

## Students` Opinions about the Use of Geogebra Computer Program as a Technological Tool in Mathematics Lessons

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**Abstract:** Students' attitudes towards mathematics are generally negative. The difficulty of the course has an important role in the development of this attitude. However, with some new arrangements to be made, students can be interested in the lesson. In this study, it is discussed to what extent the GeoGebra program makes the mathematics content attractive. For this purpose, two separate Likert scale questionnaires were applied to 12th grade students. In the first of the questionnaires, students' attitudes towards mathematics were determined. In the second, students' attitudes towards the GeoGebra program were revealed. Accordingly, students have increased their interest in mathematics a little bit thanks to the GeoGebra program.

**Keywords:** Mathematics, Geogebra Computer Program, Technology Integration

### 1. Introduction

Mathematics is often perceived as a difficult course and attracts little attention of students. Even if different attempts were put forward to overcome this problem, only some degree of success could be achieved. However, for this, it is necessary to use all available possibilities and to make the mathematics course interesting. In the modern world, technological developments have emerged that will provide this up to a point. Especially the development of computer technologies offers a number of opportunities in this regard. One of these possibilities is the GeoGebra program used in mathematics lessons. How effective this program is in mathematics lessons is the subject of this study.

### 2. Review of Literature

#### 2.1 Integration of Technology

Technology has developed very rapidly, especially in the last 200 years of humanity. Developing technology has tended to enter human life very quickly in some aspects (Al Faruqi, 2019). Integration of technology into human life has been very rapid, especially since it brings some economic benefits to people. In addition to the economic benefit, the facilitation of the work is another significant reason for

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technology integration (Link & Scott, 2019, Serin, 2020). In addition, the attractiveness of technology to people is another reason that accelerates integration.

## **2.2 Integration of Technology into Education**

The rapid development of technological tools has resulted in their more effective use in every sector. At this point, we see that one of the areas where technology is integrated is education (Nart, 2016). Technology-supported education is about using technology as a tool in presenting information to students. With the integration of technology into education, we can say that there have been great transformations in traditional face-to-face education. It should be stated that technology support is a tool that helps learning and accelerates learning at many points (Buabeng-Andoh, 2012).

After the technology integration, adapting the human factor to this new technology and making them use it in the best way is the most important aspect of this issue (Kopcha, 2012). In order for students to benefit from technology, some stages need to be adapted correctly. After the establishment of the technological infrastructure and the integration of technology tools, it is inevitable for people to undergo training to use it in the best way (Celik, 2021). Moreover, it is more important to adapt the course contents to this technology and to make the necessary planning. Otherwise, it is possible to abuse existing technological tools, and it also has the potential to harm educational processes (Chai et al., 2011).

## **2.3 Technology Integration and Teachers**

The first component of technology integration that comes to mind is the computer. First of all, learning the correct use of the computer is the first step for teachers. However, the use of technological tools in educational processes is not a planning that only concerns teachers. Many people, from the teacher, who is the main practitioner, to the policy makers, need to be involved in the processes (Voogt et al., 2013). However, the key agent here is the teacher. It is the teacher's responsibility to use all technological opportunities correctly and adapt them to the lesson (Sadiku, 2015). When we look at the changing roles of the teacher in the classroom in the modern age, it was previously understood only as an authority to convey information (Koole, 2013). However, changing conditions have imposed different responsibilities on the teacher. In this context, one of the most active roles of the modern teacher in the classroom is to guide students to knowledge. Therefore, it is important for the teacher to adapt himself to technological developments (Ertmer & Ottenbreit-Leftwich, 2010).

In this period when technology becomes widespread, teachers need to adapt themselves to these revolutionary changes. It is possible to say that one of the main factors forcing teachers to do this is today's students. These students were introduced to technology at a very young age and experienced almost no difficulties at all in this regard (Celik, 2017). In fact, their interaction with technology has reached such an advanced point that these children are called digital natives in the literature (Palfrey & Gasser, 2011, Serin, 2015). Therefore, the teacher should adapt himself to new developments in order not to fall behind the student in this regard.

When we look at the situation of middle-aged and older teachers, it is seen that they are generally problematic generations in terms of computer use. At this point, computer literacy problems of middle-

aged and older teachers have entered the literature (Darejeh & Singh, 2013). Therefore, teachers need technology integration for professional competence. The most compelling reason for this is the students.

It is possible to list the following roles of the teacher at the point of integration of technology into lessons.

- Since the roles of teachers are also changing in the changing world, they need to adapt themselves to the new situation and play a facilitating role in acquiring knowledge towards students.
- They need to reach the competence to transfer their field knowledge to students by learning the current technologies.
- It is the duty of the teacher to transfer new technological developments that will facilitate the learning of the students in the teacher's own field to the students (Kim et al., 2013).

## **2.4 The Effect of Technology on Education**

Technology has profoundly affected all aspects of human life. While these effects have emerged in positive ways, they have also emerged in negative ways at many points. When we evaluate these effects according to the realm of education, we can also talk about some positive and negative aspects.

### **2.4.1 Positive Effects**

Technology has many positive effects on education. Especially in the modern world, technological developments have a great role in changing the roles of teachers and students. In addition, new technologies play an important role in increasing students' interest in the lesson and facilitating the explanation of some subjects. For example, according to a study conducted, computer-assisted education offered some new opportunities to students. The first of these is the active participation of students in the learning process. Second, students participate more in technology-supported courses. Third, it provides the opportunity to explain many theoretical subjects in a practical way (Roschelle et al., 2000). Furthermore, technology-assisted education has led to a great saving of time and effort compared to traditional education (Serin & Oz, 2017; Sekhri, 2013).

