Chapter 23

Geogebra software in basics of flat geometry: a teaching methodology for the major fundamental

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ABSTRACT

The present study has as its main focus to address how the use of the GeoGebra software can positively impact the learning of basic concepts of plane geometry for the greater fundamental. It seeks to analyze which of the main positive impacts of the use of the GeoGebra software on basic concepts of plane geometry: a teaching methodology for the major fundamental. This is, addressing the GeoGebra operational system in basic concepts of plane geometry: a teaching methodology for the fundamental one that is more justified - there is a need to show how technology can facilitate the geometric teaching-learning process, and that becomes of notorious importance The utility in the training of the student, the way in which this computational can be used for teaching of basic notions of plane geometry. The present study consists of a research of a descriptive nature, with results treated in a qualitative manner, from the collection of data from secondary sources, including a bibliographic review. As sources of search, books, articles and sites will be used that say about the subject worked, together with authors who treat the importance of reconciling technology and education in the contemporary world. As a result of the survey of information throughout the research and the analysis of the information, it was possible to conclude that the applications of plane geometry together with the GeoGebra software, published positively by a series of authors who are referenced in this research, by country, or by the program provided The user will have a visual experience of two theoretical concepts seen in class, and these are two important factors for geometry teaching. Being likewise, the construction of flat geometric figures through the GeoGebra program shows itself to be an indispensable tool for the fundamental teaching of today, in order to form a student more prepared for future series.

Keywords: GeoGebra Software, Plane geometry and applications in basic education.

1 INTRODUCTION

The main focus of this research is to show how the use of GeoGebra software can positively impact the learning of basic concepts of flat geometry in higher elementary school. Currently we experience the era of globalization, and technology is present in all areas of society and has a fundamental role in various human functions, among them with regard to teaching-learning. Thus, technology together with education becomes an active and indispensable member in the production of remarkable knowledge and technologies in the new information society, as vehicles of economic and social development (Brennand, 2002).

According to Ribas (2008), the teacher must be creative and develop strategies for the improvement of teaching. Therefore, the educator must be committed to inserting technology as an object of teaching and learning, because it can be used in a didactic way, and this implies the intellectual and social formation of students, providing society with a critical individual, and creative in finding solutions to everyday problems.

Currently, the teaching of mathematics is in the midst of several obstacles, which hinder the teaching-learning process, such as: The lack of public policies that prioritize the improvement of the education system, lack of didactic and technological resources in schools, in addition to the absence or the wrong way of teaching using pedagogical practices, as stated by D' Ambrosio (2008, p. 80): "The school is not justified by the presentation of obsolete and outdated and often dead knowledge, especially when talking about science and technology". In view of this, it is notorious that the teaching of mathematics in educational institutions should be rethought, that is, in order to include new teaching methodologies (D' Ambrosio, 2008). Thus, the modernization of institutions would be a solution for this, because the inclusion of technology with teaching-learning is an indispensable didactic tool today.

Therefore, according to Ferrão (2013) it is essential to use new ways of teaching, and technology, are one of these tools that can contribute significantly to student education. Thus, educational programs have been developed in recent years, aiming at the unification between technology and teaching. GeoGebra software has a visible importance in the teaching of geometry, being it: flat, geometric or analytical. In the case of flat geometry, the program can be used in the learning of geometric figures and basic concepts of Euclidean geometry.

Discuss about geogebra software in basic concepts of flat geometry: a teaching methodology for the major elementary is justified by the need to show how technology can facilitate teaching and learning, because, according to Ferreira (2001, p.643) software is "any program or set of computer programs", however, "what characterizes it as educational is its insertion in teaching-learning contexts" (OLIVEIRA; COSTA and MOREIRA, 2001). Thus, it becomes notorious the importance of the GeoGebra program in the formation of the student, that is, by the way in which this teaching mechanism can be applied to the teaching of basic son of flat geometry.

Thus, it is possible to note that the importance of GeoGebra as a pedagogical teaching tool can directly or indirectly impact educational institutions together with teachers in the field of mathematics in proposing this teaching methodology to students, and thus improve their understanding of the content, through the ease of the GeoGebra app to support computers and mobile phones, which facilitates their access through students.

The educator should present to his students how to use this technological resource, and in what this teaching tool can provide for teaching and understanding the subject of the basic concepts of flat geometry, so that GeoGebra software would be a material for the student to actually absorb the theoretical subject and apply in practice by the student through digital assistance (mobile or computer). To this end, it should be recognized that it is notorious the positive impacts on the development of elementary school students who enjoy the GeoGebra operating system as a didactic methodology for teaching the basic concepts of flat geometry. Thus, the present work established as a research problem the main positive impacts of the use of GeoGebra software in basic concepts of flat geometry: a teaching methodology for the major elementary?

And as a general objective and analyze what are the main positive impacts of the use of GeoGebra software in basic concepts of flat geometry: a teaching methodology for the greater elementary. To achieve the general objective, the specific objectives will be to present basic concepts of flat geometry, conceptualize geogebra software, relate basic concepts of flat geometry together with the GeoGebra utility and thus promote the construction of the maingeometric figures s flat through the operating system in a didactic way, analyze the main benefits of the use of the GeoGebra software in teaching flat geometry to the largermental sling.

The present study consists of an applied research of descriptive character in which, according to Hymann (1967) observes a certain phenomenon, it is therefore, begins to record what is happening. Therefore, the theme aims to analyze the main positive impacts of the use of GeoGebra software in basic concepts of flat geometry: a teaching methodology for the greater elementary. In this sense, the results will be presented qualitatively, based on the collection of information from secondary sources, including bibliographic review. As sources of search will be used books, articles and websites that relate to the subject worked, together with authors who deal with the importance of reconciling technology and education today.

The developmentwill be divided into topics according to the specific objectives, having that at first will be presented the concepts of flat geometry telling a brief history of how it arose, as well as the definitions of the elements and figures that are part of the flat geometry. Then, the GeoGebra software will be conceptualized, punctuating a little of the history behind the program, as well as the geometric tools that will be used in this research. In addition, the construction of flat figures will be made through the GeoGebra program, emphasizing the sliding control tool, which will have the intention of animating geometric constructions. Moreover, a brief analysis will be made on the positive points about the use of the GeoGebra utility in the teaching of flat geometry, and whether this tool can indeed be an innovative resource for teaching flat geometry in the major elementary.

2 STUDY OF FLAT GEOMETRY

2.1 BRIEF HISTORY OF FLAT GEOMETRY

Geometry emerged around the 19th century. XX BC seen in Egyptian and Babylonian civilizations. The word geometry comes from the Greek Geometrin, which means to measure the earth. Geometry at this time was used in everyday tasks to tell mecertain situations, such as : construction of houses, delimitation of land and plantations, and even in the observation of stars, which contributed to the success of the harvests. (BRAZ, 2009).

In ancient Egypt, the Nile River crossed the banks and flooded its delta (Triangular land accumulation zone at the mouths of rivers), and this occurred every year. Thus, farmers and administrators of temples, palaces and other productive units that had ties to agriculture in Egypt, noticed that these floods did not give them a due notion of how these lands should be divided, so that there is a better plantation.

In addition, in the collection of taxes, which were charged according to the availability of the land. In view of this, the former pharaohs hired reliable employees, and the same, had the job of more accurately dividing these plots of land, this and, in a rectangular or triangular way, improving the methods of agriculture, in addition to farmers and administrators to pay their due taxes on the land. Thus, because of this problem and others, it emerged to geometry in ancient Egypt (BRAZ, 2009).

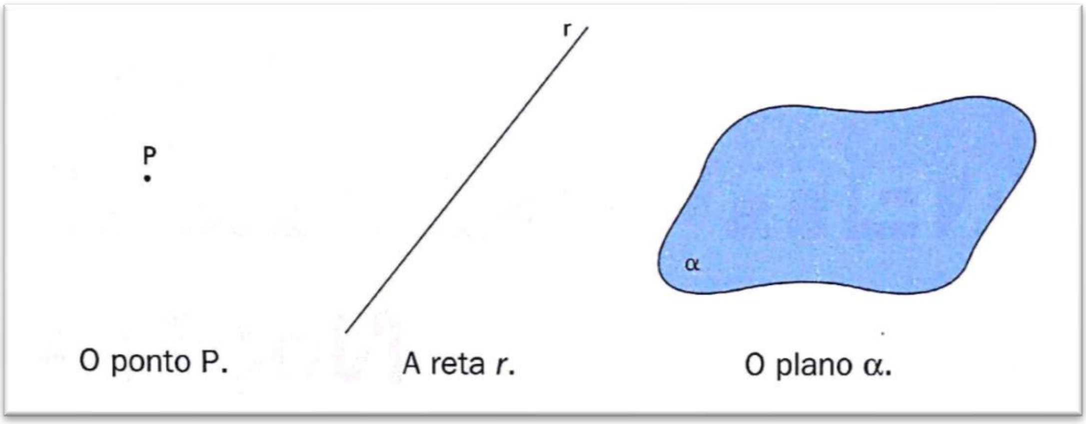
In ancient Greece the first report on the study of flat geometry took place around the 19th century. (360 BC – 295 BC), where Euclid of Alexandria was a very influential mathematician at the time, the same contributed significantly to the study of flat geometry, being even said as Euclidean geometry, in honor of the mathematician (CONTADOR, 2006).

