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The effective use of educational software and media in teaching and education

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Abstract: The use of software tools for manipulating data and engineering mathematical models has made life much easier for us. Different software programs have allowed us to analyze 3D modeling to demonstrate concepts to students during various teaching sessions. Various software techniques have been developed that are not only efficient but also easy to manipulate. The use of software tools to calculate complex mathematical formulas and equations has been implemented and is being taught at universities worldwide, enabling students to better understand the material in a practical context. Similarly, software programs in music production have transformed the process of creating and teaching compositions, allowing students to experiment with sound design and digital instruments in real-time. This approach deepens their understanding of musical theory and composition. The use of software in teaching is an ongoing process, especially with the advent of AI and ICT, which continue to advance educational methods and tools.

Keywords: *Calculate, Formulae, Mathematicalmodels, Modeling, Software, Teaching.*

1. Introduction

GeoGebra is a software program that is open-source and easy to learn. The software was designed by Markus Hohenwarter and a team of software designers.The software is easy to learn and can be used by students throughout their field of study years. GeoGebra allows one to do geometry, algebra, statistics, and calculus.Geogebra helps students have a better understanding of the concept at hand. When it comes to implementing graphs, GeoGebra allows students to plot different functions. In the case of geometry, it allows students to create different geometric figures as in Figure 1.

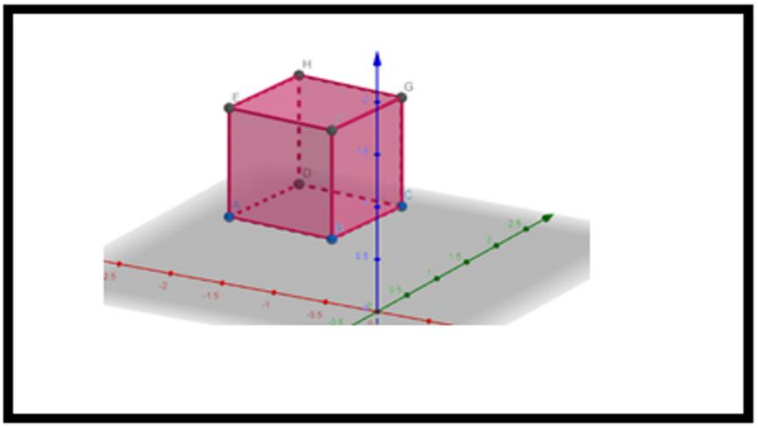

Figure 1.
Cube designed in Geogebra.

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The marvelous thing about geogebra is that students and also easily implement a calculator simulator in order to solve two equations with two unknowns as in Figure 2.

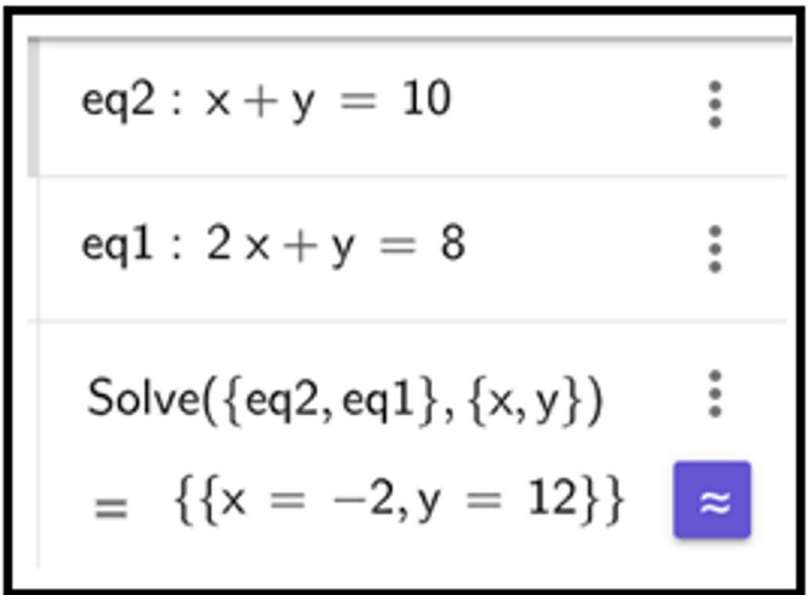

Figure 2.
Solving 2 simultaneous equations with GeoGebra.

The implementation of 3D modeling and images is also another important tool that is easily implemented, meaning that 3D graphs can be illustrated with the geogebra software.

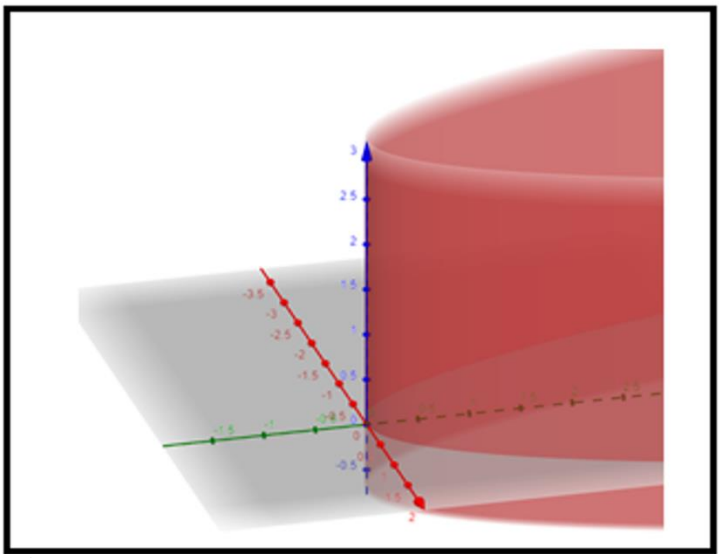

Figure 3.
A 3D image of the graph.

Figure 3 shows a 3D image of a graph representation of the function $y=2x^2$. As can be observed in Figure 3 the effect of GeoGebra is amazing. Most importantly it can be rotated at different angles where the values can be zoomed and observed more clearly.

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Geogebra can also be used to plot different graphs as in figure 4. You can clearly see inFigure 4 how the two lines intersect with one another and how they be observed and analyzed clearly. According to Figure 4, we can see how the intersection occurs with the lines of the x-axis and the y-axis. One of the best things about geogebra is that the line graphs are clearly distinguished by the fact that you have different line colors between them.