We can list the contributions of modern technologies to education as follows.

- Thanks to technological developments, processes have become easier for both students and teachers. Many new technologies have emerged that will facilitate teachers' lectures (Raja & Nagasubramani, 2018).
- Existing technologies have enabled students to be more creative. In addition, the traditional education of the students has considerably reduced their dependence on the teacher (Edwards-Groves, 2012).
- In particular, the courses in which the theoretical explanation is intense are presented to the students in a more concrete way thanks to the technological infrastructure (Schmid, 2008).
- The absolute authority of the teacher in the traditional understanding disappeared in this period. New developments are built on a student-centered understanding (Öztürk, 2011).
- With modern technology, student roles have changed drastically. In this way, students were able to solve more complex problems and produce projects (Ertmer et al., 2012).
- Students can also use technology individually and adjust their learning speed accordingly.

- Many experiments that cannot be done in a laboratory environment or that are dangerous and costly can be demonstrated by computer.
- Students can create personal learning environment for themselves and adjust their learning speed (Johnson & Liber, 2008).
- Even students working individually can be supervised by the teacher and the teacher can intervene where the student makes mistakes.
- Lesson repetition, which is very difficult for teachers, becomes unnecessary thanks to technology (Kesendere et al., 2020).

#### **2.4.2 Negative Effects**

In addition to the many benefits that technology offers to people, it also offers some disadvantages. First of all, due to the attractiveness of technological devices, children's sitting in front of the computer for too long brings along some health problems. Although computer technologies provide opportunities to teach the subject very well, they do not have any opportunity to provide attitude and value education to students (Roschelle et al., 2000).

Another negative aspect of computer technologies is that programs that are fully compatible with the content of the course are not created (Ożadowicz, 2020). The high cost of computer technologies prevents them from being supplied to meet the needs of all students. In addition, the technical support needed to solve the problems of existing technologies has emerged as a separate burden. At this point, it is necessary to employ trained personnel and to allocate financial resources (Molinuevo, 2020).

One of the aims is to increase the knowledge of the students in the educational processes. At the same time, it is important to develop students' affective and psychomotor aspects. However, computer technologies have no way of making this happen. Moreover, the use of these technologies requires further planning. This puts an extra burden on teachers. Some students find their homework online because computer technologies offer many opportunities to students. Sometimes the slowdown of technological tools hinders the progress of the lesson (Burrows et al., 2021).

#### **2.5 Teacher Roles**

What was expected from the traditional teacher type was to have their own field knowledge. However, modern times has required the teacher to take on other roles as well (Mart, 2013; Celik, 2017). In this context, teachers need to be equipped with some knowledge in order to be competent in their profession.

1. **Content Knowledge:** It is the teacher's duty to know the theories, practical information and methods related to his/her field. At this point, knowing the formulas in mathematics and applying these formulas to problems is within his content knowledge.
2. **Pedagogical Knowledge:** It is within the pedagogical knowledge that the teacher knows how to transfer his knowledge to the student apart from his/her own content knowledge. Here, what is expected from the teacher is to know enough to apply measurement and evaluation effectively, as well as methods of presenting a subject to students. Classroom management is also included in this type of knowledge.

3. Pedagogical Content Knowledge: It is the teacher's ability to present his own knowledge in a format that the student can best understand and to give examples from daily life (Shulman, 1986).
4. Technological Content Knowledge: It is the teacher's knowing how to use technological tools.
5. Technological Pedagogical Content Knowledge: It is the teacher's knowing how to use technological tools in educational processes (Mishra & Koehler, 2006).

### **1.6 GeoGebra Computer Program**

This program was developed by Markus Hohenwarter in 2001. He developed this program in his master's thesis and made it available to the world of mathematics. The feature of this program is that it is useful for all mathematics curricula. In this respect, it is possible to use it in all curricula, from primary school mathematics to university mathematics. This program is an open-source dynamic software. It is possible to see mathematics, algebra and analysis in one interface. After the presentation of this program in the thesis, we see that it started to spread on the internet. The fact that mathematics teachers especially liked the program and found it useful has made it more popular with each day. The program developer received the European academic software award in 2002. After the program became so popular, the developer made more additions to the program and made it more useful. It is possible to find more educational applications in the developed content. In addition, Hohenwarter prepared his doctoral thesis on this program and discussed the pedagogical applications of the program in the thesis. Later, this program was also used in other projects. Within these projects, it is aimed to develop teachers' Mathematics content knowledge and technological content knowledge (Hohenwarter & Lavicza, 2007).

Since the GeoGebra program was developed as a Java-based program, it works on many platforms. This program allows equations and coordinates to be entered directly into the computer. Also, thanks to this program, it is possible to define functions algebraically. This program visualizes functions in graphic form. This program shows points, line segments, lines and conic sections. In addition, it provides dynamic relations between them. It is an important feature that it effectively establishes the relationship between geometry and algebra (Ancsin et al., 2013).

## **3. Methodology**

### **3.1 Research Model**

This research was applied to 12th grade students in the high school of Ronaki Duhok. In this study, qualitative and quantitative methods were used together. First of all, students' opinions on mathematics were obtained in two separate Likert scale questionnaires presented to the students. In 2 questionnaires, questions about the GeoGebra program used by teachers in different mathematics courses throughout the year were asked and opinions about this program were taken.