The elements of Euclid was one of the most significant in the history of mathematics, as this work served as the basis for all the geometry we know to this day. The Euclidean or flat geometry, and based on primitive elements such as: the point, straight and plane. Thus, "Primitive or postulated propositions or axiomas are accepted without demonstration" (DULCE et al., 2013, p. 9).

2.2 BASIC ELEMENTS AND FIGURES THAT MAKE UP FLAT GEOMETRY

According to Dulce (2013)the notations for point, straight and flat (Figure 1) is described as follows: Point: uppercase Latin letters – A, B, C, ... ; Straight: lowercase Latin letters – a, b, c, ... And Plan: tiny Greek letters – α, β, γ, ... Where, graphically we have the following:

Figure 1 - Intuitive elements of flat geometry



Source: Book "Fundamentals of Elementary Mathematics" - Flat Geometry 2013.

Noé (2013) states that in view of the basic principles of Euclidean geometry, which would be the point, straight and flat, we have the following programmatic contents that serve as the basis for flat geometry, which are: Point, straight and flat; Relative positions between straights; Angles; Triangles; Quads and Polygons;

2.3 DEFINITIONS OF ELEMENTS AND FLAT FIGURES

2.3.1 Straight - definition

"Two distinct points determine a single (one, and only) straight (Figure 2) that passes through them" (DULCE, et al 2013, p. 3).

Figure 2 - Two points determine a line.

Source: Own authorship 2022

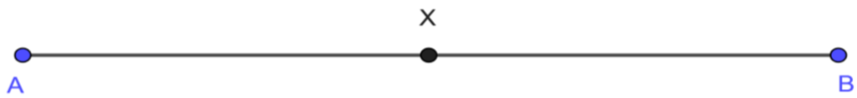
So, uh, i'm r=(AB) ↔going to be

2.3.2 Straight segment - definition

"Given two distinct points, the meeting of the set of these two points with the set of points that are between them is a straight segment (Figure 3) " (DULCE, et al 2013, p. 8).

"Thus, data A and distinct, , the straight segment (indicated by) is as follows: BA≠BAB(AB)̅(DULCE, et al 2013, p. 8)."

Figure 3 - A and B are internal points of segment AB.



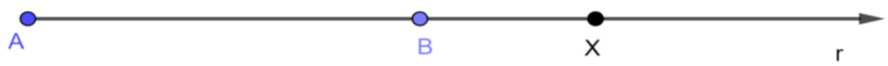
Source: Own authorship 2022

Therefore, (AB)̅={A,B}∪{X|X it is between and AB}

2.3.3 Semirreta - definition

"Given two distinct points A and , the meeting of the straight segments with the set of such X points that is between and the semirreta (B(AB)̅BAXABFigure 4) indicated by(AB) →" (DULCE, et al 2013, p. 8).

Figure 4 - The point and origin of the semirreta .A(AB) ⃗



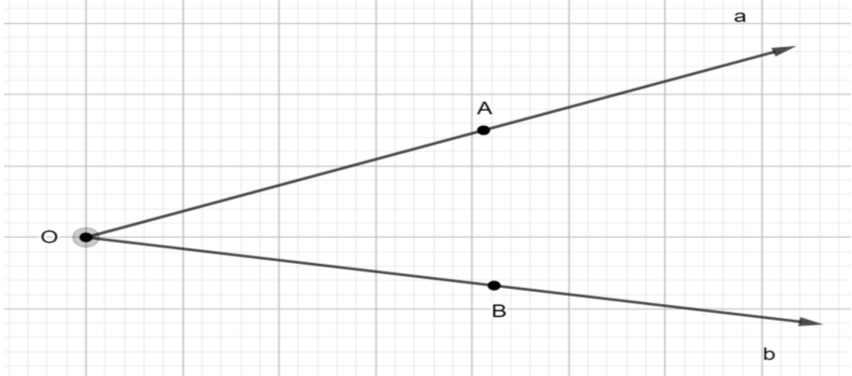
Source: Own authorship 2022

Thus, (AB) ⃗=(AB)̅∪{X|B it is between and AX}

2.3.4 Angle - definition

"An angle (Figure 5) is called the meeting of two semirretas of the same origin, not contained in the same line (not collinear) " (DULCE, et al 2013, p. 20).

Figure 5 - Measurement of the relative inclination of two semirretas starting from the same point.



Source: Own authorship 2022

So, uh, i'm AÔB=aÔb=(ab)̂going to be

2.3.5 Triangle - definition, Parallel straight - definition

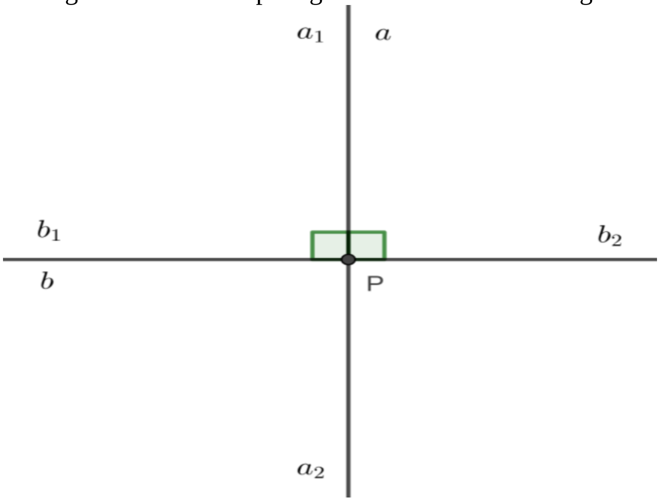
"Given points3A, and, BCdo not collinear the meeting of the segments(AB)̅, and it is called triangle ((AC)̅(BC)̅ABCFigure 6) " (DULCE, et al 2013, p. 35). Elements that make up a triangle, according to Dulce et al (2013) are: Vertices: PointsA, , and BCare the vertices of the triangle ; Sides: The segments, and , are the sides of the ABC(AB)̅(AC)̅(BC)̅ABC triangle and angles: The triangle has as internal angles , , ABCBA ̂CAB ̂CAC ̂B.

"Two lines are parallel (symbol: ∥) (Figure 7) if, and only if, they are coincident (equal) or are coplanar and have no common point: " (a⊂α,b⊂α,a∩b=∅)⇒a∥b(DULCE, et al 2013, p. 60).

2.3.6 Perpendicular lines - definition

"Two lines are perpendicular (symbol: ⊥) (Figure 8) if, and only if, they are concurrent and form congruent supplementary adjacent angles and " (DULCE, et al 2013, p. 78).a⊥b⇔(a∩b={P} a_1 P ̂b_1=a_1 P ̂b_1)

Figure 8 - Two competing lines that form a 90° angle.



Source: Own authorship 2021

2.3.7 Polygons - definition

"Given a sequence of points of a plan with , all distinct, where three consecutive points are not collinear, considering consecutive , and , as well as , and , it is called polygon the meeting of segments , ..., , " (DULCE, et al 2013, p. 129).(A_1,A_2,…,A_n)n≥3A_(n-1) A_n A_1 A_n A_1 A_2 (A_1 A_2)̅(A_2 A_3)̅(A_(n-1) A_n)̅(A_n A_1)̅

In addition, for a better understanding of polygons, we have to according to Luiz (2022, online):

> Polygons are flat, closed geometric figures formed by straight segments. Polygons are divided into two groups, convex and nonconvex. When a polygon has all its sides equal and, consequently, all internal angles equal, it is a regular polygon. Regular polygons can be named according tothe amount of their sides.

2.3.8 Notable quads, Trapezoid and Paralelogramo

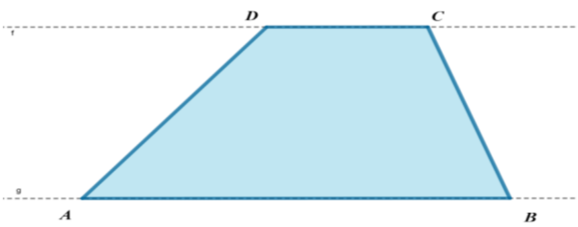
Definition: "Notable quads are trapezoids, parallelograms, rectangles, diamonds and squares" (DULCE, et al. 2013, p. 97).

"A convex flat quadrilateral is a trapezoid (Figure 9) if, and only if, it has two parallel sides" (DULCE, et al. 2013, p. 97).

