use of geogebra on lines and angles. The case study approach and focus group interview method were used in the study. In this context, 14 students studying in the city of Ankara were taught within the framework of the activities on lines and angles and carried practice out. At the end of these practices, a focus group meeting was held with the students, and the data provided from these interviews were expressed with sample sentences. In this regard, 3 activities were developed by the researcher for each of the two different acquisitions under the sub-learning area relating to the teaching of lines and angles. According to the results of the research, it was concluded that geogebra makes mathematics learning processes fun and enjoyable, helps students in concretizing abstract concepts often found in mathematics, and that students with low computer literacy have hardship in applying geogebra activities.

**Keywords:** Geogebra, Mathematics Teaching, Dynamic Geometry Software Programs

### INTRODUCTION

As mathematics is a discipline that requires abstract operations under many sub-learning areas, it is considered hard by students to learn. In this respect, it has become indispensable to make mathematics teaching processes fun and to structure teaching procedures by using different teaching methods, techniques or materials. As a result of this, reform movements in mathematics processes made dynamic mathematics software programs an inseparable part of this process.

The use of dynamic software in mathematics teaching processes has great importance in terms of obtaining students with trial and error opportunities, allowing the student to make assumptions, test and generalize from the results provided by seeing the student as a mathematician who discovers. Considering the sub-learning areas of mathematics, the geometry learning area is regarded as the most prominent area where the student can perform these trial and error activities. Geometry is a difficult learning area to learn in terms of its abstract conceptual structure and the expectation of high-level thinking skills from the student. According to Toluk (2003), it is possible for a student to acquire high-level learning skills in an area only if the student is interested in activities in the teaching process. It is clear that dynamic geometry software will be effective in obtaining this interest in geometry teaching processes.

Dynamic geometry software programs developed for geometry sub-learning area are used in geometry teaching because of their features such as creating geometric shapes, changing the angles and edges of these shapes, dragging the shapes, tracking the quantities measured during the movement of the geometric structure depending on this change, allowing the measurement of variables such as length, area, angle. One of these software is Geogebra software, that is developed as open source and carries geometry, algebra and analysis to a single interface. The superior aspects of geogebra over other dynamic geometry software are that it is designed for meaningful mathematics learning and it provides the opportunity to follow the movements of independent objects. In addition, the fact that the user interface and help menu of the geogebra provides service in Turkish and allows unlimited freedom in its use with educational tools are among the superior aspects of Geogebra compared to other software. Geogebra is a computer algebra system as well as being a software that can operate with points, coordinates, equations and functions, draw shapes and make measurements.

Geogebra was initially prepared as a program for the use of analysis, algebra and arithmetic operations by student groups at different levels, and later entered educational processes as a versatile tool by combining computer algebra systems and dynamic geometry software (Antohe, 2009; Hohenwarten and Jones, 2007). Geogebra is a dynamic software that is easy to use in teaching environments due to its ability to create interactive learning material as a web page, to provide language support and to be a free of cost open-code software.

There are plenty of studies on the use of geogebra in education processes. As a result of these studies, it was observed that the use of Geogebra in educational processes positively increased student achievement and self-sufficiency, designed the guidance of teaching processes and made learning easy (Erdogan & Seker; 2017). In the study conducted by Selcik and Bilgici (2013), it was concluded that using Geogebra in teaching the subject of polygon increased the motivation of students and facilitated learning basic geometric concepts. In the study by Icel (2011) examining the effectiveness of Geogebra teaching with activities on the subject of triangles and the Pythagorean theorem, it was found that Geogebra had a positive effect on students' learning and achievement as a result of the tests and the comparisons between the groups, and the recall test results showed that it is also effective in increasing the permanence of information. Research has also revealed that Geogebra teaching makes teaching processes fun, enables students to participate in the class effectively and that the learning environment creates a positive learning competition between groups with in-group and out-group interaction (Bagcivan, 2005; Topuz & Birgin; 2020).

In the light of all these findings, the purpose of this study is to determine teachers' views of 7th grade students about the use of Geogebra on lines and angles. The motives for choosing the subject of lines and angles in the study are that the subject is suitable for teaching with dynamic geometry software, the information about the use of dynamic geometry software in the explanations of the curriculum, and the teaching options related to lines and angles are widely included in the Geogebra program. The gains of the 7th grade on lines and angles are listed as determining the bisector by dividing an angle into two equilateral angles, examining the properties by determining the corresponding, inverse, internal inverse, external angles formed by a pair with two parallel lines, determining the angles that are equal or wholes and solving related problems. Under the title of this topic, the states of three lines in the same plane with respect to each other and deciding whether two lines are parallel or not are explained to students.