### **3.2 Sampling**

This research was applied to 12th grade students. The reason why it is especially applied to these students is the university exams they will take at the end of the year. Therefore, they need mathematics courses, and their motivation is high. Since the students needed mathematics, they studied this lesson seriously. It is predicted that the high motivation in their lessons will carry their perception of mathematics to a

different level. Therefore, it is important how the GeoGebra program, which facilitates the mathematics course, creates an impression on them. Twenty students were used for this questionnaire.

### 3.3 Data collection

The data collected in this study were carried out through two Likert scale questionnaires presented to the students. First of all, students' ideas about mathematics were taken, and then what they thought about the GeoGebra program was tried to be determined through the questionnaire.

## 4. Findings

First of all, the students were asked questions about the mathematics lesson and their attitudes towards the mathematics lesson were revealed. Since these students are 12th grade students, they are more motivated than other classes. However, this motivation is mostly due to the questions that will be asked in the university entrance exam, rather than the interest in mathematics.

### 4.1 Attitudes towards Mathematics

First of all, we asked the students what kind of a course mathematics is and got the answers from the students.

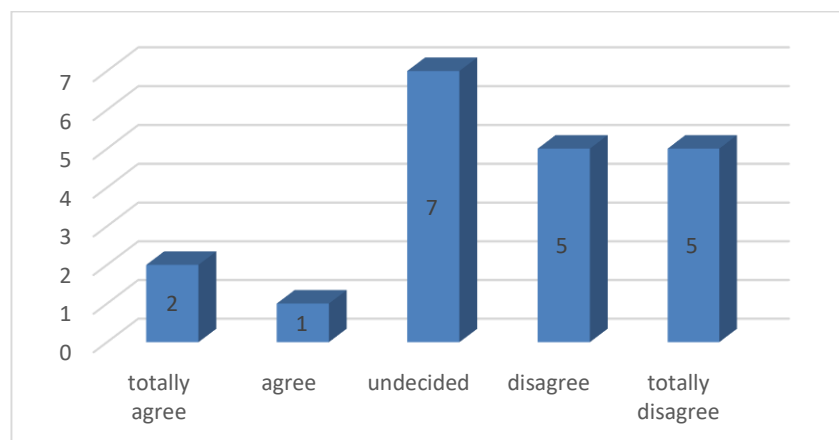


Figure 1: Mathematics is an easy subject

While 50% of the students expressed a negative opinion on this issue, 35% were undecided. Only 15 percent of students think that mathematics is an easy subject. Therefore, it is seen here that students generally accept mathematics as a difficult subject.

Students' interest in mathematics increases considerably when they come to the 12th grade, because the mathematics lesson is very important in the exams they will take at the end of the year. However, it is also possible for students to accept mathematics as their favorite subject. Here, we asked the students the next question to see what level of interest the students were in Mathematics.

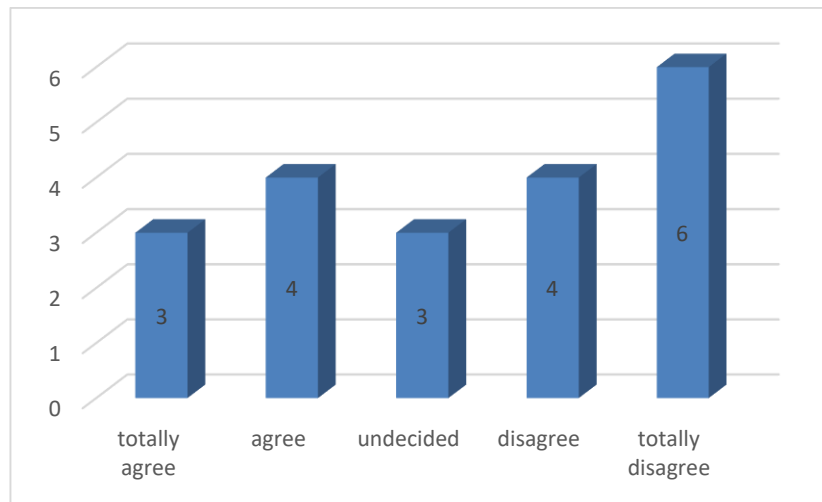


Figure 2: Mathematics is one of my favorite subjects

As can be seen, half of the students have a negative opinion on this issue. Only 7 students (535) stated that mathematics is their favorite subject. The students do not generally choose mathematics as their favorite lesson.

Although mathematics is not the students' favorite subject, students may enjoy being interested in mathematics. To determine this situation, students were asked whether they liked solving mathematical problems or not. The answers received are shown in the statistics below.

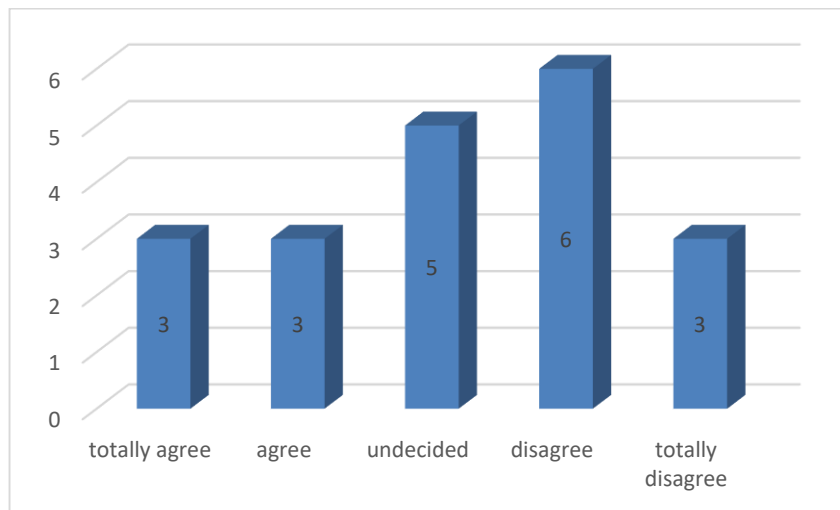


Figure 3: I enjoy solving mathematical problems

45% of the students express a negative opinion on this issue. 6 people (30%) state that they enjoy solving mathematical problems. In fact, it is seen here that their interest in mathematics is due to the exam.