ABCD is a trapezoid ⇔(AB)̅//(CD)̅

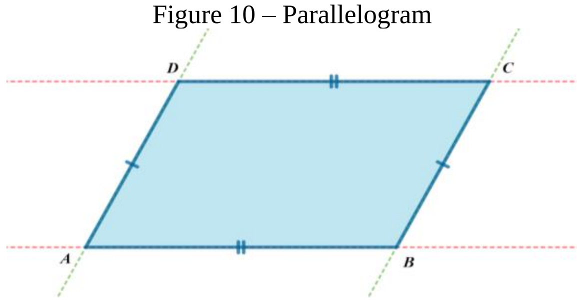
"A convex flat quadrangle is a parallelogram (Figure 10) if, and only if, it has parallel opposite sides" (DULCE, et al. 2013, p. 97).

Figure 9 – Trapezoid



Source: Theutoria itself 2021

Figure 10 – Parallelogram



Source: Theutoria itself 2021

ABCD is parallelogram ⇔(AB)¯ //(BC)¯ // (CD)¯(DA)¯

2.3.9 Rectangle, Ram and Square

"A convex flat quadrilateral is a rectangle (Figure 11) if, and only if, it has the four congruent angles" (DULCE, et al. 2013, p. 98). ABCD is a rectangle ⇔A ̂≡ ≡ ≡ B ̂C ̂D ̂

"A convex flat quadrilateral is a rand (Figure 12) if, and only the four congruent sides are possessed" (DULCE, et al. 2013, p. 98). ABCD is a ⇔ (AB)¯≡(BC)¯≡(CD)¯≡(DA)¯

"A convex flat quadrilateral is a square (Figure 13) if, and only if, it has the four congruent angles and the four congruent sides" (DULCE, et al. 2013, p. 98).

ABCD is a square ⇔ (A ̂≡ ≡ ≡ and B ̂C ̂D ̂(AB)¯≡(BC)¯≡(CD)¯≡(DA)¯

2.3.10 Circumference and circle

"Circumference (Figure 14) is a set of points on a plane whose distance to a given point of that plane is equal to a given (not null) distance. The given point is the center, and the given distances are the radius of the circumference" (DULCE, et al 2013, p. 143)

"Circle (or disk) (Figure 15) is a set of points on a plane whose distance to a given point of that plane is less than or equal to a given (not null) distance" (DULCE, et al. 2013, p. 145).

3 GEOGEBRA SOFTWARE

3.1 THE SOFTWAREGEOGEBRA APPLICATION

According to the authors Basniak and Estevam (2014) the GeoGebra software was created in 2001 by the developer Markus Hohenwarter, where he made free and free software available, in order to reach as many people as possible, the app is available on the internet through the www.geogebra.org website. In addition, the program is available on most operating systems, both for desktop/servers, as well as for mobile devices (tablets and smartphones).

According to the Instituto São Paulo GeoGebra ratifies that currently the program is used in 190 countries, translated into 55 languages, there are more than 3,000.00 monthly downloads , 62 GeoGebra

Institutes in 44 countries to support its use. In addition, it has received several educational software awards in Europe and the US, and has been installed on millions of laptops in various countries around the world.

According to GeoGebra's own platform on the Internet, it states the following

> GeoGebra is a dynamic mathematics software for all levels of teaching that brings together Geometry, Algebra, Spreadsheet, Graphs, Probability, Statistics and Symbolic Calculations in a single easy-to-use package. GeoGebra has a community of millions of users in virtually every country. GeoGebra has become a leader in the field of dynamic mathematics software, supporting teaching and learning in Science, Technology, Engineering and Mathematics. (GEOGEBRA, 2021, Online)

Some important features about the software, available on geogebra's own web page: Graphics, algebra and tables are interconnected and have dynamic characteristics; User-friendly interface with several sophisticated features; Interactive application production tool on WEB pages; Available in multiple languages for million usersaround the world and free and open source software;

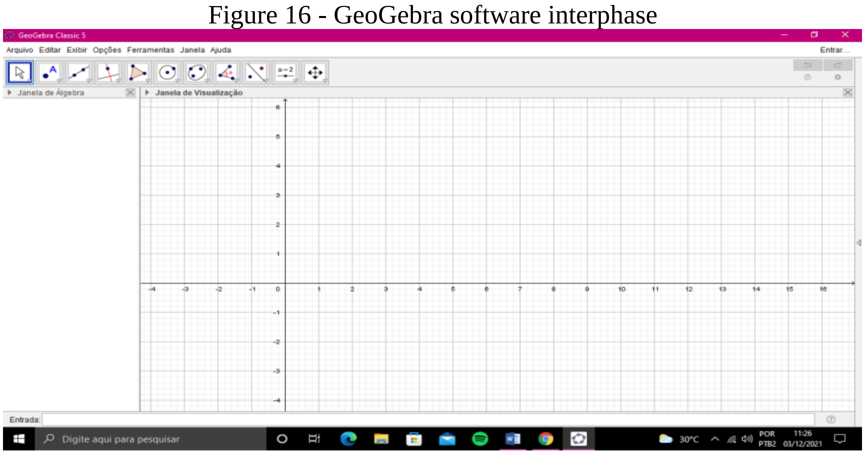
3.2 SOFTWARE TOOLS THAT WILL BE USED IN RESEARCH

The software to be used in this research will be GeoGebra Classic version 6.0.688.0–offline on February 15, 2022, which is available for download on the www.geogebra.org.

3.2.1 - Program interface

The GeoGebra program has a very simple interface (Figure 16) that seeks to show the Cartesian plane in and the meshes, as well as the bar that identifies the tools that can be used according to the user's need.2D

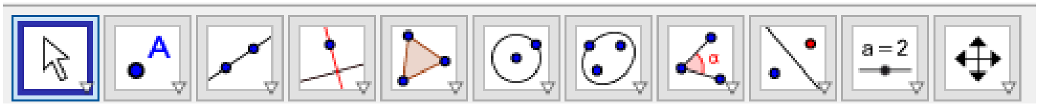
Figure 16 - GeoGebra software interphase



Source: Own authorship 2021

The main tools that will be used in this pesquisa are available in the Toolbar, as shown in figure 17 below

Figure 17 - Toolbar



Source: Own authorship 2021

In this way we can mention the following components to be used in the geogebra software toolbar, taking into account that each element of this has a brief explanation according to the GeoGebra program on how to use the chosen tool, so we have the following

Point: "Select a position or straight, function or curve"

Straight: "Select two points or two positions"

Fixed-length segment: "Select a point, then enter with a length." Given a point in the preview area, then click on the point with the fixed-length segment function, a window opens to fix the desired measure.

Perpendicular line: "First select the point and then a line (or segment, or semirreta or vector) "

Parallel line: "First select the point and then the line (or segment, or semirreta, or vector) "

Polygon: "Select all vertices and then the initial vertex again"

Circle with center and radius: "Select the center, and then type the radius measure"

Angle: "Select three points or two straights"

Fixed amplitude angle: "Select a point, vertex, and amplitude for the angle." Having a colon in the preview window and possible to use this tool. With the command already selected, click on one point, and then on another, so the second point will be the vertex for the Fixed Amplitude Angle. Thus, a settings box is opened asking for the angle to be fixed, as well as its direction (clockwise and counterclockwise).

Slider: "Select a position". With the slider function selected, clicking anywhere in the preview window opens a box with some settings on the slider, such as point name, range (minimum and maximum), increment, horizontal or vertical control, as well as animation that has speed and oscillation according to user preference.

4 THE CONSTRUCTION OF FLAT FIGURES WITH THE HELP OF GEOGEBRA

The figures that will be demonstrated under construction are those that have been presented so far in the research as: triangle, remarkable quads, circumference and circle. In addition, to present theslider function that is available in the GeoGebra software, and that has the function of animating the geometric figures that are constructed, made the teaching experience of flat geometry through computational aid even more interesting.

Moreover, and with regard to the organization of the production of geometric figures that will be in order, there is beginning with the triangle, and after the quads, and by last circumference and circle. Moreover, it is worth mentioning that the procedures for each geometric figure will be divided into objective and the modes of construction into steps.

4.1 TRIANGLE - CONSTRUCTION PROCEDURES

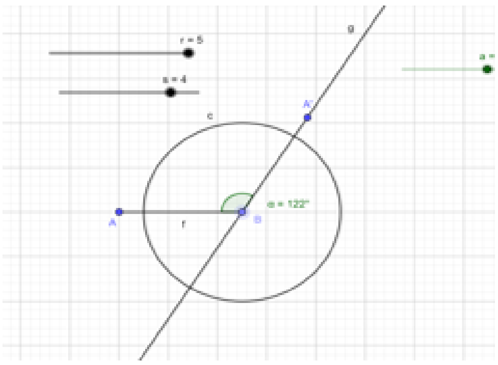
Objective: Build a triangle of sides and variables and variable rsα angles.

