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THE TEACHING OF MATHEMATICS ASSOCIATED WITH THE APPLICABILITY OF THE GEOGEBRA SOFTWARE (MATHEMATICS SOFTWARE).

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SUMMARY
This present project reports how important the Geogebra software is in the teaching-learning process of mathematics, specifically in spatial geometry, as through studies, it was found that this is defined by many teachers in the area as being one of the most difficult contents to learn. demonstrate to students with the basic material previously available to them. In this study, it was necessary to present Geogebra and draw up lesson plans to exemplify how this software can be an ally for teachers of this subject, enabling them to provide better development of students' reasoning, also encouraging them to research, as In this software there are many tools, which facilitate the search for different ways of visualizing the same figure, thus arousing more interest from teachers and students, both in the teaching and learning process.
Keywords: Teaching mathematics. Spatial geometry. Geogebra.

ABSTRACT
This present project reports how important the Geogebra software in the teaching and learning of mathematics, specifically in spatial geometry, because through studies it was found that this is defined by many teachers of the area as being one of the toughest contents demonstrating to students with basic equipment previously available to them. This study required the presentation of Geogebra and the preparation of lesson plans to exemplify how this software can be an ally to the teachers of this discipline, enabling them to provide a better development of students' thinking, encouraging them to research, because this software there are many tools, which facilitate the search for different ways to view the same figure, thus arousing greater interest of teachers and students, both in the teaching process, as in learning**. Keywords:**Mathematics Education. Spatial geometry. Geogebra.

1. INTRODUCTION

GeoGebra is free software for manipulating Geometry and Algebra in the plane (2 dimensions). Its name comes from the union of GEOmetry and ALGEBRA. The aim of this mini-course is to carry out basic operations in the software, studying a little of each one

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of these two areas, as well as carrying out simple geometric constructions. GeoGebra also writes LaTeX texts, remembering that its use is as a tool and not as a text editor.

Winner of several awards in Europe, GeoGebra is a dynamic mathematics program, designed to be used in the classroom, which combines arithmetic, algebra, geometry and calculation. GeoGebra allows you to draw points, vectors, segments, lines, functions, and dynamically change them. It is also possible to insert equations and coordinates directly into the graphs. Furthermore, it can deal with number variables, vectors and points, find derivatives and integrals of functions.

2 METHODS

In general, bibliographical research was used on various points relating to the teaching-learning process in schools with new technologies, specifically the Geogebra software, as an ally of mathematics teachers for the success of an innovative proposal for learning the contents of geometric figures, spatial and flat.

3 THEORETICAL FRAMEWORK

3.1 Geogebra software brief history

It was created by Markus Hohenwarter to be used in a classroom environment. The project began in 2001, at Universität Salzburg, and has continued in development at Florida Atlantic University. GeoGebra is capable of dealing with variables for numbers, points, vectors, deriving and integrating functions, and even offering commands to find roots and extreme points of a function. With this, the program brings together traditional geometry tools with others more suitable for algebra and calculation. This has the didactic advantage of representing, at the same time and in a single visual environment, the geometric and algebraic characteristics of the same object. From version 5.0 onwards, it is also possible to work with geometry in three dimensions. The program allows you to carry out geometric constructions using points, lines, line segments, polygons, etc., as well as allowing you to insert functions and change all these objects dynamically, after construction is finished. Equations and coordinates can also be directly entered. Therefore, GeoGebra is

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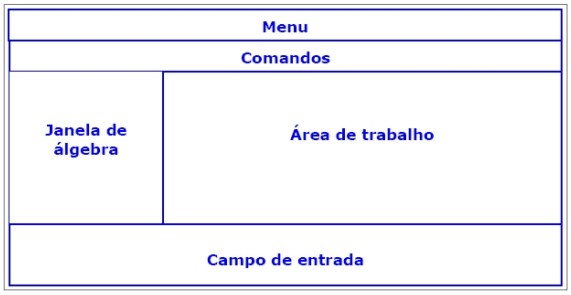
capable of dealing with variables for numbers, points, vectors, deriving and integrating functions, and also offering commands to find roots and extreme points of a function.