We asked the students the next question to get their thoughts on what mathematics has taught people. Thus, how much they value mathematics in general will be revealed in this question.

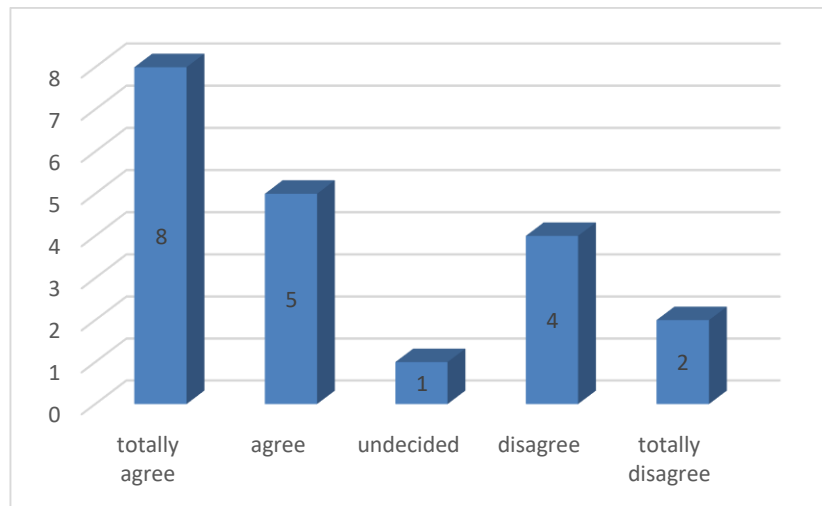


Figure 4: Mathematics gives people creative ways of thinking

65% of the students have a positive opinion on this subject. In other words, the majority of students stated that mathematics shows people the ways of creative thinking. On the other hand, 30% of the students expressed a negative opinion on this issue. However, it can be said that students generally think positively about this subject and consider mathematics important. On the other hand, the reason for the low interest in mathematics in other questions may be the difficulty of the mathematics course.

Compared to other courses, we can say that the self-confidence of the students who are successful in the mathematics is very high. In order to determine this situation in students, the next question was asked to the students and their opinions were taken.

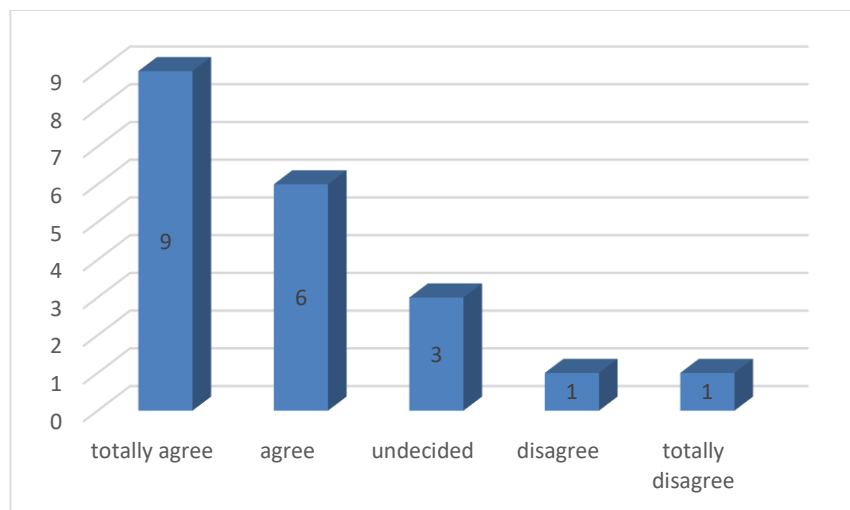


Figure 5: Solving math problems increases my self-confidence



75% of the students expressed a positive opinion on this issue and stated that solving mathematical problems increased their self-confidence. Only 10% of the students expressed a negative opinion on this issue.

Considering students' problems related to mathematics, it is possible to concentrate on some of the reasons for this. Among them, the most striking reason is the issue of how carefully students listen to their teachers in the lesson. We asked the next question to determine how sensitive students are to this issue and how much they listen to their teachers.