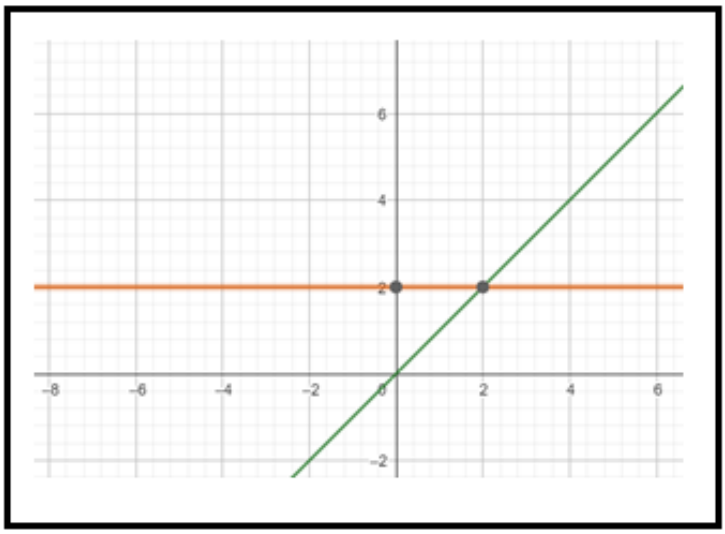

Figure 4.
The line graphs.

Figure 4 shows how the slope can be easily determined as well as how we can see the incremental values and the decremental values of each of the two line graphs.

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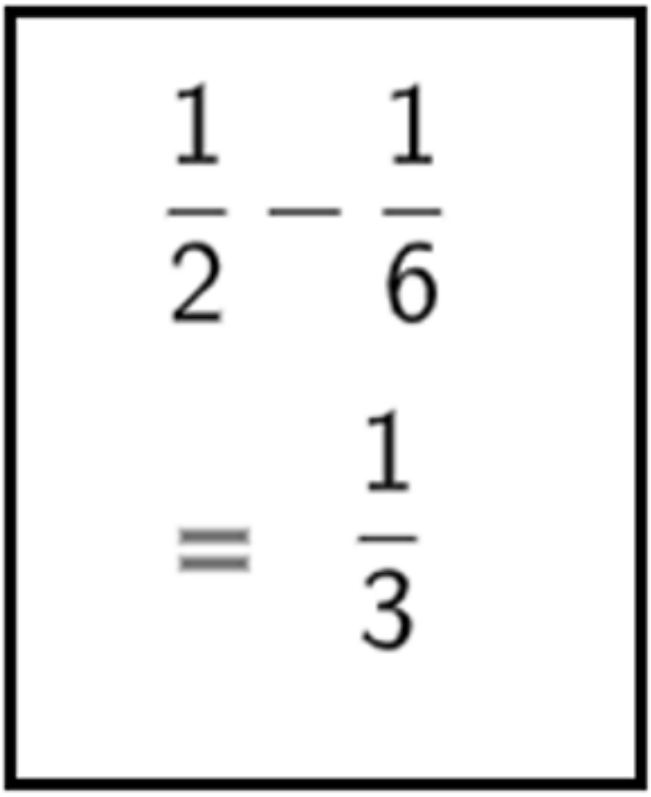

Figure 5.
Calculating fractions.

Geogebra can also be used to calculate fractions of different values. In Figure 5 we can see how geogebra can be used to calculate fractions. This typical example is one where two fractions are being subtracted. The advantage of this is that the output result can be a fraction as well as a decimal. Figure 6 shows the output result of the same fractions being calculated but in decimal format.

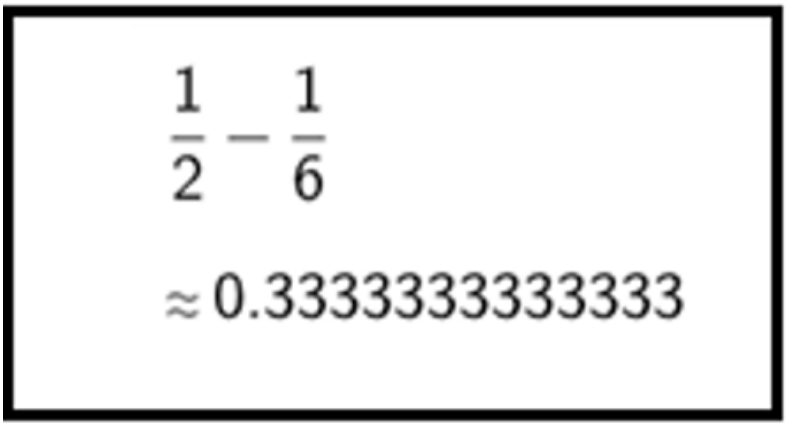

Figure 6.
The output result as a decimal.

If we had 3 equations and we wanted to see the plots on a graph along with their intersection. We can easily perform this graphical operation by using Geogebra. Figure 7 shows the 3 equations.

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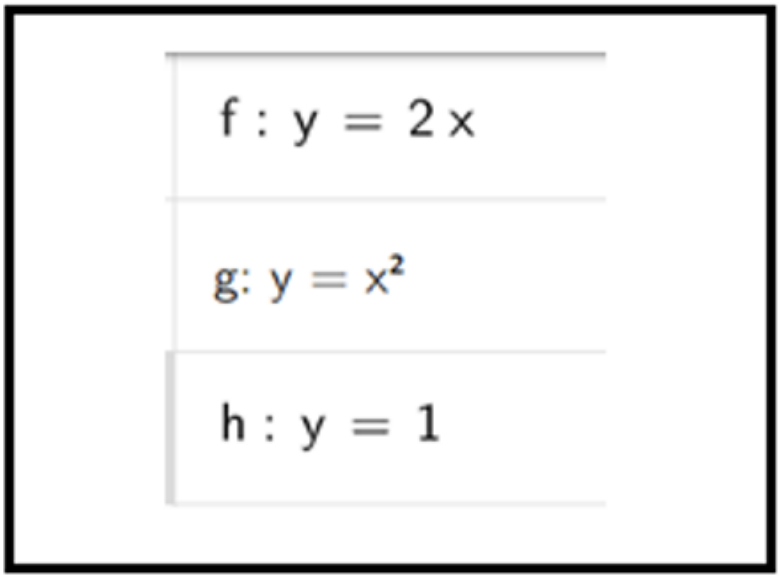

Figure 7.
The graphs.

Geogebra allows us to see the 3 intersections of each of the 3 graphs. By easily clicking on the segment we can see the intersection of each graph with the other. Hence the fact that each graph has a designated color in order to be able to distinguish it from its equation in Figure 7.