3.1.1 Familiarizing yourself with geogebra.

GeoGebra has numerous tools that will be useful in producing figures for expository classes, creating an applet to run on the internet, executing didactic sequences for Mathematics content in primary and secondary education. It is software with five work areas:

a) Main Menu;
b) Toolbar;
c) Algebra Window;
d) Commands
e) Input Field



Without losing focus on the objectives contained in the PCN (National Curricular Parameters) and the PPP (Pedagogical Political Project) of each location, which is summarized in the formation of citizens. As stated in the PCN (1998):

> We live in an era marked by competition and excellence, where scientific progress and technological advances define new demands for young people who will enter the world of work. This demand imposes a review of the curricula, which guide the daily work carried out by teachers and education specialists in our country. (BRASIL, 1998, p. 1).

In order to successfully carry out the proposals contained in the PCN, many teachers, including mathematics, have adopted the use of various resources in their teaching, since teaching mathematics is seen by many professionals in the field as a great challenge, as Not all content is easy to present and understand using the whiteboard.

3.2 The mathematics teacher and the use of geogebra in teaching mathematics learning

Bicudo (1999) shows a new reality that is found in schools in Paraná with the advent of computer equipment. This new phase can be seen as a

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moment of technological evolution, which could bring several benefits to digital inclusion, socialization of educational programs and enrichment. Given the current context of public schools, where the government has made investments in the area of information technology in favor of improving education and the lack of preparation of teachers to deal with this situation, it is of great importance that a mini course be offered to Basic Education teachers , from the public education network, with a limited number of places, with the following proposals: knowledge and use of GeoGebra educational software as an alternative to mathematics classes through studies and flat geometric constructions.

According to Papert (1985), the use of Geogebra software, object of studies in the Educational Development Program (PDE), can enable, through its tools, the execution of mathematical activities, providing the necessary conditions to reduce the distance between the teacher and the computer so that you feel comfortable handling it and not threatened by this technology, addressing possibilities and limitations of using software in teaching mathematics, encouraging the use of computers in teaching practice to enrich learning environments and assist the teacher and student in the process of knowledge construction.

According to Piaget (1996), he proposes a necessary reflection to always value the work in the classroom, that is, the GeoGebra software is just an alternative instrument in pedagogical practice and can provide greater precision and speed in certain actions. This technological resource aims to help students understand their geometric constructions, ensuring them the knowledge already acquired in the classroom and promoting new discoveries. The study of function is relevant because it is not just limited to the interests of mathematics, but put into practice in other sciences, such as physics and chemistry. In mathematics, the study of polynomial functions is divided, mainly into:

- Characteristics, types and elements of a function.
- Function of the first degree.
- Function of the second degree.
- Exponential function.

It is not always observed, but contact with functions occurs all the time in our daily lives, for example: when watching or reading a newspaper, we often see a graph, which is nothing more than a relationship/comparison of two quantities or even a function, but represented graphically. For this graph to take shape, it is essential that this relationship / comparison is represented in a function in algebraic form. To start the study of

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function requires knowledge of equations, as the entire algebraic development of a function is solved through equations. For the introduction of teaching functions, the National Curricular Parameters highlight:

> Traditionally, the teaching of functions establishes a prerequisite for the study of real numbers and sets and their operations, to then define relationships and from there identify functions as particular relationships. This entire path is then abandoned as soon as the function definition is established, because for the analysis of the different types of functions, any study relating to the set is unnecessary. Thus, teaching can begin with the notion of function to describe situations of dependence between two quantities, which allows the study from contextualized situations, described algebraically and graphically (BRASIL, PCN, 2002, p.121).

When contemplating this content, it is noted that the concept of function, its properties, algebraic language, graphical interpretation, as well as its application should be emphasized. Regarding the teaching of special cases of functions, the curricular parameters highlight: "Teaching, when focusing on studies of special cases of functions, must not neglect to show that what is being learned allows a more critical and analytical look at situations described" (BRASIL, PCN, 2002, p. 121).

The need for the teacher to master teaching methodologies. It is not enough for this professional to just master the use of educational information technology. He needs to learn how to plan based on students' possible difficulties in relation to the class topic.

This planning must also include the teacher's mediation during the class, in order to provide students with moments in which they can present their solutions for possible discussions.