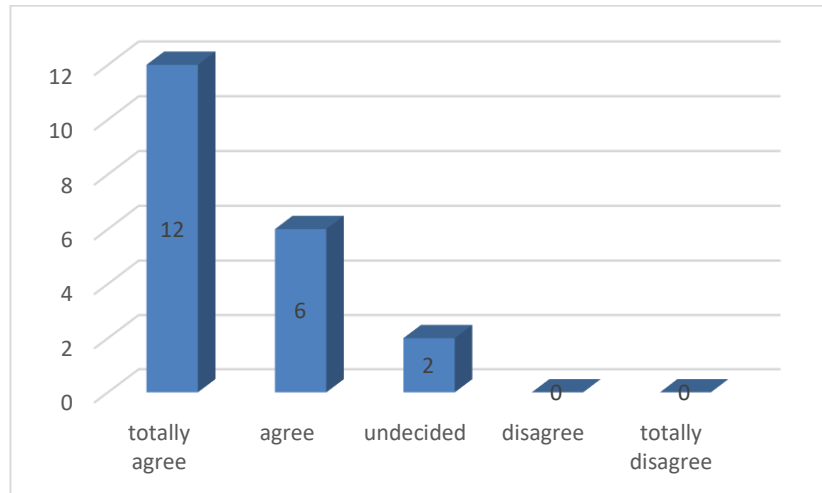


Figure 6: I listen carefully to my teacher in mathematics class

90% of the student's state that they listen to their teachers carefully. Only 10% are undecided about it. On the other hand, there is no student who says that he does not listen to the teacher. It was stated above that an important reason for this is the university exams that students will take. Here, too, a statistic has emerged that confirms the same situation. Students mostly listen to their teachers carefully. However, other problems arise due to the difficulty of the mathematics course.

Students' problems with mathematics may stem from their indifference to the lesson. To determine this, we asked students if their low grades in math mattered to them.

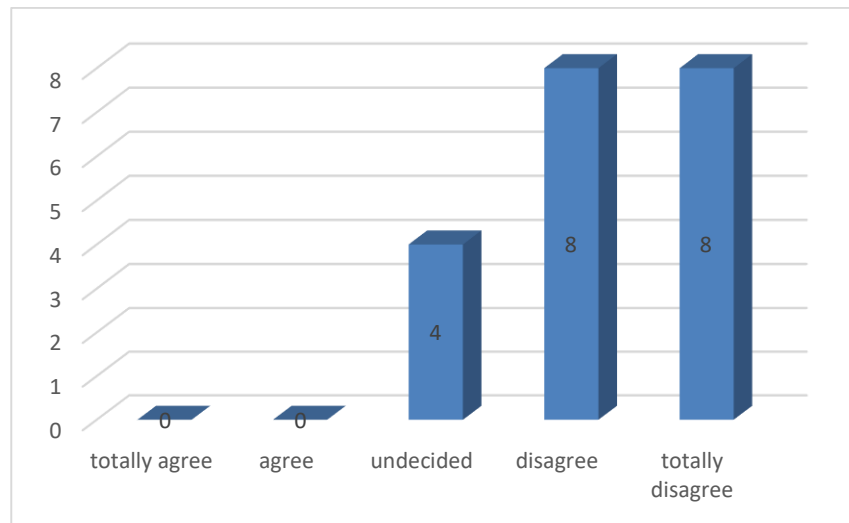


Figure 7: I don't mind getting low grades on math exams

80% of the students gave a negative answer to this question. Therefore, students consider the grades they will get from mathematics important. As can be seen, problems related to mathematics are not due to indifference to mathematics.

It was stated above that students' interest in mathematics is due to the exam. The next question was asked to the students to confirm this situation.

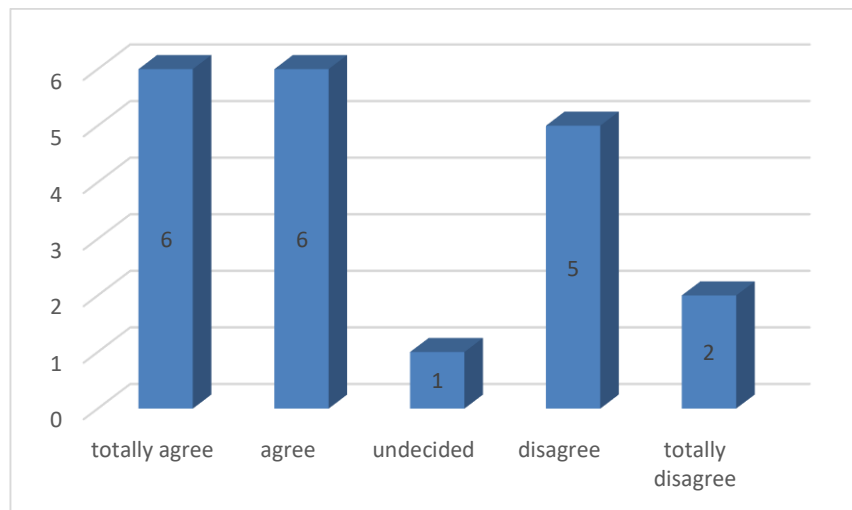


Figure 8: If I didn't have to, I wouldn't want to learn mathematics

60% of the students stated that they would not be interested in this course if they did not have to learn mathematics. 35% of them stated that they will learn mathematics under all conditions. Therefore, most of them are interested in this course because they have to learn mathematics.

Here we can say that students generally have negative attitudes towards mathematics. It can be said that the reason forcing students to be interested in mathematics is the university entrance exam. It is understood that students see mathematics as a difficult subject. However, they accept that there is a feature of giving people some thinking skills in the nature of mathematics, so they mostly have positive ideas that it contributes to creative thinking. In addition, students stated that solving mathematical problems increased their self-confidence. However, many of them stated that their interest in mathematics stemmed from some necessity. While accepting that mathematics gives a lot to people due to its nature, they also stated that they do not have much interest in mathematics.

#### 4.2 Attitudes towards GeoGebra

After observing the students' attitudes towards mathematics, in the next step, a second questionnaire was applied to learn the attitudes of the students towards the GeoGebra program that their teacher used throughout the year. Although the students generally have a negative attitude towards mathematics, we will make a comparison by seeing what attitude they have towards this program.

The first question asked to the students is how simple and useful this program is.