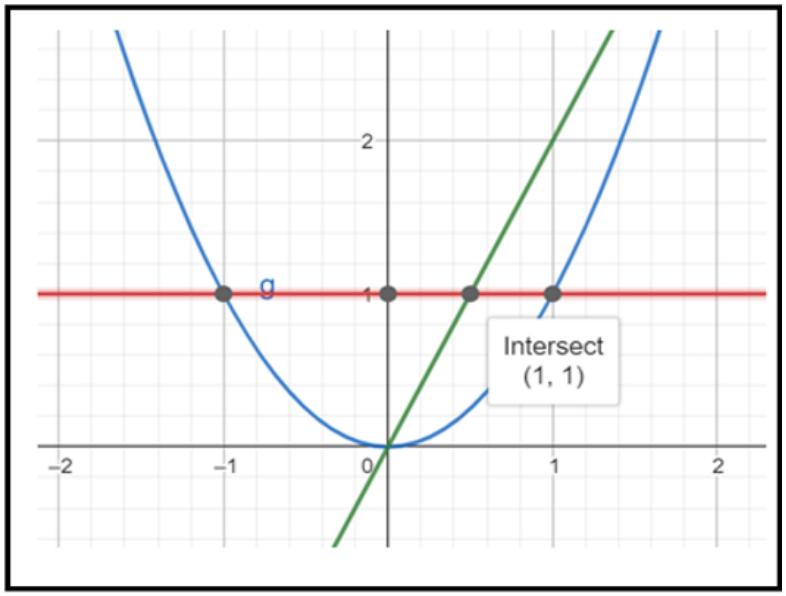

Figure 8.
The intersection of graphs.

Figure 8 shows the intersection of two graphs, the straight line graph y = 1 and the curve, this intersection occurs at (1,1). Another intersection occurs at the coordinates (-1,1) the line graph and the curve graph both intersect at this point.

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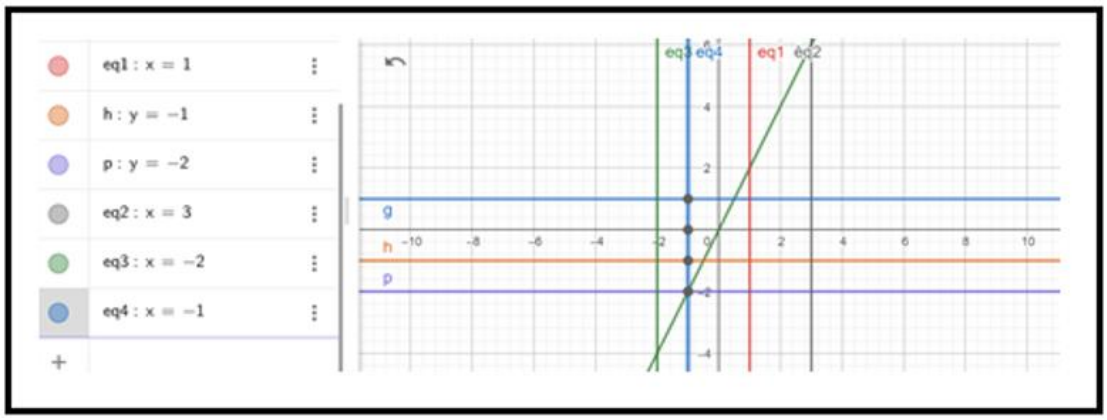

Figure 9.
Intersection of 8 graphs.

Figure 9 shows the intersection of 8 graphs that can be represented in geogebra. It can be seen how they each intersect in detail with one another. The great advantage of geogebra is that one can have several different graphs on the grid.

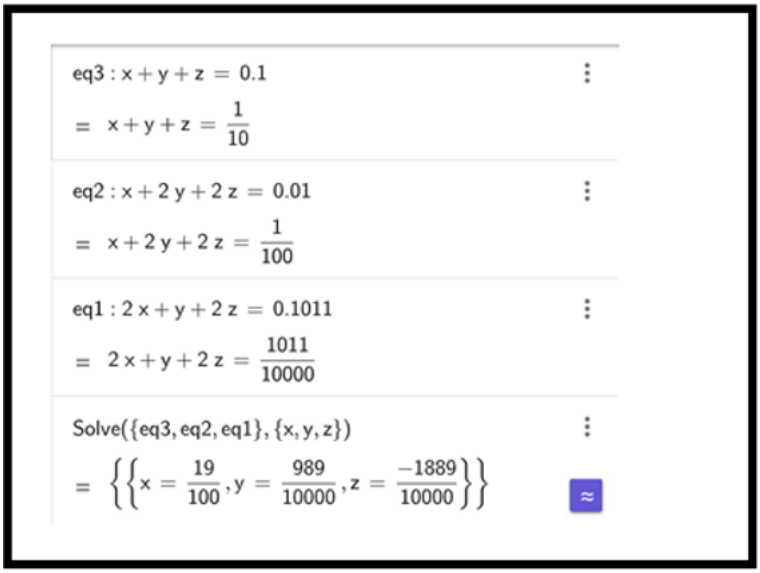

Figure 10.
3 Equations with 3 Unknowns

Geogebra is capable of solving 3 equations with 3 unknowns simultaneously as can be seen in figure 10. We can also have the opportunity to draw several graphs on one representation.

Figure 11 shows this implementation. In Figure 11 you can see how one of the graphs is a typical 2D graph however at the same time you can see the other graphs that are in the other planes with an amazing representation of its illustration. The marvelous thing about geogebra is that it can not only represent itself with an intersection of its 3D representation but it also illustrates to us how they stand when having several different plane graphs on a coordinated system.

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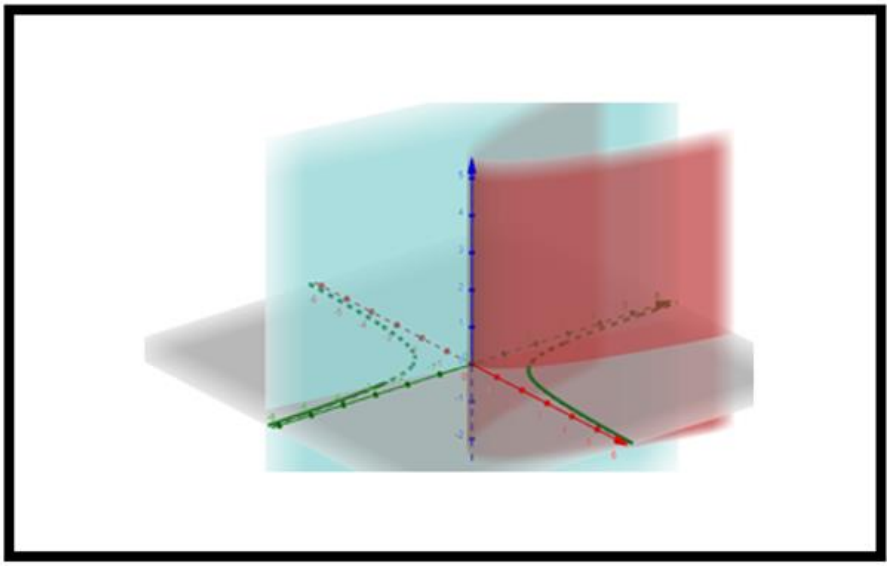

Figure 11.
Several graphs.