Step 1: A Priori, you must select the slider option in the GeoGebra toolbar, and thereby insert the sides with the values of minimum 0 and maximum with increment. In addition, for the variable angle the sliderrs50,2α must contain minimum and maximum with increment.0°180°1°

Step 2: Continuing construction, select the segment option with fixed length and click on the area of the preview window, and with it, fixed the letter, getting . r(AB)̅=f In addition, prioritizing to construct the angle of use the angle tool αwith fixed amplitude by clicking first on the point, and then at the point respectively, and with this, just enter the name of the angle that will ABa be and with the clockwise. This way, the angle and α_1 the point appear. The next step and build the second side of the triangle, for this is made a straight that passes through the points and , and from that line and possible to use the option A'BA'of Circle: Center & Radius, this and, center in the point and radius . Following steps 1Bs and 2 we have the following as shown in figure 18

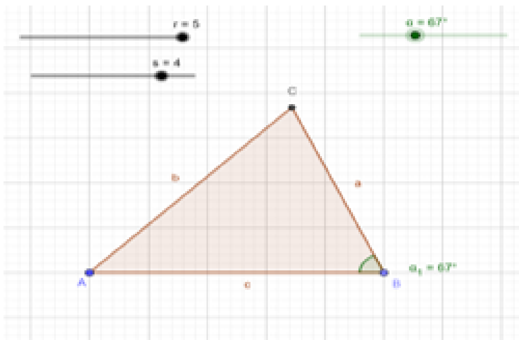
Step 3: Done this, now you intersect the circumference with the line, getting the point. Therefore, in order for the geometric drawing to become more visible, the drafts such as, the line, the point, and the circumference must be took out. To and this is necessary to right-click on what you want to hide and select the option to cgC(AB)̅=fgA'cdisplay objects. Thus, what remains is only the points , and from these points form a triangle using the AB,Cpolygon option and connecting the points,the ssim as shown in figure 19

Figura 18 - Construção após os passos 1 e 2



Fonte: Autoria própria 202

Figura 19 - triângulo a partir dos pontos ABC



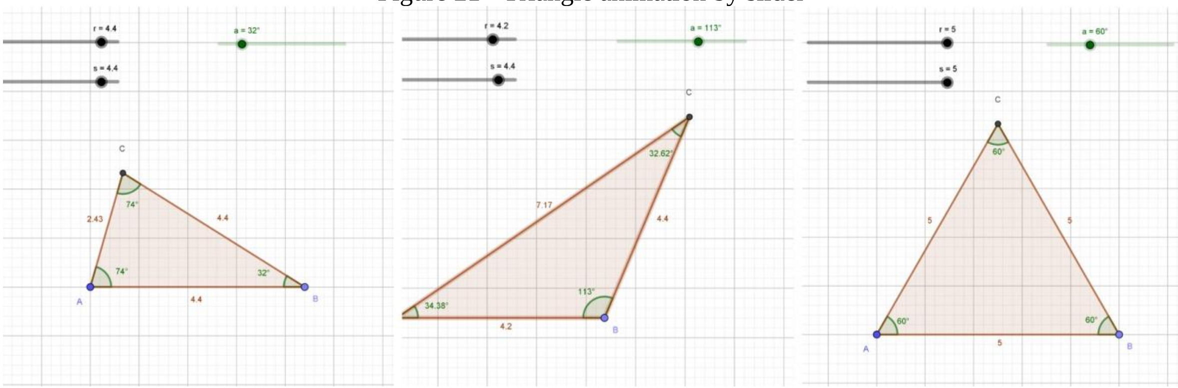
Fonte: Autoria própria 2021

Step 4: For there to be a better view of the angles and sides, the other two angles and their respective values will be inserted by selecting the option in the angle toolbar and then clicking on the points, and then doing the same for the vertex, only now selected the points, and . So we have the angles BACCACBγ and.δ

Finally, in order for there to be a better understanding of the sides of the triangle, you have to select the three sides by pressing the key of the keyboard and selecting the segments by left-clicking, still with the key pressedCtrlright-click the mouse and go to the settings option, in the basic window go toCtrl display label and on this option select value. Thus, the sides of the triangle no longer appeared to be represented by letters, but rather the numeric value on each side. Given what was above wehave the following figure 20 on the ge ometricconstruction of the triangle performed

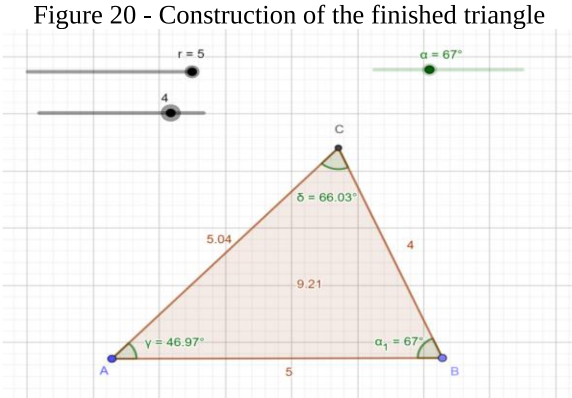
According to figure 21, the threeimages represent triangles with different sides and consequently, tamanhos (areas) that differ them. This was due to the animation provided by the slider tool available by geogebra software.

Figure 21 - Triangle animation by slider



Source: Own authorship 2021

Figure 20 - Construction of the finished triangle



Source: Own authorship 2021

4.2 QUADs

4.2.1 Square - Procedures

Objective: Build a variable side square.r

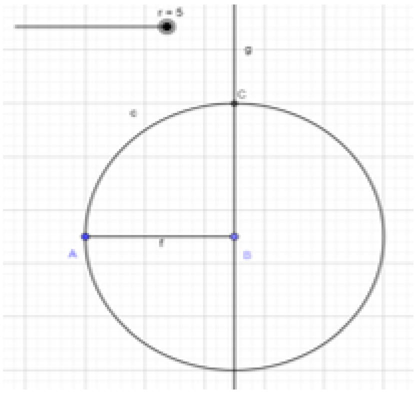
Step 1: First in the toolbar is the slider option that will be fixed in the preview window, then the configuration of the same was made, giving the name because it is the variable in question, and then configure the intervals with minimum and maximum increment with increment .r050,2

Step 2: In addition, in the straight options, click on the segment option with fixed length, and after clicking on the preview window, this is how a box opens to enter what the fixed length value, which for example will be the variable , and so we have . In addition, the next construction will be a perpendicular line at the point, for this you select the r(AB) $\overleftrightarrow{}$=fBoption of perpendicular straight and with this click on the segment and the point respectively, so the line arises ABBg. Then go up in circle tool and select the option of Circle:

Center & Radius, and with that, click on the point and informs that the radius is equal to , where the intersection gives circumference and the line should place a point . Thus, we have the following after the steps and according Br cgC12 to figure 22

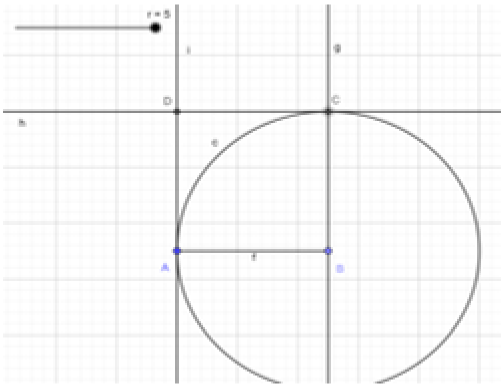
Step 3: Ahead, going up to the straight options select straight perpendicular, click on and then on the point, getting the straight (BC)̅Ch. Then make another perpendicular straight by clicking on the tool and selected the straight and the point, getting the straight, and from the intersection of the straights hAihi and fix a point. ContuDdo, we have the following in figure 23

Figura 22 - Construção dos passos 1 e 2



Fonte: Autoria própria 2021

Figura 23 - Construção após o passo 3



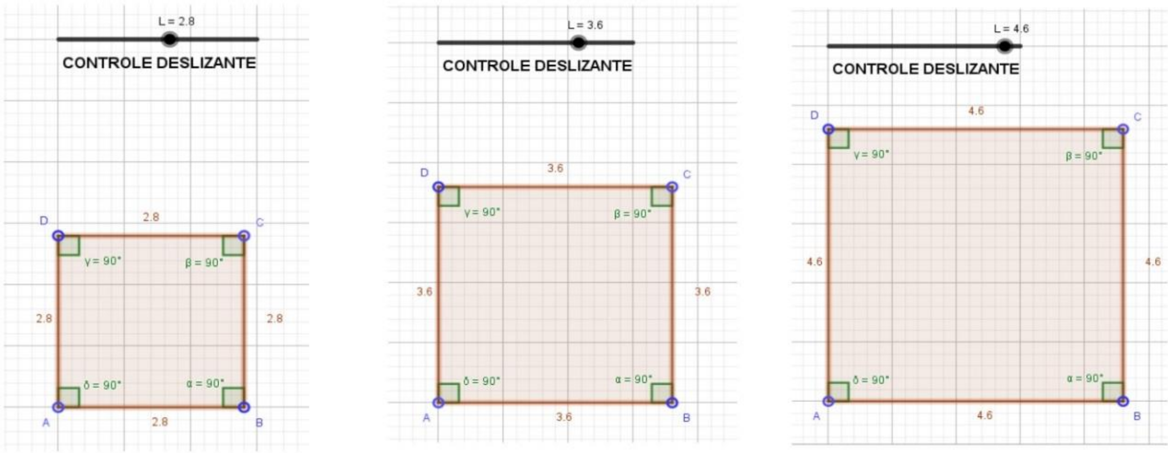
Fonte: Autoria própria 2021

Step 4: Before using the polygonoption you can "clear" the square sketch by removing the straights, segment and circumference in order to leave only the points and as being the vertices of the square, for this, and just ABcA ,B ,CDright-click on and select the option to display object. In this way, you can use the polygon tool by connecting the points (vertices) of the square.