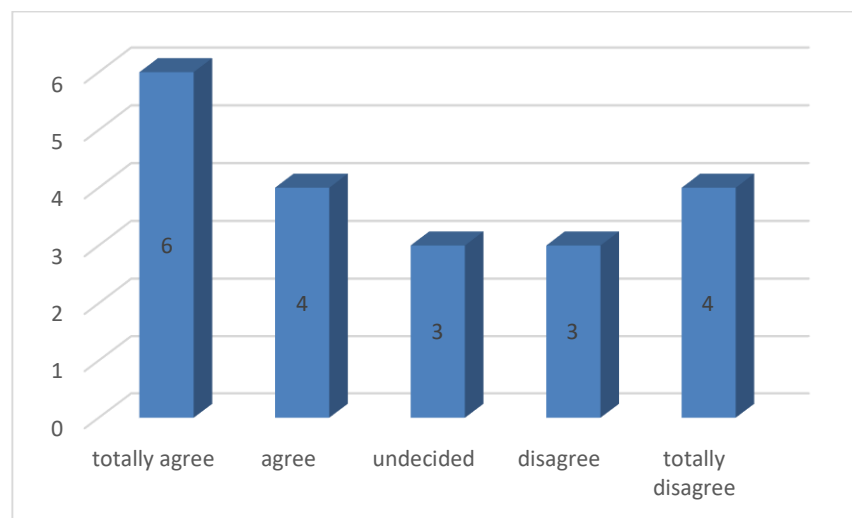


Figure 9: GeoGebra software is easy to use, simple and user friendly

When we look at the answers given by the students, it is seen that 50% of them evaluate this program as easy to use, simple and user-friendly. 35% of the students have a negative opinion about this issue.

The ideas of the students, who generally develop negative ideas against the difficulty of mathematics, about how easy this program makes mathematics are important. In this context, we asked the students a question about the issue in order to make comparisons.

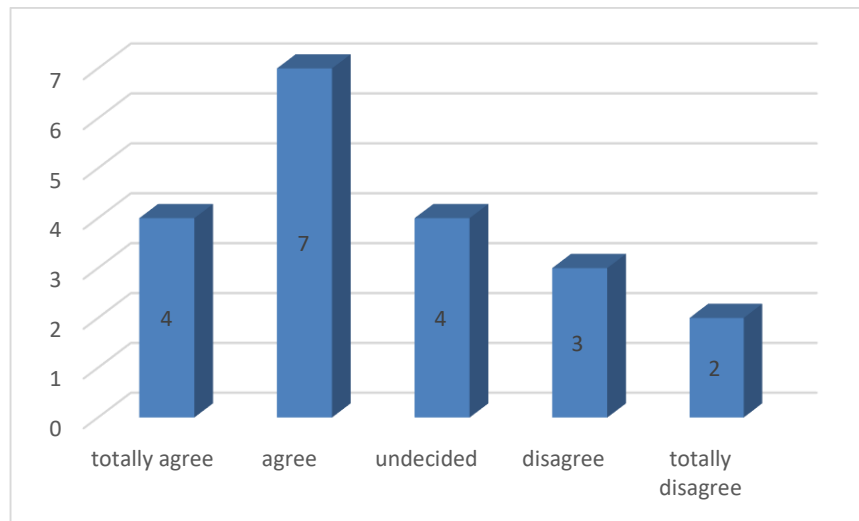


Figure 10: GeoGebra software is useful in facilitating math

It is seen that 55% of the students answered this question positively and had the idea that this program facilitated mathematics. At this point, we can say that the students believe that the GeoGebra program brings a facilitating benefit to them.

In line with the previous question, we asked the next question to determine how students emotionally approached this program. Thus, we tried to understand how students find this program interesting, impressive and fun.

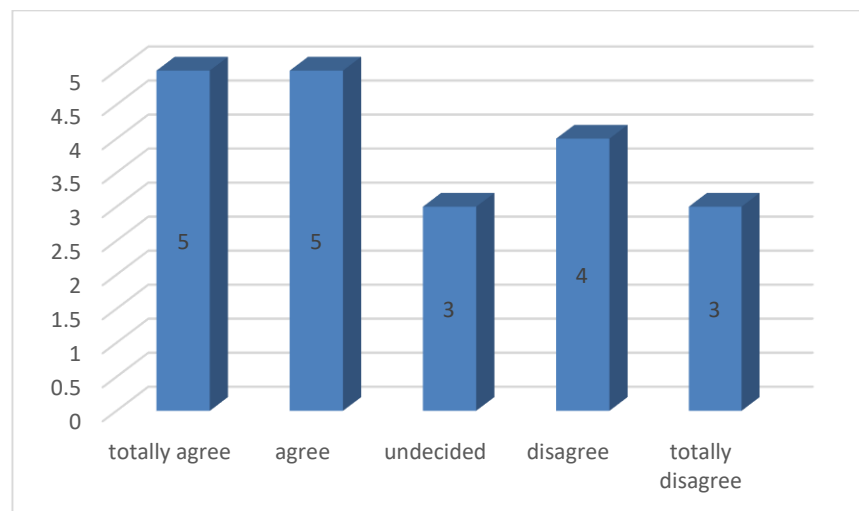


Figure 11: GeoGebra software is impressive, interesting, fun

When we look at the results, half of the students agreed with this judgment. 3 people from the other half were undecided and 7 people, 35% of the total, expressed a negative opinion on this issue.

We asked a series of questions to determine how much this program made students' jobs easier. First, we asked the students if it helped them draw graphs and draw geometric shapes.