Geogebra can also be used to solve a simple equation like in Figure 12 consisting of one unknown. This is such an excellent way that can be used to be illustrated by university students.

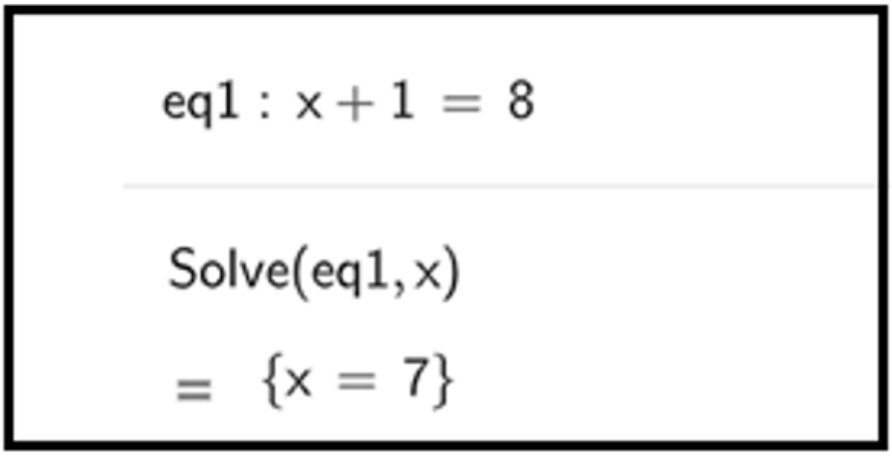

Figure 12.
1 equation with 1 unknown.

Geogebra also has an amazing way of manipulating the different objects that have been generated whilst on stand work online. In Figure 13 we can see clearly how we can select 3D Objects and rotate them according to our selected tasks and expectations.

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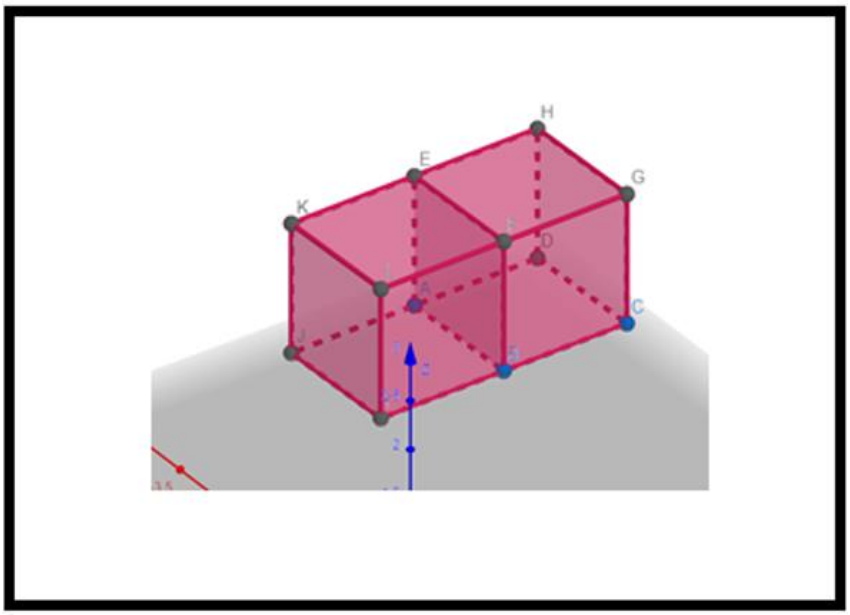

Figure 13.
Selecting Objects.

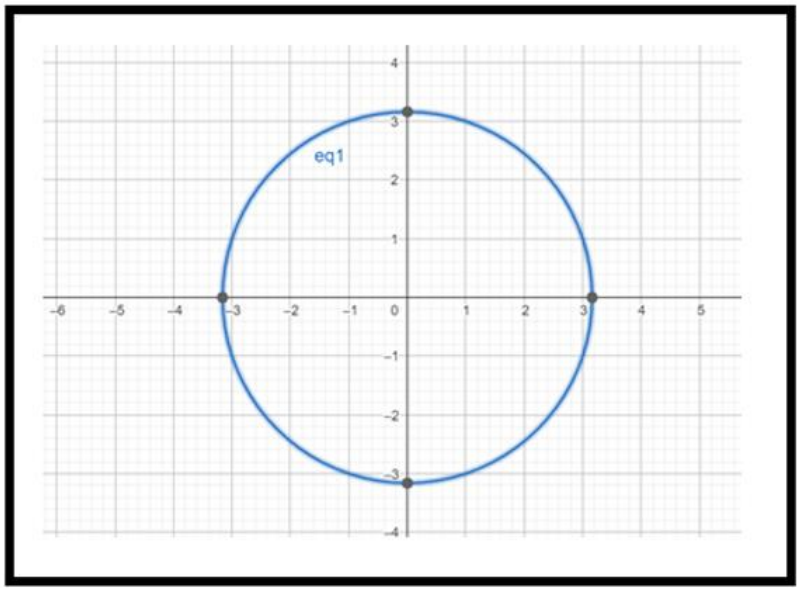

Figure 14.
Circle drawn.

Figure 14 shows how we can use geogebra to draw a circle with an origin at the center point (0,0). Figure 14 makes it so easy to understand where the radius center point is and where exactly it stops.