This way, the square is ready. However, for there to be a better animation experience when using the slider, before you can select the sides and the square pressed the key and selected each side, still with the Ctrl pressed right-click and go to the settings option, and then in the basic window click on label a,b ,c1dCtrldisplay option and select the option (value). Thus, the sides no longer appeared represented by letters, but rather the numerical measure on each side. And finally, to show the value of the internal angles of each vertex of the square, you must select the angle tool and click on three points in the timefelt. In view of the 1 steps to be4feared as shown in Figure 24

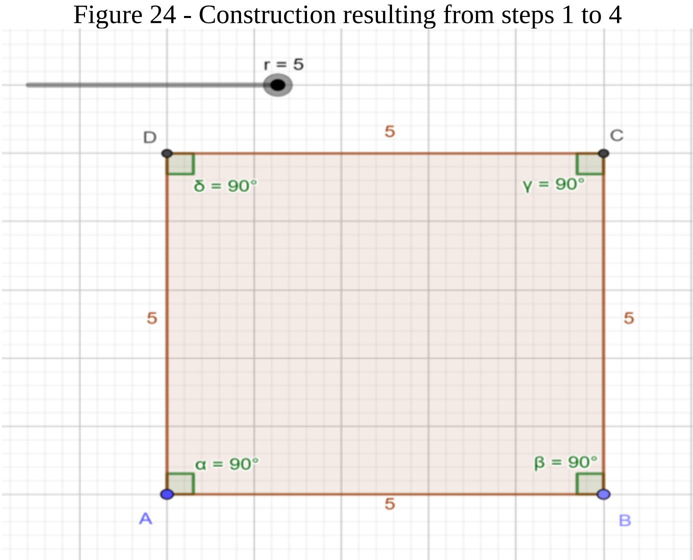
Now by right-clicking on the slider andr selecting the animation option, the sides of the square will vary according to the numberings stipulated in the slider. Thus, the geometric figure varies in various sizes (areas) so that the sides vary, as shown in figure 25

Figure 25 - Square animation by slider tool



Source: Own authorship 2021

Figure 24 - Construction resulting from steps 1 to 4



Source: Own authorship 2021

According to figure 25, the three images represent squares with different sides and consequently, tamanhthe (areas) that differ them. This was due to the animation provided by the slider tool available by geogebra software.

4.2.2 Rectangles - Procedures

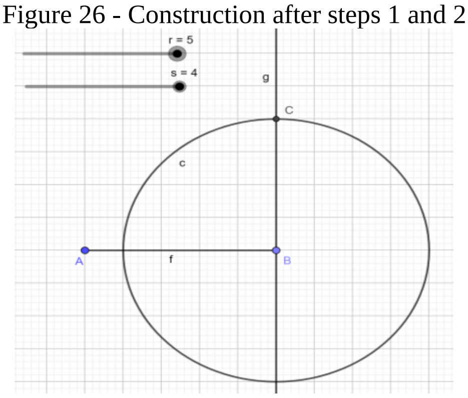
Objective: Build a rectangle with sides and variables.rs

Step 1: For the geometric construction of the rectangle a few steps will look like the square construction. That said, one should first fix the slider to the sides and, however, because it is a rectangle and will have the maximum rsrsvalue 5 and 4 respectively, and for both minimum and increment.00,2

Step 2: Then select the segment option with fixed length and clicking on the on the on the preview window and indicate the valuer, getting. In addition, draw a (AB) $\overleftrightarrow{}$=fperpendicular line passing through the point, for this you select the tool available in Bstraight lines, and then click on the segment and the point respectively, obtaining the line fBg. In addition, to trace the other side of the rectangle creates a circumference from the option Circle: Center & radius and with this, click on the point and insert the radius equal to , obtaining the circumference , where the intersection of the circumference with the line will be placing a point . Thus, and following the previous steps we have the following rBscgCandsultados as shown in figure 26

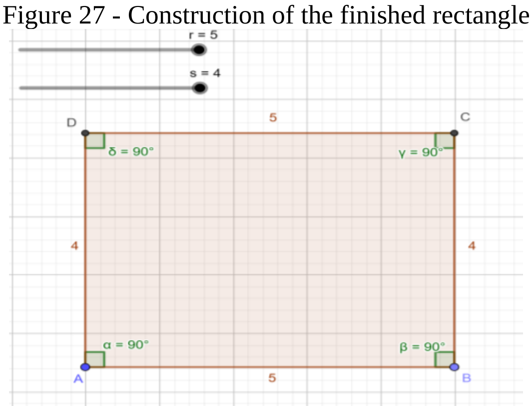
Step 3: Also, will be done two other perpendicular lines, for this with the selected tool click on the line and the point , getting the straight , just after clicking on the line and the point , getting the straight , where the intersection of the straights and and placed a point . Before using the gChhAihiDpolygon option you can "clear" the square sketch by removing the straights, segment, and circumference in order to leave only the points and as being the vertices of the square for this, and just right-click on and select the object ABA ,B ,CDdisplay option. In this way, you can use the polygon tool, connecting the points (vertices) of the square. This way, the rectangle is ready. However, for there to be a better animation experience when using the slider, before you can select the sides and the square pressed the key and selected each side, still with the Ctrl pressed right-click and go to the settings optiona ,b ,c1dCtrl, and then in the basic window click on option display label and select the option value . Thus, the sides no longer appeared represented by letters, but rather the numerical measure on each side. And finally, to show the value of the internal angles of each vertex of the rectangle, you must select the angle tool and click on three points clockwise. In view of the steps, the following13are the following as shown in Figure 27.

Figure 26 - Construction after steps 1 and 2



Source: Own authorship 2021

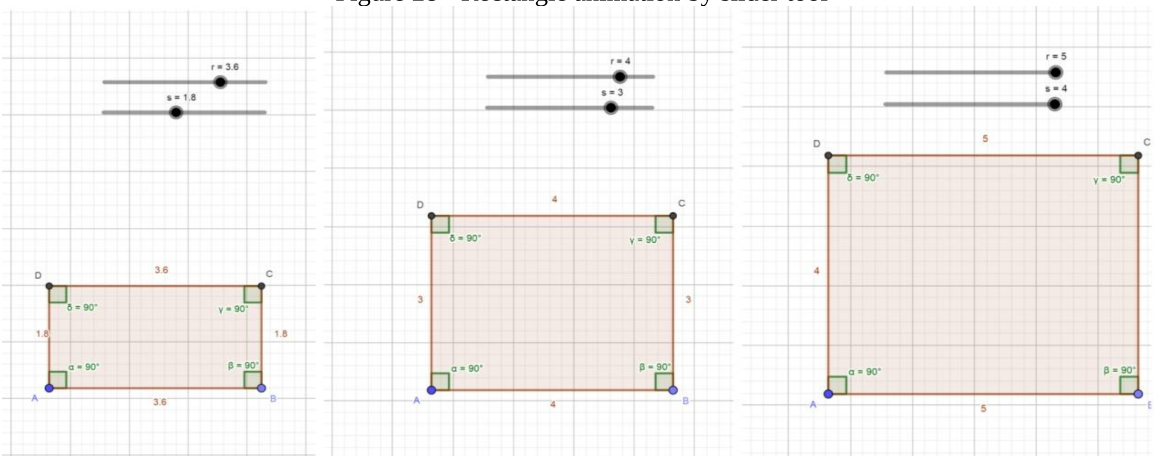
Figure 27 - Construction of the finished rectangle



Source: Own authorship 2021

According to figure 28, the threeimages represent rectangles with different sides and consequently sizes (areas) that differ them. This was due to the animation provided by the slider tool available by geogebra software.