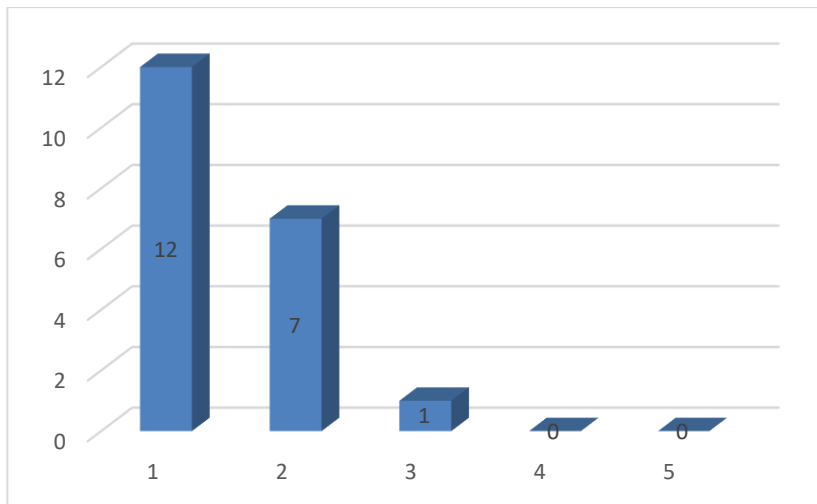


Figure 12: Helps GeoGebra software to draw graphics and geometric shapes

Almost all of the students (19 people) expressed a positive opinion on this subject. According to the students, this program is very helpful in drawing geometric shapes.

Another related question, when asked whether this program visualizes mathematics or not, a total of 17 students (85%) expressed a positive opinion on this subject. Therefore, we can conclude that this program visualizes mathematics very effectively.

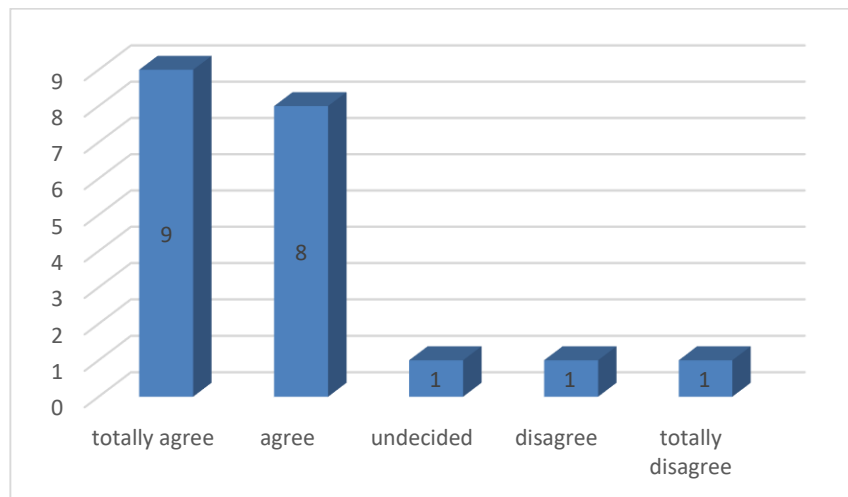


Figure 13: GeoGebra software visualizes mathematics

After these questions, we got the following feedback from the students when we asked how much this program helped in understanding mathematics.

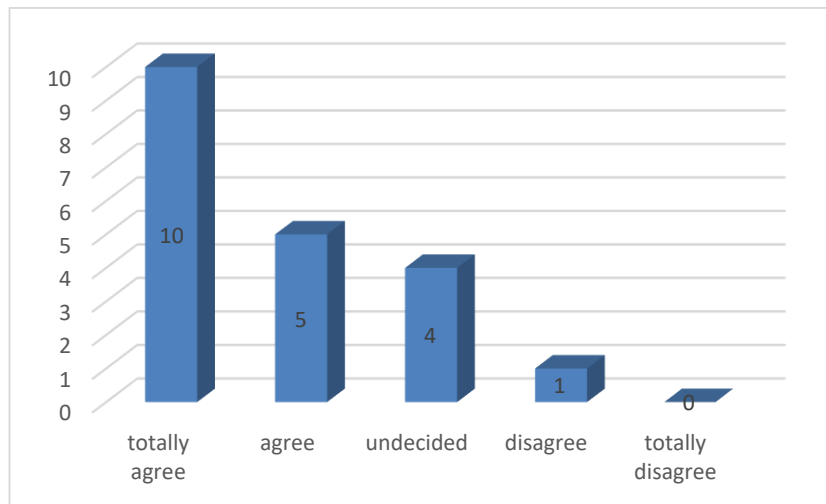


Figure 14: GeoGebra software is helpful in understanding mathematics

15 of the students (75%) stated that this program helped them to understand mathematics.

We got the following answers from the students when we asked how effective the use of this program's interface is in constructing mathematical terms.