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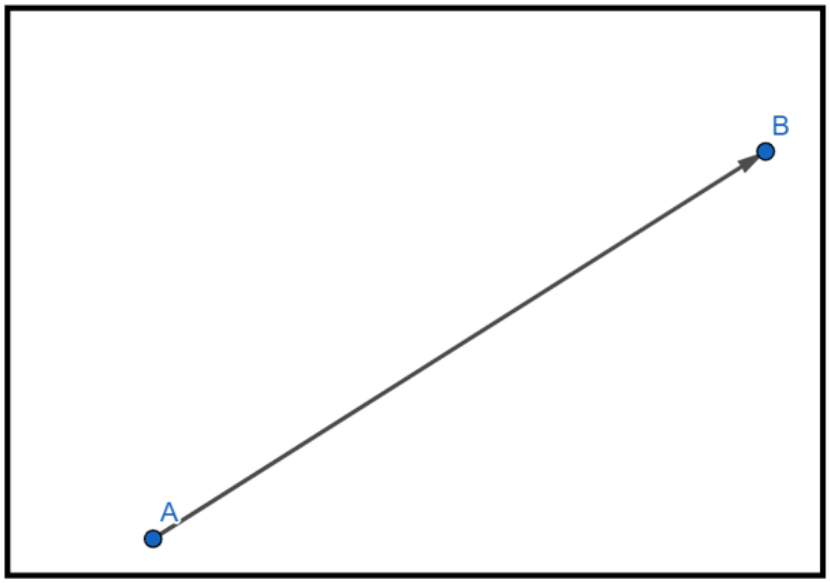

Figure 15.
Vector.

Figure 15 shows the representation of a vector illustrated in geogebra. We can see the start point of the vector which in this case happens to be point A and the end point of the vector which happens to be point B.

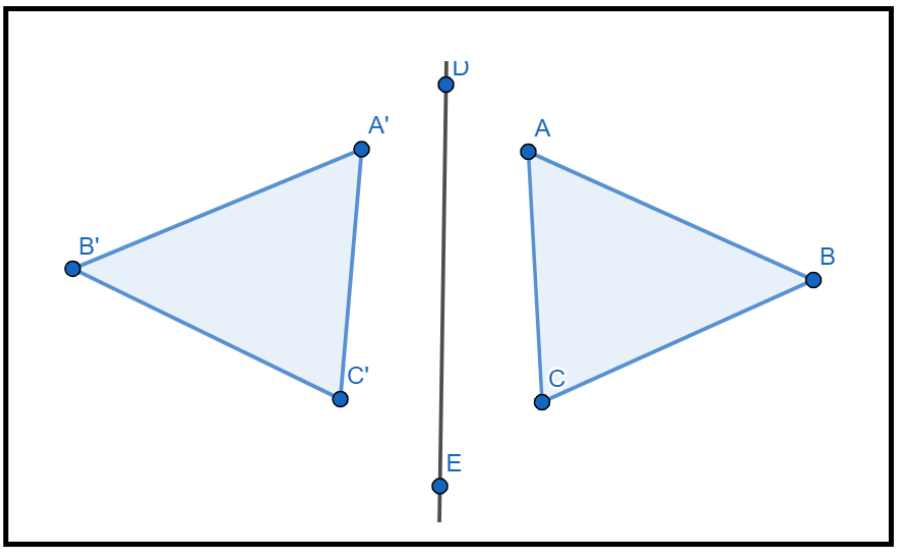

Figure 16.
Reflection of Object.

Figure 16 shows how GeoGebra can be used for the reflection of one polygon with 3 sides via the line of points D to E. It can be seen clearly in this figure, that points A', B' and C' are the reflection of the points A, B and C.

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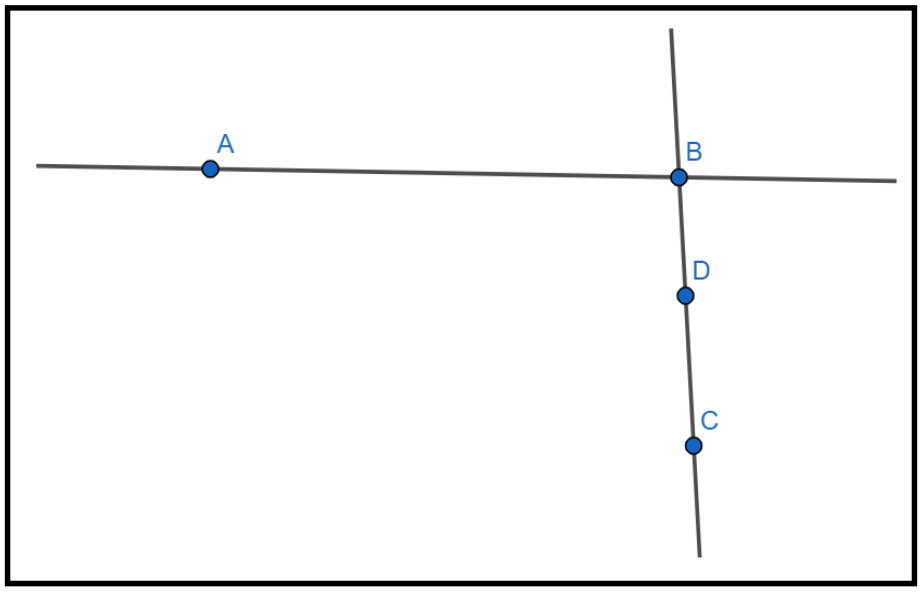

Figure 17.
Freehand shape.

Figure 17 shows the drawing of a freehand shape of two lines intersecting one another the point B. Geogebra can be used to draw several different lines of such with different intersecting angle points.

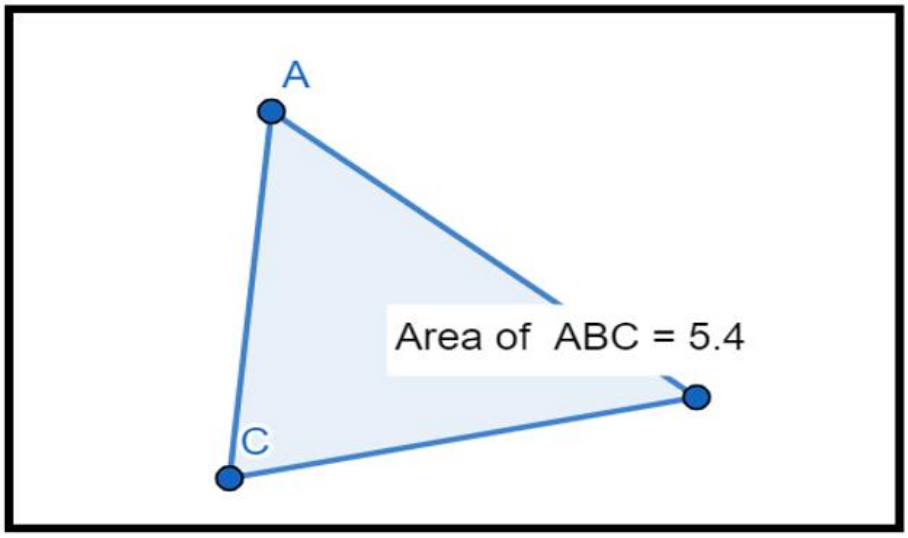

Figure 18.
Calculating the Area.