Figure 28 - Rectangle animation by slider tool



Source: Own authorship 2021

4.2.3 Parallelogram - Procedures

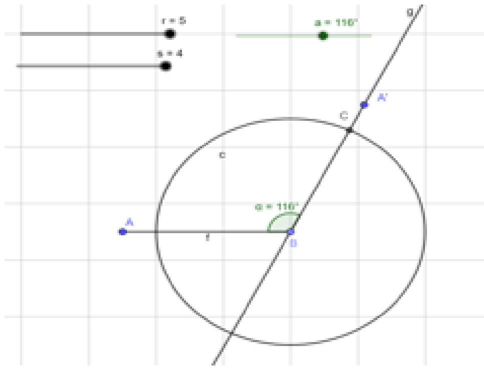
Objective: to construct a parallelogram of r-sides and s variables and angles α and variables.β

Step 1: To build the parallelogram first you must insert the slider referring to the sides, the construction will be done with r with the minimum value 0 and maximum 5, already s will have minimum 0 and maximum 4 and both with increment of 0.2. In addition, for the angle-related slider, the given name will be with a minimum of 0° and maximum 180° and an increment of 1°.a

Step 2: Continuando with the construction of the parallelogram, one should add a fixed length segment through the toolbar with the size, obtaining. Ademias, click on the angle r(AB) ↔=ftool with fixed amplitude and insert the letter, getting the angle, as well as the point aαA'. Then select the option Circle: Point & Radius, and clicking on the point and informs as being radius equal to , getting the circumference renamed, where the intersection of the circumference with the line g should fixed a point C. Thus, we have the following after the steps and as Bsc12 shown in figure 29

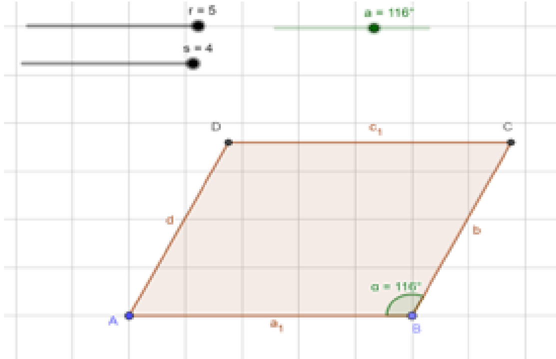
Step 3: Othersim, and draw two parallel lines, for this we select the option that is located in straightlines, and so by clicking on the segment and point we have the straight ABCh. To get the other parallel straight click on the straight and point, so we have the straight. However, the intersection of the parallel lines h and i is placed a point called D. Thus, one can "clean" the sketch of the figure by removing, the straights, and, as well as the point. Thus, with the dots and one can use the gAi(AB) ↔ghiA'A,B,CDpolygon tool and from that interconnect the points by clicking on, so we have what is outlined in figure 30

Figura 29 - Construção após os passos 1 e 2



Fonte: Autoria própria 2021

Figura 30 - Construção após o passo 3

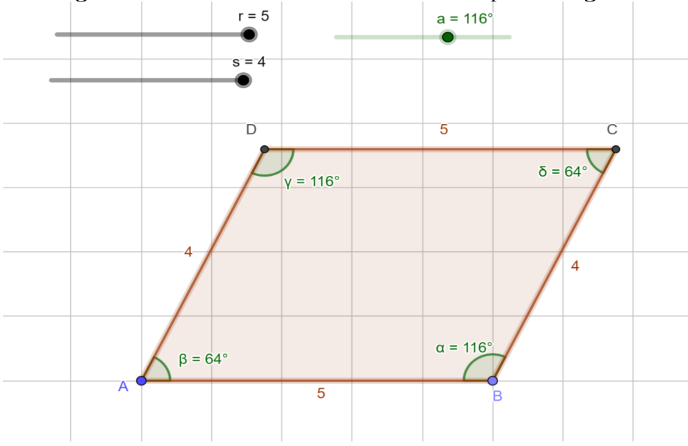


Fonte: Autoria própria 2021

Step 4: However, in order to better understand the geometric figure, the internal angles of the parallelogram must be inserted, for this feat the angle tool is used, and with this selected click on the points and respectively, obtaining the angle B,ADβ. In this way, it will be done for the other vertices and , obtaining the angles and in the appropriate order. In addition, for the sides get vaCDδγlores and not letter s press the key of the keyboard and select all sides of the parallelogram, still with the key CtrlCtrlpressed right-click and go to settings, and after going to the option display label and select value. Therefore, with the previous steps we have figure 31 of the parallelogram.

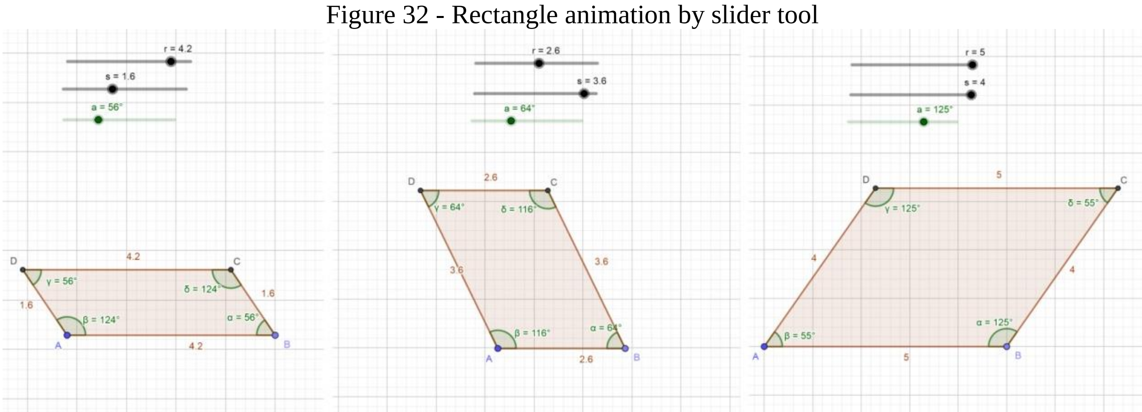
According to Figure 32, the threeimages represent parallelograms with different sides and consequently, tamanhthe (areas) that differ them. This was due to the animation provided by the slider tool available by geogebra software.

Figure 31 - Construction of the finalized parallelogram



Source: Own authorship 2021

Figure 32 - Rectangle animation by slider tool



Source: Own authorship 2021

4.2.4 Losango - Procedures

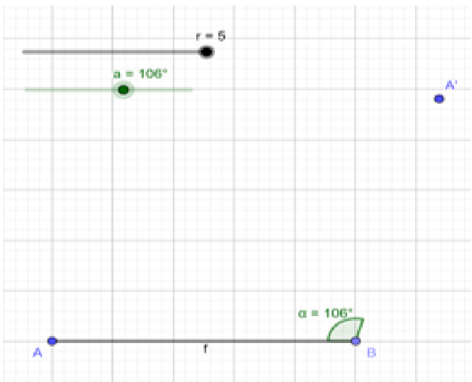
Objective: Build a rand with sides and angles rα and variables.β

Step 1: Fix the slider to the sides of the renamed rum, with minimum and maximum and increment. In addition, fix another slider r050,2in relation to the angleα, where it will be denoted by the letter, and the minimum is and maximum with increment of .αa0°180°1°

Step 2: Select the segment option with fixed length and type in length the letter, with this arises . Then, use the angle option r(AB) ↔=fwith fixed amplitude and click on the points and respectively, already in the angle box type the letter clockwise, obtaining the angle, as well as the point,ABaαA' such that the distance between , because (BA') ↔=(AB) ↔the GeoGebra configures with this point that emerged has the same measure of the previous segment constructed. So, and one side of the rummage. In view of the steps and we have the following results according to FigureA'BA'12 33

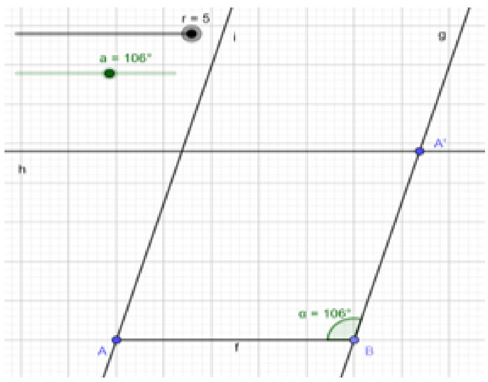
Step 3: Build a line that passes through the points, and from that gBA'draw parallel lines by selecting the tool and clicking first on the segment and then on the point respectively, so we have a straight parallel to the segment. In addition, make another ABA'hfparallel straight, selected the tool and clicking on the line and point respectively, getting the straight . However, we have the following geometric construction conforms to gAi∥gfigure 34

Figura 33- Construção após os passos 1 e 2



Fonte: Autoria própria 2021

Figura 34 - Construção após os passos 1 e 2

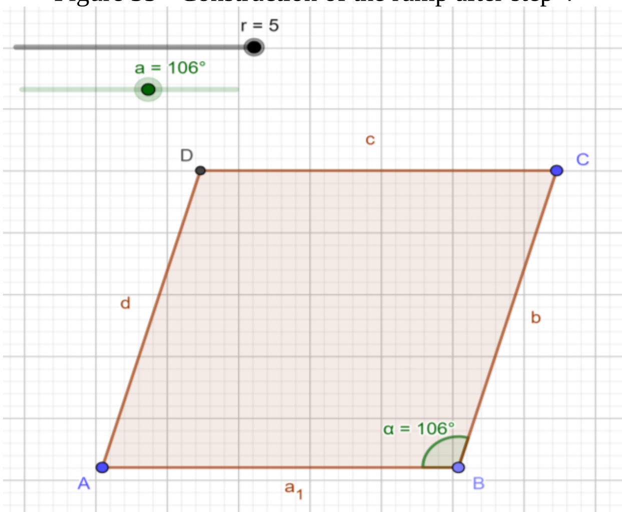


Fonte: Autoria própria 2021

Step 4: Before following used the polygon tool, for the sake of aesthetics the point will be renamed to , this makes itself possible by right clicking A'Cthe right mouse, is going to the rename option. Also, place a point at the intersection of the straights and , and after hiding the sketch of the building by taking the lines and segments by clicking Dhithe right-click on and select display object, with this remains only the points and . Thus, the polygon option A ,B ,CDis used and clicking on the connecting points until the figure g andometric form, as shown in figure 35