3.3 The student and geogebra

According to BORGES NETO (1999), these aspects are very important to take into consideration in this context. Draw attention to the fact that teachers should not think that by using this or that software they can solve a large part of their problems, which are closely linked to students' motivation for Mathematics and the difficulties they experience in studying it. The teacher must admit that he needs to study to use this tool as efficient and effective support for his classes. With the support of the Geogebra software, this scientific language of Mathematics can make greater sense to the student when he, for example, constructs a straight line in the Cartesian plane,

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it marks any two points and uses the command reflection of one point in relation to the other. The student sees a point appear on the line that is opposite to the one marked previously. It is possible to identify that the distance between the points is the same. On the blackboard, the most the teacher can do is draw a point opposite the first and equidistant from the second, and hope that the student understands and believes this. This knowledge is simple, but it serves as a basis for others, such as midpoint and symmetry, for example.

This software, according to (BRASIL, 2001, p. 37), due to its applicability in working with geometric design using the computer as a multimedia aid in learning, as it is a powerful instrument for working on mathematics content such as: geometry, calculation , algebra and the ease of working with software with simple, easy-to-use commands, where students, even if they are not computer users, will not encounter difficulties in developing work and building knowledge of the subject. The work must be carried out with students from an eighth grade elementary school class, in twin classes, having previously worked on the basics of the content in class, using traditional teaching methods (textbooks, chalkboards, etc.). Within this work perspective, we aim that, when students work on these contents, they can verify and visualize in practice the mathematical concepts previously seen in theory and drawings on the board.

A group, made up of 24 students, is considered by teachers as a team that presents behavioral and learning problems. The ideal is to form teams of two students where the paths taken and the productions carried out on each computer can be observed. The work can be divided into three parts:

Presentation of the software commands to students and random exploration so that they can familiarize themselves with its graphical interface. Secondly, formulate some exercises in a guided way, where they can observe the results.

And finally, present some activities, described below, about the structuring content of functions, where, in addition to the proposed constructions, they can answer some questions on the subject.

Activity 1: Points on the Cartesian plane.

The objective of this activity is to familiarize the student with the program, locating points on the Cartesian plane, based on coordinates.

Activity 2: Graph of an affine function. This activity aims to:

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• Identify relationships between two variable quantities;

• View the value of x that cancels the function defined by y=ax+b;

• View the values of x for which the function defined by the positive equation or null.

Activity 3: Graphs of the quadratic function

This activity has the following objectives:

• View the zeros of the quadratic function;

• Associate the zeros of a given function with the abscissa of the points where the parabola intersects the x axis;

• Determine the minimum point or maximum point of a given function quadratic;

• Visualize the values of x for which the given quadratic function is increasing and decreasing.

3.4 Geogebra as a requirement for the mathematics discipline: possibilities and challenges.

Still according to Hebenstreint (1987, *apud* BORTOLOTTI, 2008): "The computer allows us to create a type of object – 'concrete-abstract' objects. Concrete because they exist on the computer screen and can be manipulated; abstract because they deal with realizations made from mental constructions".

For Hebenstreint (1987), the computer can provide some benefits for teaching mathematics, but for this to happen it is necessary to choose software that presents characteristics appropriate to the pedagogical proposal, in addition to a good interface in order to attract the interest of students. students. The interest in proposing work that involves the use of computational resources in teaching mathematics is motivated by the low success rates that are generally presented in this subject.

We proceeded in this way, selecting software that suited our needs to assist us in teaching geometry. We decided to use Geogebra software, a dynamic geometry software that combines the qualities of good geometry software.