**METHODOLOGY**

The case study approach and focus group interview method were used in the study. In this context, 14 students studying in the city of Ankara were taught and implemented practice within the framework of activities on lines and angles. At the end of these practices, a focus group meeting was held with the students, and the data gathered from these interviews were expressed with sample sentences. In this context, 3 activities were developed by the researcher for each of the two different acquisitions under the sub-learning area regarding the teaching of lines and angles. For the practical studies, two hours of Geogebra activities were carried out by 14 students for 5 days within the framework of lines and angles unit activities in mathematics lessons. At the end of this practice, the opinions of the students about the Geogebra applications were taken. The main reason for choosing the focus group interview method in the study is to determine the opinions of the students on the use of Geogebra within the framework of predetermined instructions according to the logic and personal characteristics of the interviewee.

**FINDINGS**

Following the implementation of the geogebra activities, the data gathered from the focus group meeting with the students are detailed below.

**1- Students' Opinions Concerning Advantages or Benefits of Using Geogebra:**

In this context, the students were asked about the advantages or benefits of the use of Geogebra in teaching them the topic of angles and angles, sample answers from the student opinions are given in Chart 1 by numbering them as K1, K2, K3 etc. and compiling them under subheadings.

**Chart 1. Student Opinions Regarding the Benefits of Using Geogebra**

Subheading	Student Opinion
Making teaching fun and enjoyable	<p><b>K2:</b> I easily drew the lines that intersect each other. I measured the angles of these without needing anything else. I do not like using compasses and rulers. This topic always seemed very depressing to me. This time I enjoyed.</p> <p><b>K4:</b> Math is a very difficult subject. I wasn't enjoying. Rather I love playing games on the computer or social media. I learned the subject of lines for the first time.</p> <p><b>K9:</b> Learning subjects using computer is fun,</p>

	<p>especially if it is geometry.</p> <p><b>K10:</b> We worked together with my friend. We cut one angle into two identical parts on the computer. I used compasses before, I did not like it at all. This is nicer.</p>
Benefitting the process of making assumptions, generalisations and discovery	<p><b>K3:</b> If this angle used to be this much, the other would be this much. Or if these angles were in the same direction, I could not comment that they would be equal. But I made such comments in this application.</p> <p><b>K7:</b> I predicted that the dimensions of the leading angles would be equal.</p> <p><b>K9:</b> The teacher said break the parallel of the lines. When the parallel was gone, the angles did not match either. I will no longer forget in my life.</p>
Being facilitating	<p><b>K3:</b> I do not like using compasses or something like protractor. This program made my work easier. I wish we learned other subjects like this..</p> <p><b>K5:</b> I can not measure angles by using protractor. This program has an angle measurement feature.</p> <p><b>K12:</b> You can learn all subjects in a short time. Saving on time. Otherwise, it would take years for me to do these works with a compass and ruler.</p>

When the Chart 1 is examined, it is seen that Geogebra makes the process of learning mathematics fun and amusing. Reis and Ozdemir (2010) stated that computer-aided teaching methods in which visual elements are used in teaching parabola are interesting to students. Zengin et al. (2013) also stated these methods using visual elements in their studies on prospective mathematics teachers are found interesting by students.

When the Chart 1 is examined, students state that Geogebra assists them to concretize abstract concepts often found in mathematics. Some students stated that they acquired generalization skill with this application. According to Baki (2002), computer-equipped environments obtain students with skills such as solving complex problems, developing various solutions, making generalizations based on assumptions, or they can provide suitable learning environments to develop these skills. Kabaca and Aktumen (2010) explain that the most significant feature of Geogebra that distinguishes it from other software is to use multiple representations to see mathematical relations. From these viewpoints, it can be said that Geogebra offers students learning environments that develop students' exploration and generalization skills by offering trial and error opportunities. When the chart is examined, it can be said that students agree that Geogebra is useful in learning mathematical concepts or making measurements. When the MEB (Ministry of National Education) curricula are examined, it is seen that geometry acquisitions are included in all grade levels as a sub-learning area, starting from the first grade with the vertex and raised numbers of geometric shapes, the concepts of bisector, directional, inverse, internal inverse and external inverted angle in the 7th grade Geometry and Measurement learning area and handled in a very broad perspective. When the 7th grade gains are examined, it is seen that there are many gain explanations for the use of compasses, rulers and protractors. In this context, using Geogebra to teach geometry learning area gains will remove the application burden with tools such as compasses and rulers. According to Ciftci and Tatar (2014), it is possible to construct dynamic geometric structures on paper by using Geogebra software that has features such as compass-ruler-measurement. Since the Geogebra program also has the principle of resilience to motion, when certain properties of a shape change (such as parallelism of lines in terms of lines and angles), it can give clues to the student about if other properties are preserved. The findings obtained from the results of this research coincide with the findings of the research conducted by Kabaca (2010). In this study, too, it is stated that different learning environments are offered to students and teachers in constructing geometric structures or shapes with geogebra. Can (2010) also states that dynamic software is a software that enables repeatable experiments in course teaching processes and provides rich environments to students.