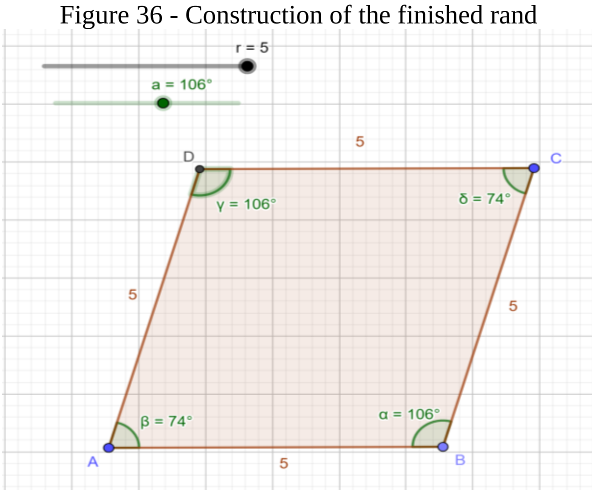
Step 5: For a better understanding of the constructed geometric figure one can propose in making the other internal angles, this can be done by selecting the angle option and clicking on the points and resulting in the angle , for the other angles the same procedures are done taking into account that the direction to be constructed internal angles and the clockwise direction. In addition, with the key pressed select the sides and B,ADβCtrla_1,b,cd and still with theCtrl key pressed right-click, and in the window that opens go to the option to display label and select value, and so the sides of the rarego passed the show to numerical information and no longer in letters. Therefore, the final construction following the steps to the and the following according to 15figure 3

Figure 35 - Construction of the rump after step 4



Source: Own authorship 2021

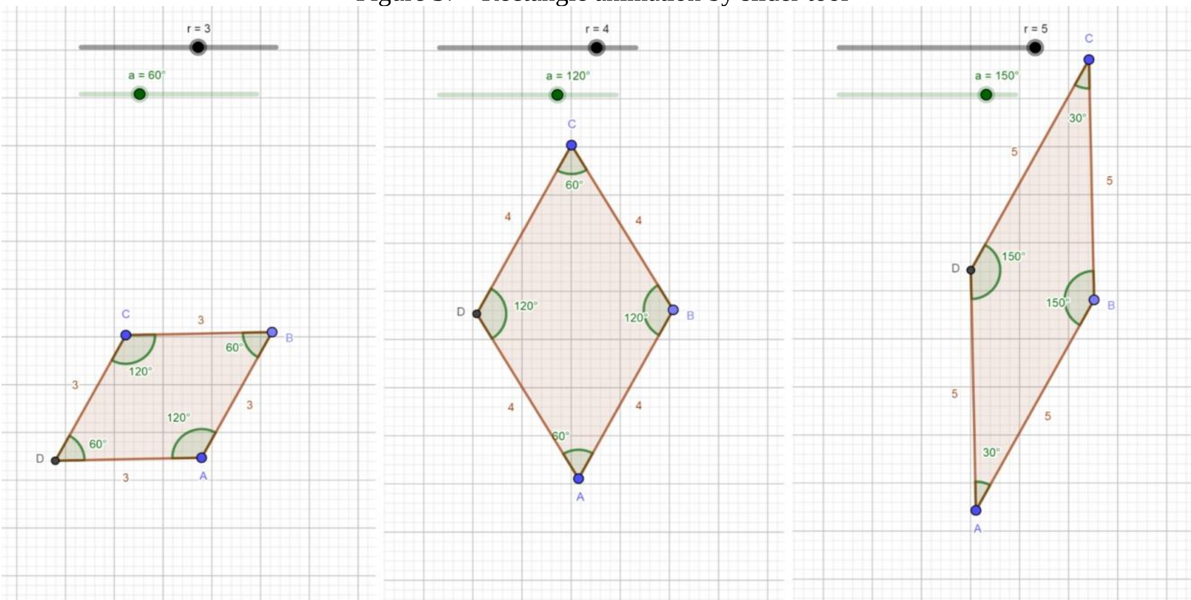
Figure 36 - Construction of the finished rand



Source: Own authorship 2021

According to figure 37, the threeimages represent diamonds with different sides and consequently, cam(areas) that differ them. This was due to the animation provided by the slider tool available by geogebra software.

Figure 37 - Rectangle animation by slider tool



Source: Own authorship 2021

4.2.5 Trapezoid - Procedures

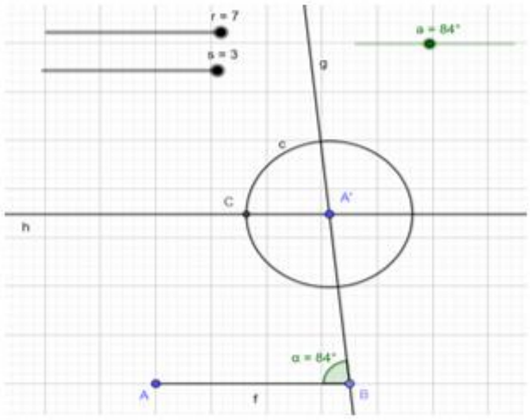
Objective: Build a trapezoid with sides and parallels and variable(AB) ↔(CD) ↔α angle.

Step 1: Build two sliders intended for the sides of the trapezoid bases which consequently are . That way, the slider will (AB)‾‖(CD)‾1ºr have name with maximum size and increment, since the slider will be named from and will have maximum size with increment. These values were stipulated differently so that there is a better visualization in relation to the larger and smaller base of the trapezoid by the observer. In addition, another slider intended for the angle, with name, minimum and maximum and increment of.70,22ºs30,2a0°180°1°

Step 2: Now with the fixed-length segment option selected click on the preview window and rename as rbeing, getting. In addition, select the angle tool (AB) ↔with fixed amplitude, and clicking on the points and respectively insert the angle clockwise, getting from this the angle and the point that will be renamed to . In addition, build a circumference, for this is used the ABaαA^',Ctool Circle: center & Radius, and from there click on the point and insert radius, now having the circumference . With this, build a Crcstraight parallel to the segment, then with the selected option click on and then at the point, in this way getting the straight, intersecting with the line, where it will be placing a point. In front of the steps and built, we have the following expressed by AB(AB) ↔CchD12Figure 38

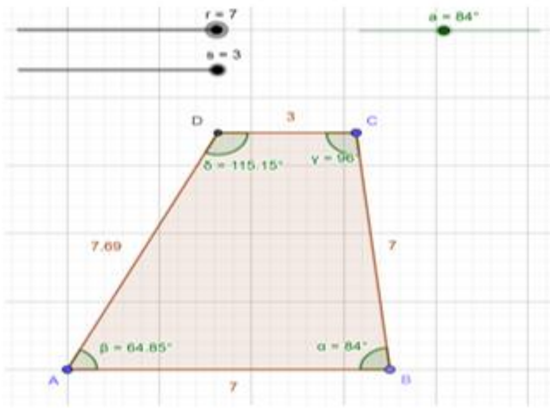
Step 3: Before using the polygon option, you must remove the strokes that you no longer want in the construction, and staying only with the points (vertices) of the trapezoid. To do this, i need to right-click on , and select the display object option. In this way, you can trace the polygon from the selected tool. In fact, before finishing the construction of the trapezoid you can insert the internal angles through the angle tool, as well as assign value to the sides and not letters, and this selected the sides with the key pressed and Ctrlright-click and select the option value in display label. However, the geometric figure will be finished according to Figure 39