Geogebra has pedagogical characteristics such as ease of use and is free distribution software. It is based on the Java language and works across platforms (Linux, Windows and Macintosh), it also has tools for manipulating elements

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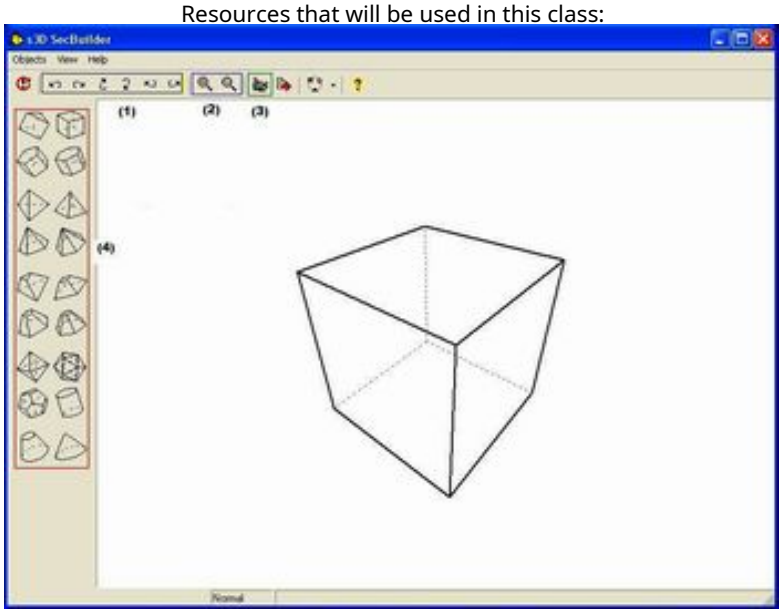
geometric, and allows you to insert coordinates and equations while being geometry and algebra software at the same time.

3.5 Spatial geometry with geogebra

Based on Silva (2011), Brasil Escola, the mathematics teacher, Kauby Santos published on his blog:

Resources that will be used in this class:



Source: Image of the Author

(1) Rotation of the solid:

Options: Left / Right / Up / Down / Rotate left and right around its own axis;

(2) Zoom;

(3) Option to rotate the software automatically, that is, by squeezing the solid geometric rotates without user assistance and only stops with a new click on that option;

(4) Geometric solids. To draw them you need to click on the solid and then on the white area of the software.

It is recommended that the teacher set aside 15 minutes in class to explain to students how to manipulate the S3D Secbuilder software.

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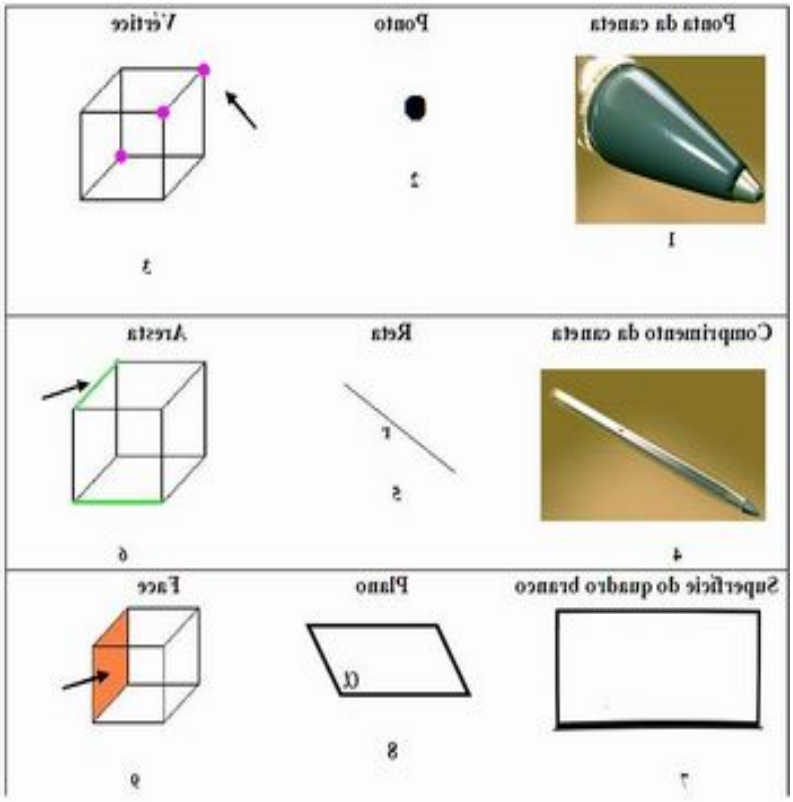
3.5.1 Description of the activity:

The teacher must establish, together with the class, an analogy between the elements of the polyhedron: vertex, edge and face with the primitive notions of point, straight and plane, respectively.