Figure 18 shows the calculation of the triangle with points ABC. In Figure 18 we can see here that the area under the triangle is 5.4.

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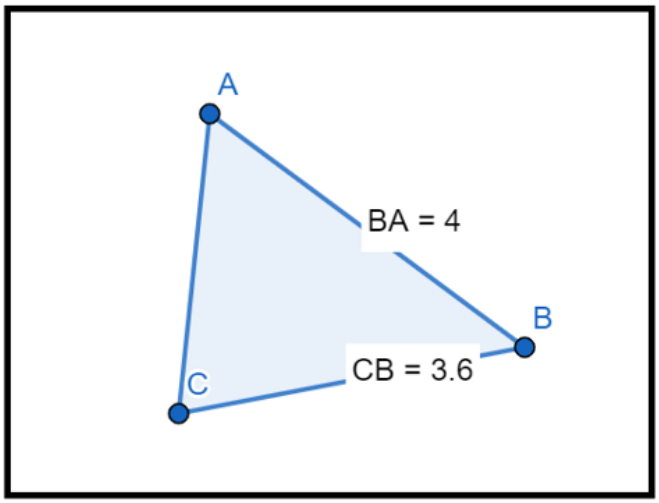

Figure 19.
The distance.

Figure 19 shows how GeoGebra can be used to measure the distance from one point to another. The distance between points a and b happens to be 4.

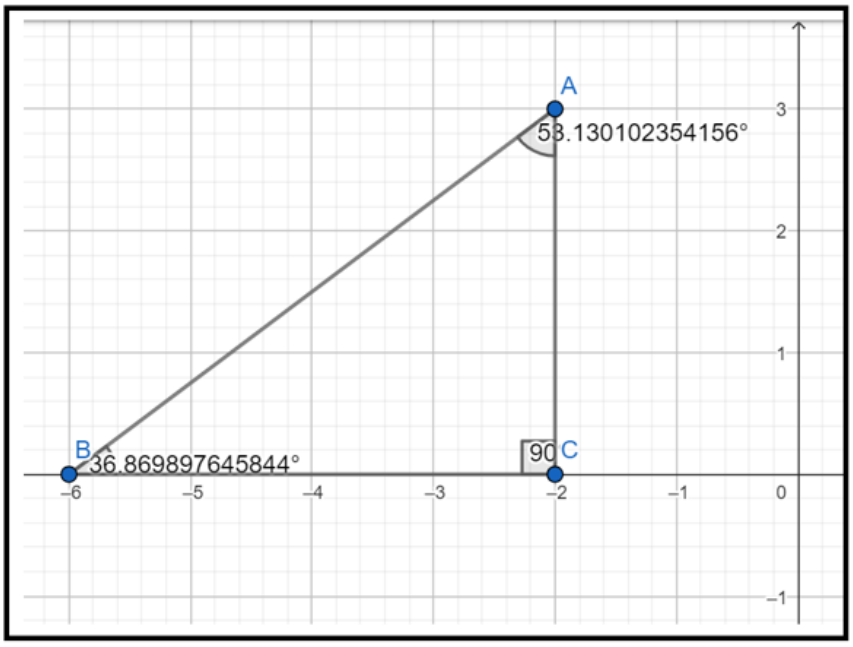

Figure 20.
The angle.

Figure 20 shows a triangle with points AB and C. The inner angles are measured by clicking on the two different slanting lines on each side.

Geogebra can also be used to represent a diagram representation of the probability of a certain sector function. Figure 21 shows the representation of the graphical implementation of the value of sigma when it happens to be one.

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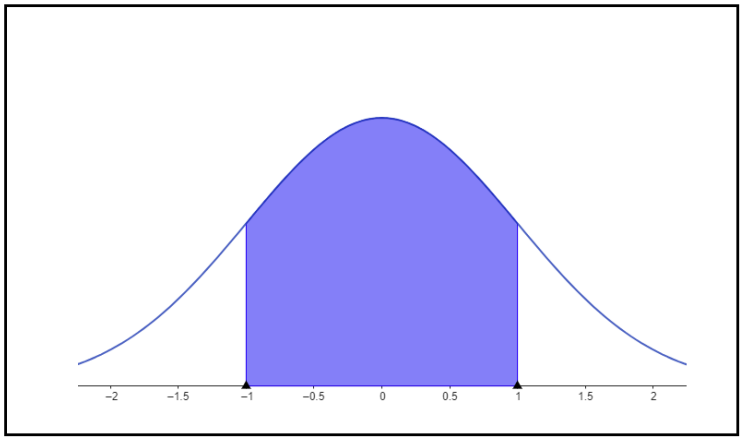

Figure 21.
Probability.

2. Methodology

The soul method that we used to test how ICT and softwares like Geogebra does have an effect on the learning techniques of students was based on several questionnaires that we selected and we distibuted them amongs certain students that did take mathematics and ICT. This great thing is that, both of authors of this paper are Unviersities professor that actually taught these two course this semester. ICT and mathematics was taught and an interchange of ceratin topics done in order for us to be able to analyse the use of software in teaching. One can easily agree that the use of geogebra made life easier for students that actually took the course of mathematic for the faculty of education.

Geogebra is an open source tool that is free and can be used by both students, lecturers and teachers. Since Geogebra can be used for multi-classes of education then we decided to perform an analysis that is focused on several different group targest and that this enables us to see the different ways of assessing the valnarabligy of how software and ICT has shapped its effect in teaching and mathematics. There are several different modes of teaching both that can be taken into by using a software tool and without the use of software techniques. One mode of teaching is know as the authority or lecture style of teaching [1] . In this case lectures tend to be long and they tend to last for several hours [2].The other form of teaching is known to be called as the Demonstrator or the coaching style of teaching [3]. This mode shows different modeling techniqus and it include several hands on activities [4]. The last form of lecturing is based on a hybride technique or a so called blended style [5].This is a very interesting model which is focused on interets and students needs to the study [6].

Each of these different forms may or may not require a software or the use of ICT for better illustration and teaching. The use of geogebra allows students to be able to provide a solid understanding background of the idea at hand. The different methods of teaching mentioned above have been used in teaching mathematics for the faculy of education at the Unviersity of Gjakova, Kosova. A follow through to that students whom never used Geogebra were entittled to use it and then an anaysis was carried out. This anaysis was a questionnaire that was directed to university students, professors teaching mathematics as well as high school teachers. This analysis was divided amongst several different groups and each group had its own opinion presented. The first group to be analyzed were the lecturers and professorswho taught mathematics at the university. A graphical representation and a pie chart had to be illustrated in order for the results to come out clear and concise. This group was those who taught at the university of Gjakova on previous occasions and are still teaching now.