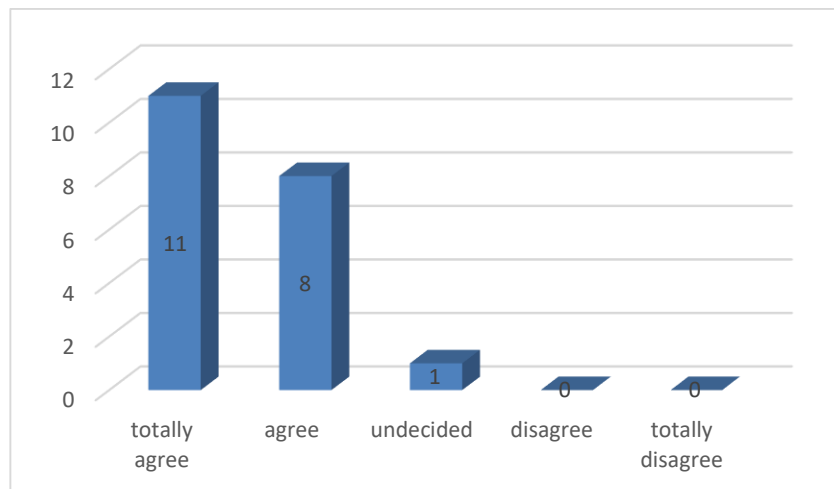


Figure 15: Using the GeoGebra tools and menu was not difficult to construct the mathematical terms

Again, almost all of the students (19 people) expressed a positive opinion on this subject and stated that it was not difficult to construct and use mathematical terms in this program.

Another question was that we asked the students their opinions about the inclusion of this program in the mathematics curriculum.

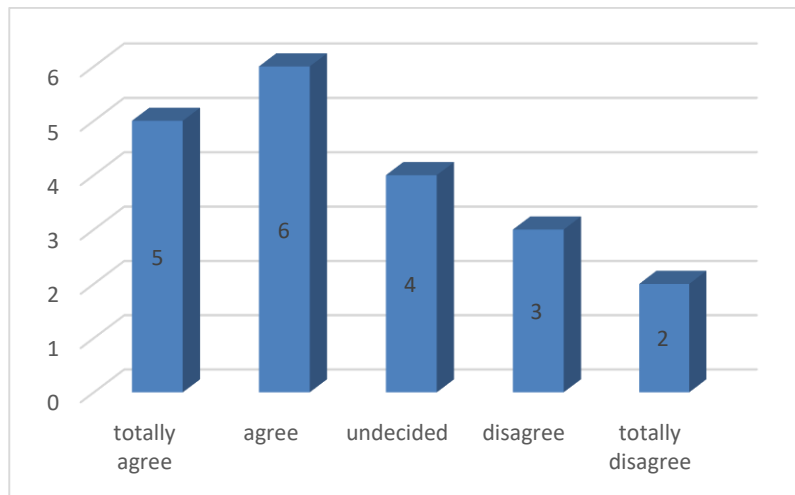


Figure 16: GeoGebra Program should be integrated into the mathematics course for visualization and design studies

11 students (55%) stated that this program should be integrated into the mathematics curriculum at the point of visualization and design. 5 people (25%) have a negative opinion on this issue.

## 5. Discussion

In this study, students' attitudes towards mathematics were determined. Accordingly, a significant part of the students exhibited a negative attitude towards mathematics. The difficulty of mathematics plays an important role here. However, we found that the students showed a close interest in mathematics. The reason for this is that mathematics is highly effective in the university exams they will take at the end of the year. Despite such motivation, students did not develop positive attitudes towards mathematics at the expected rate. However, they accepted that mathematics gives people creative thinking. Here we see that they value mathematics. They also stated that their self-confidence increased when they solved the mathematics questions. Therefore, they accept the positive aspects that mathematics brings to people. However, due to the difficulty of the course, they developed negative attitudes towards mathematics. For example, most of the students stated that they would not learn mathematics if they did not need it.

It is seen that students who develop some negative attitudes towards mathematics have a very positive approach towards the GeoGebra program used in mathematics lessons. First of all, they especially stated that this program is easy to use. In addition, these students shared the idea that the program facilitates mathematics. In addition, they stated that the GeoGebra program is impressive and interesting. They stated that it is very easy to draw mathematical figures and graphs with this program and that the program visualizes mathematics. Therefore, most of the students shared the idea that this program should become more widespread in mathematics lessons.

## 6. Conclusion

Getting students to be interested in a difficult subject like mathematics is a very difficult task. First of all, students do not believe much in the necessity of learning this. In addition, the fact that the course includes

difficult and abstract concepts is an important factor in the development of negative attitudes of students. Teachers need to make more efforts to make students be interested in such an important lesson that will pave the way for technological developments. To achieve this, different alternatives need to be evaluated. As revealed in this study, the GeoGebra program has the potential to contribute to students' better understanding and interest in mathematics. Therefore, the inclusion of such programs in the curriculum may contribute to students' interest in this course.

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**Appendix 1- Liker-scale mathematics attitude questionnaire**

	totally agree	agree	undecided	disagree	totally disagree
1. Mathematics is an easy subject.					
2. Mathematics is one of my favorite subjects.					
3. I enjoy solving mathematical problems.					
4. Mathematics lesson gives people creative ways of thinking.					
5. Solving math problems increases my self-confidence.					
8. I listen carefully to my teacher in mathematics class.					
9. I don't mind getting low grades on math exams.					
10. If I didn't have to, I wouldn't want to learn mathematics.					
11. I use mathematics in solving some daily problems in my social life.					

**Appendix 2- Liker-scale GeoGebra attitude questionnaire**

	totally agree	agree	undecided	disagree	totally disagree
1. GeoGebra software is easy to use, simple and user friendly.					
2. GeoGebra software is useful in facilitating math.					
3. GeoGebra software is impressive, interesting, fun.					
4. Helps GeoGebra software to draw graphics and geometric shapes					
5. GeoGebra software visualizes mathematics.					
6. GeoGebra software is helpful in understanding mathematics.					
7. Using the GeoGebra tools and menu was not difficult to construct the mathematical terms.					
8. GeoGebra Program should be integrated into the mathematics course for visualization and design studies.					