Sample answers when asked students about the disadvantages of using Geogebra are given in Chart 2.

**Chart 2 - Students' Opinions on the Disadvantages of Using Geogebra:**

Subheading	Student Opinion
Computer Literacy	<p><b>K7:</b> I am not good at computers. So it took time for me to find the icons the teacher said there. Ia I am tired.</p> <p><b>K11:</b> I can not use the computer well. Therefore, it was not much fun.</p> <p><b>K14:</b> Those who play games on the computer learned better. I found it very hard to draw lines and measure angles. I wish we had the training for this as well.</p>
Collaboration	<p><b>K4:</b> The teacher formed groups of two. I dislike working with someone else. I myself am very good at the computer.</p> <p><b>K13:</b> We fell into the duo group with a friend of mine whom I really do not like. That's why I did not enjoy it.</p>

When the Chart 2 is examined, it is observed that students who do not have computer literacy skills have difficulty using the geogebra software program. It is also observed that students who have the skills of accessing information and understanding information, analyzing, producing and sharing through devices such as smart phones, tablets, laptops and desktop computers participate more effectively in geometry learning processes with geogebra. In this sense, it seems vital to create course content for individuals to know the ways to access information on the internet, to realize the stages of purchasing products and services from the internet, and to acquire skills in being aware of the risks in the virtual environment. It is thought that the introduction of the software and informing about the toolbars before using these software programs in the teaching processes will prevent negative experiences in this process.

When the Chart 2 is examined, it is seen that a group of students does not like collaborative working environments and they have difficulties in Geogebra learning processes, which are performed by forming groups. However, studies indicate that students like their work and develop a positive attitude towards mathematics in mathematics education processes where collaborative learning methods are applied (Bilgin and Gelici, 2011). In this context, it is thought that students will enjoy the collaborative learning environment by enhancing the applications.

The opinions of the students on the applicability of the Geogebra program in other sub-learning areas of mathematics are given in Chart 3.

Subheading	Student Opinion
The compatibility of the software's toolbars to the sub-learning zone	<p><b>K5:</b> I wish this program had been used especially in the teaching of triangles and quadrilaterals. Not only could I measure angles but also I could grasp the properties of triangles better.</p> <p><b>K6:</b> There are icons on the toolbars such as measuring, drawing various shapes. It would be very good to use the geogebra program in teaching other topics of geometry.</p>
The Difficulty of Topics of Mathematics	<p><b>K8:</b> I find it difficult to learn especially probability topics in mathematics. How nice it would be if we could use this program on these topics.</p> <p><b>K11:</b> I have difficulty with subjects related to algebraic expressions. While working with this program I saw that there was an algebra window. I do not know what this window does, but it can be useful in teaching this topic.</p>

When the sample responses in Chart 3 are examined, it is observed that students want to use Geogebra in teaching mathematical topics that are difficult to understand in general, such as probability and algebra. In addition, due to the suitability of the structure of the Geogebra software, it is seen that there are students' opinions concerning the use of this software in teaching other topics of geometry. Research findings indicate that using Geogebra software in mathematics teaching processes augments the academic success of students (Kaya & Ocal, 2018; Genc & Oksuz, 2016)

## CONCLUSION

When examining the findings provided as a result of the research, it is observed that the use of Geogebra lets students to make mathematical generalisations and makes mathematics teaching processes fun and entertaining, but students who are not sufficient in computer literacy or who dislike collaborative work environments have difficulty in doing Geogebra applications.

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