To do this, he or she can show students, for example, the tip of a pen and ask them if it refers to the point, the straight line or the plane. After checking the relationship between the tip of the pen and the point, the teacher must establish that the vertex resembles the point. For the other elements and using the same strategy, the teacher can show the length of the pen and the surface of the whiteboard. These analogies can be recorded on the whiteboard as follows:



Sources: Images 1 and 4: http://padilhaverde.blogspot.com/2009/12/o-misterio-das-canetas-bic.htm
Images 3,6 and 9: http://www.brasilescola.com/matematica/poliedros.htm
Images 2, 5, 7 and 8: Images by the author

And then, with the students organized in pairs, the teacher should propose the following activity:

Fill in the field in each row of the table, following the instructions below:

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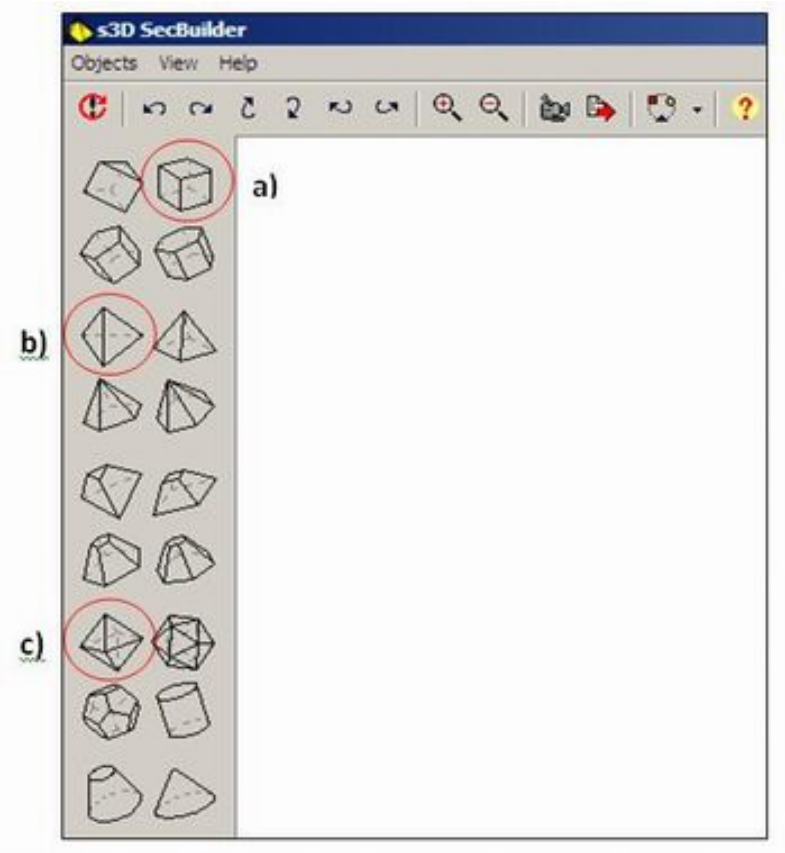
1) Using the S3D Secbuilder software, draw each of the solids highlighted in the figure below (the teacher can sketch this figure on the whiteboard so that students can visualize which solids they should draw)



Source: Image of the Author

2) When drawing each solid, manipulate it (see options (1), (2) and (3) in the GUIDELINES REGARDING THE USE OF THE SOFTWARE field), identify the number of vertices, edges and faces of each of them and record the data

FINAL CONSIDERATIONS

Through this article it was possible to verify that with the Geogebra software it is possible to change this process of teaching and learning mathematics, specifically in spatial geometry, as the student has other ways of visualizing the figures presented. There is also a great possibility for students who take classes through this software to become researchers, as it is an opportunity for them to make conjectures, analyses, tests and come to their own conclusions about the content explored with Geogebra. There is often an exchange of knowledge between students and teachers, as there are many students up to date with new technologies, on the other hand teachers who have not yet acquired technological knowledge, but this is not so relevant, they just need to be both willing to

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this exchange of knowledge. As with any program, with Geogebra you have to be careful that students do not lose focus on learning when using it, but it is up to the teacher, as a mediator, to guide them so that they visualize the objectives and can use this tool at will. your favor.

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