The second group where students who had to undergo that test and they were those who actually had both mathematics and ICT at the University of Gjakova, Kosova. They signed up for the questionnaires and those questionswere different from the test given by the lecturers. The third group

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underwent different questionnaire test however this was primarily directed to the teachers teaching at high school. Those teachers included those who actually taught mathematics to students for classes students of grades 9, 10 ,11, and 12. The questions were different from those given to the other set of groups and they were mainly focused on the details of their pupil's mathematical learning techniques. We also decided to ask other extra questions that involved the use of Geogebra for teaching as well as other software teaching methods. There were more than 120 who took place in the questionnaire. The questionnaire was online and it took more than a couple of days to complete it. The data was then represented in a pie chart and analyzed.

Similarly, software tools used in music production have transformed how music theory and composition are taught. Just as Geogebra provides a clear and practical understanding of mathematical concepts, digital audio workstations (DAWs) and other music production software allow students to create, manipulate, and comprehend music in real-time. This interactive approach to learning music enhances students' understanding of music theory, composition, and sound design. By integrating these tools into music education, students can experiment creatively, gaining a deeper appreciation of musical techniques and fostering their artistic expression.

3. Tests

The three different distinct groups that were asked to answer those questionnaires were given two days to complete the questionnaire. The first set of questions for the group was intended for the lectures that wereprimarily focused on how they felt about using software for teaching mathematics and ICT. The second group that took the questionnaire where the group that where a class of primary school teachers who took the questionnaire and happened to be teaching maths for school years from one to five. The third group that took the questionnaire where a a group of students who passed the mathematics and the ICT course and that they happened to be satisfied with their grades.

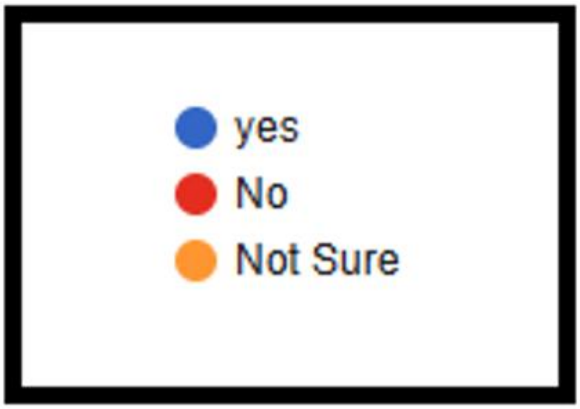

Figure 21.
The color code chart.

Figure 21 shows the color code that represents the data that was used to calculate the expected outcome from the results of the questionnaire.

4. Results

The results of each question that was answered were illustrated on a pie chart percentage diagram as well as a graphical representation via a bar graph.
The first question assigned to the questionnaire was “Is using the Software Difficult?”

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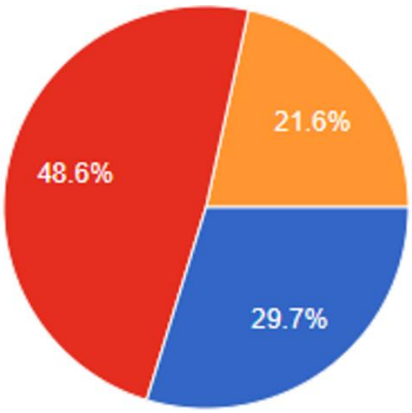

Figure 22.
Pie chart of the 1st Question.

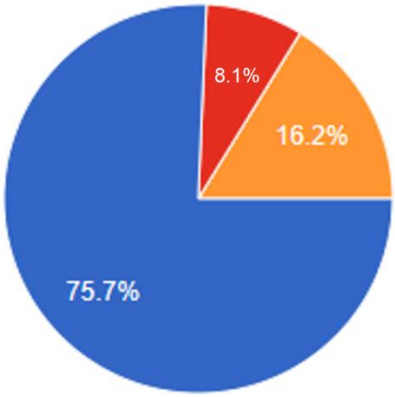

Figure 23.
The second question of the questionnaire.

The second question assigned to the questionnaire was "Do you know how to use the Software?"

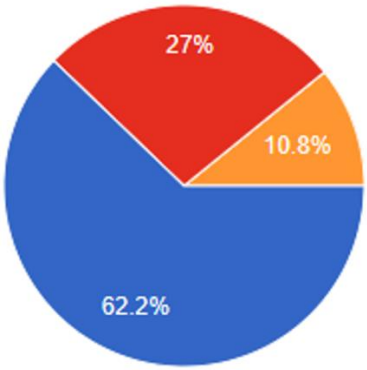

Figure 24.
The third question of the questionnaire.

The third question assigned to the questionnaire was "Is Mathematics Difficult?"

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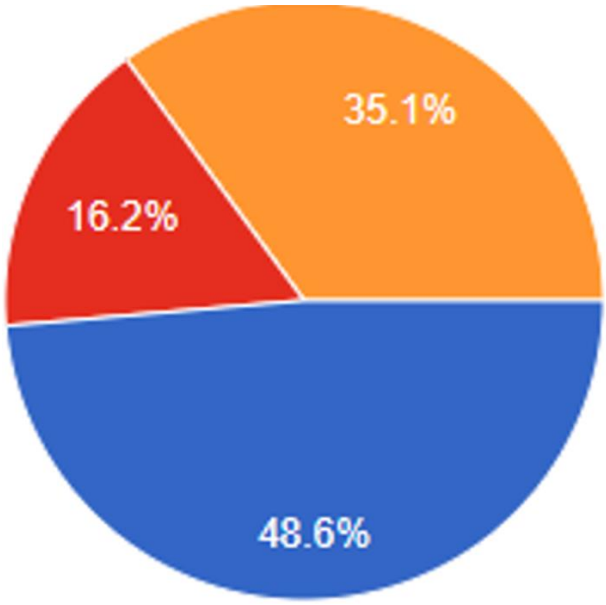

Figure 25.
The fourth question of the questionnaire.

The fourth question assigned to the questionnaire was "Do you think the Software helped in Learning Mathematics?"

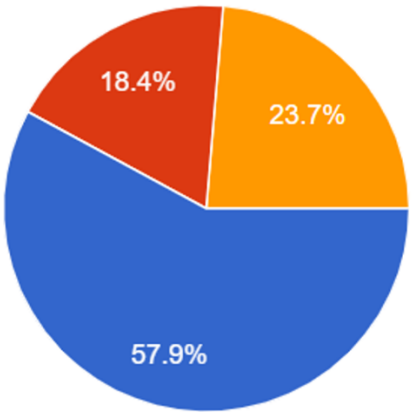

Figure 26.
The fifth question of the questionnaire.

The fifth question assigned to the questionnaire was "Was the software helpful in preparing for the exam?"

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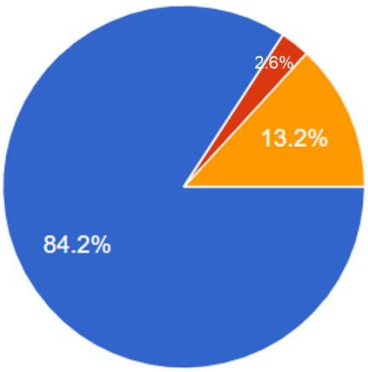

Figure 27.
The sixth question of the questionnaire.

The sixth question assigned to the questionnaire was "Was the software helpful in preparing for the exam?"

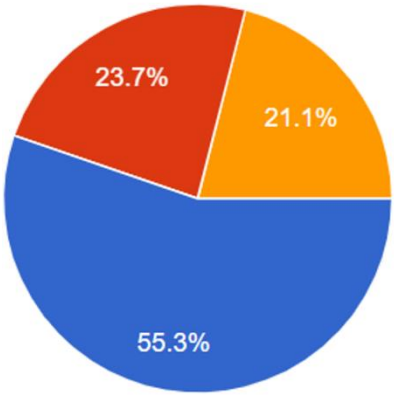

Figure 28.
The seventh question of the questionnaire.

The seventh question assigned to the questionnaire was "Did the use of such software affect the final grade?"

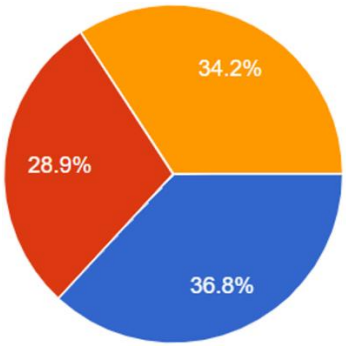

Figure 29.
The eighth question of the questionnaire.

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The eighth question assigned to the questionnaire was "Did it take long to learn to use the software?"

5. Discussion

The set of results that we obtained from the questionnaire enabled us to define several different factors that have to be taken into account regarding the use of software that would be used for teaching and demonstration during a class session.

The questions were so specific and concise that the pupils who answered them had the opportunity to think deeply before answering them.

The 1st question of question gave us a rough understanding of how easily they can become familiar with the use of such software. The other 4 upcoming questions helped us underline whether we were able to draw the actual good side of the use of such software in comparison to the old traditional one. The last final question was the one that put aside the good and the best sides of the use of software to be able to be used for education and learning. Many software programs take longer for certain individuals to be able to adapt to the learning requirements.

The 1st two questions allowed us to be able to distinguish from the other set of questions and we were able to see how the outcome was expected to be.

Because our main target where not lecturers, we were able to understand the outcome based on the differential results of questions 1 and question 3.

"Mathematics and music have been intimately intertwined for over 2,500 years, dating back to when the Greek mathematician Pythagoras of Samos (circa 500 BCE) developed a theory of consonance based on ratios of small integers" [7, 8]. This connection between two seemingly different fields provides an excellent opportunity for innovative and creative teaching.

The integration of technology and the arts in education has brought about a new approach to engage and inspire students, motivating them to pursue and develop their careers as educators.

GeoGebra and music demonstrate a deep connection between mathematics and music, starting from the frequencies of notes to the symmetry in compositions.

As discussed earlier, GeoGebra provides a powerful platform for teaching mathematics and geometry, while music is a universal tool for communication and creativity. Combining these two fields offers the opportunity to create rich learning experiences that blend both art and mathematics.

This material focuses on how these two fields can contribute to the development of students' logical and creative skills. While mathematics and music may seem to be opposites, they share a close relationship. GeoGebra is a dynamic software that helps students and teachers visualize complex mathematical and geometric concepts, while music has a significant impact not only on emotional aspects but also on the development of analytical and creative skills.

Music aids in improving logic, problem-solving skills, and critical thinking. Furthermore, GeoGebra can be used in music to illustrate creative activities, such as graphs that visualize musical notes, their pitch, and rhythm. 'In music theory, much attention has been devoted to the study of intervals used in pitch scales [9] but relatively little work has been done on analyzing time-duration intervals of rhythm.

Another unique aspect is the explanation of mathematical relationships through chords in various scales."The regularity in musical chords plays a crucial role in the effectiveness of voice leading, as discussed in the work of Epp and Miller [10]. Additionally, GeoGebra can be used to explore rhythms, harmonies, musical intervals, and sound frequencies.

"Musical rhythms and scales can be represented as infinite binary sequences, where each bit indicates the presence or absence of a note" [11].

GeoGebra also aids in creating musical models of symmetry by allowing the repetition of musical sections through geometry, offering the possibility of combining these two fields in effective and creative ways for educational experiences.

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In conclusion, the integration of GeoGebra and music in education provides an exceptional opportunity for the development of students' mathematical and creative abilities, offering a rich and inspiring learning experience that can significantly impact their professional futures.

6. Conclusion

The effective use of programs such as GeoGebra and other educational programs in teaching and learning offers tremendous opportunities for improving the learning process. These technological tools help increase students' interaction with mathematical and scientific concepts through dynamic simulations and interactive interfaces. GeoGebra, for example, facilitates the visualization of abstract concepts, making them more tangible and understandable for students. At the same time, these programs can help teachers diversify their teaching methods, including personalized approaches, problem-based learning, and various creative activities. Implementing them effectively requires good preparation by teachers and a clear understanding of their educational goals, but when used properly, they help create a rich learning environment where students are more engaged and motivated. to learn. In conclusion, the integration of these programs in the learning process significantly contributes to the improvement of the quality of education and the increase of the students' technological competencies. From all that was mentioned above and also from the questionnaire, I concluded that a large part of the surveyors are good at using the Software, they call Mathematics a difficult site, but at the same time, the Software helps you learn Mathematics.

The software helps you in preparing for the exam to a large extent, as well as in the final assessment. As for the question of the difficulty of learning software, the answers are divided into the three options almost equally. As can be seen from the questionnaire, respondents in the largest percentage were for the Yes option, in two questions there was No, while No for Sure was the highest percentage after the Yes option.

Moreover, just as educational software enhances understanding in subjects like mathematics, similar tools in music production help students explore the complexities of music theory, composition, and performance. These tools provide students with opportunities to experiment creatively with sound, rhythm, and harmony, enriching their learning experience and developing both their technical and artistic skills.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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