Figura 38 - Construção após os passos 1 e 2



Fonte: Autoria própria 2021

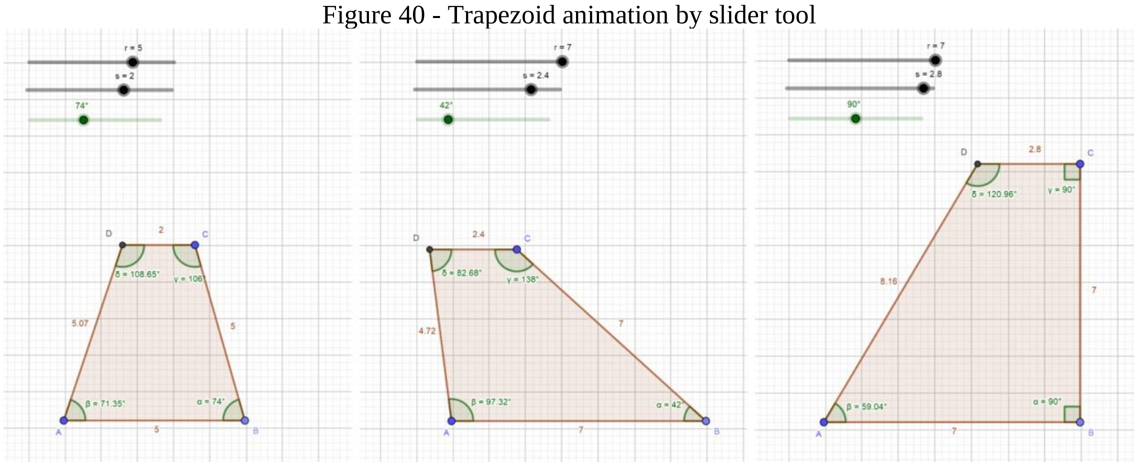
Figura 39 - Construção do trapézio finalizada



Fonte: Autoria própria 2021

According to figure 40, the three imagesrepresent trapezoids with different sides and consequently, tamanhthe (areas) that differ them. This was due to the animation provided by the slider tool available by geogebra software.

Figure 40 - Trapezoid animation by slider tool



Source: Own authorship 2021

4.3 CIRCUMFERENCE AND CIRCLE

4.3.1 Circumference - Procedures

Objective: Build a circumference with variable r radius.

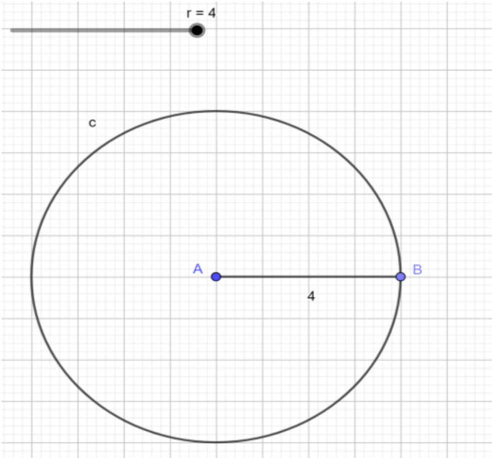
Step 1: Pin on the preview window a renamed slider that will be the circumference radius, with minimum and maximum increment.r040,2

Step 2: With the segment tool with fixed length selected click on any area of the validation window and from there insert the letters as value to the size of the segment, thus obtaining the segment . In addition, go to the radius r(AB) ↔=foption, and select the Option of Circle Data Center and One of your Points, and as this click on the point A, and then at the point respectively, thus getting the circumference Bc.

What's more, for a better view of the angle value during the animated presentation of the slider it is necessary to right-click the right-click sobre(AB) ↔ , and with that go to settings and select the option display label and choose value. Thus, the radius will show the numerical measure during the slider animation process. Com all, we have the following after all the constructions of the circumference as shown in figure 41

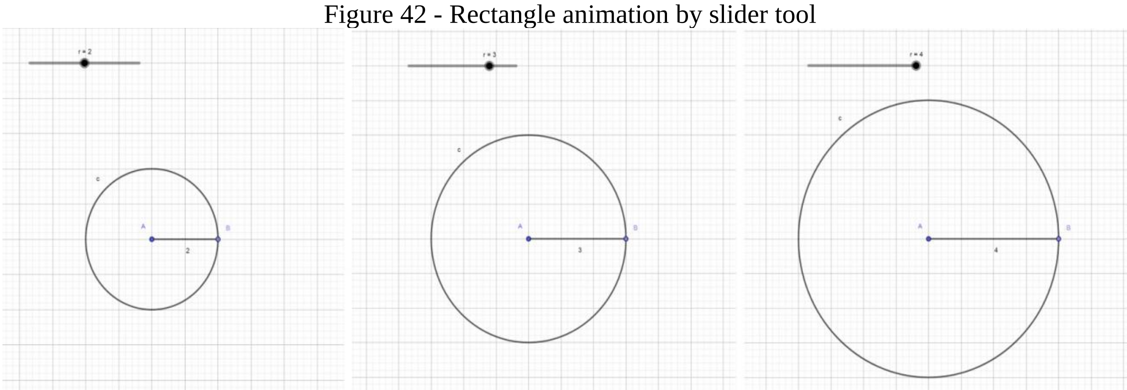
According to figure 42, the imagesrepresent circumferences with rays that differ them. This was due to the animation provided by the slider tool available by geogebra software.

Figure 41 - Construction of the finished circumference



Source: Own authorship 2021

Figure 42 - Rectangle animation by slider tool



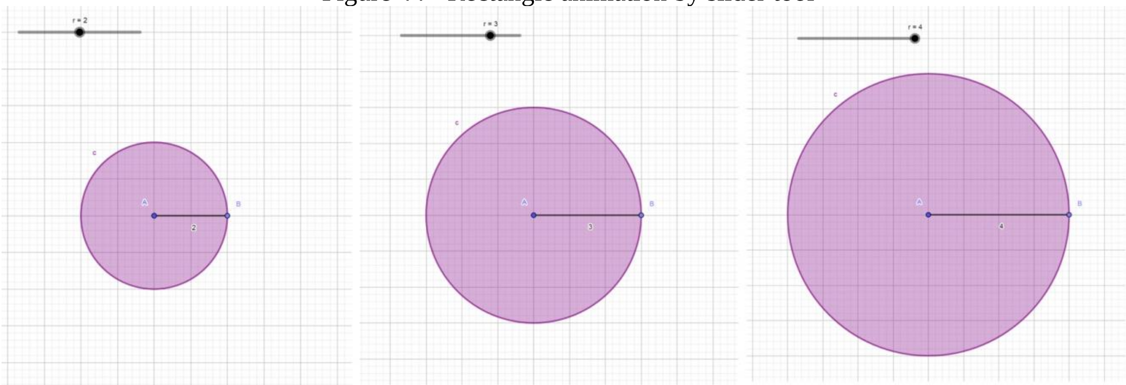
Source: Own authorship 2021

4.3.2 Circle - Procedures

Goal: Build a circle with variable r radius. Procedures (steps)

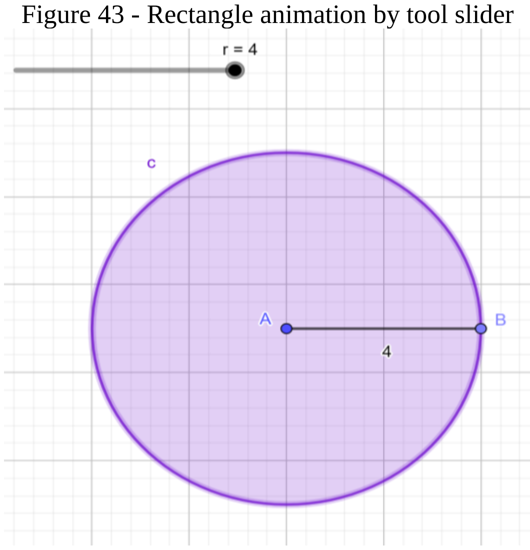
Step 1: The circle construction will be using the same procedures to assemble the circumference and added only one color of choice to the inside of the circle so that it can represent a figure that has an area. Therefore, to incorporate a color of internal shape the circumference one must right-click on the circumferencec and thus go to settings, go to the color window and select a color of choice, and increase transparency until it is possible to identify an internal color the circumference . Making the necessary changes now we have the circlecc, as shown in Figure 43. According to figure 44, the three images represent circles with different rays and consequently sizes (areas) that differ them. This was due to the animation provided by the slider tool available by geogebra software.

Figure 44 - Rectangle animation by slider tool



Source: Own authorship 2021

Figure 43 - Rectangle animation by tool slider



Source: Own authorship 2021

5 BENEFITS IN THE USE OF GEOGEBRA SOFTWARE IN THE TEACHING OF FLAT GEOMETRY

Educational software is tools that collaborate with teaching and learning today, its ease of access is free in some programs, makes this technological aid accessible to most students, being the same from public or private schools. Therefore, according to (Costa 2017, P. 19) states that

> The potential of the computer, through software as an educational tool, is undeniable, but should be used with discernment, and it is necessary that the teacher observes the quality of the material that is available to use, if it fits the age group of the students, if it favors the construction of knowledge and whether it is easy to use.

Therefore, the contemporary teacher must pay close to these new teaching methodologies, in order to reconcile the teaching of mathematics together with the technological devices of today, and thus provide the student with a didactic alternative of teaching through computer aids. The learning process by the student does not occur only leaving the same without any guidance from a professional who knows both the computational point of view, as well as the pedagogical and psychological. In addition, through the computer the student is inserted in a social environment, experiencing the experience of learning from others around him or her. Thus, the student is led to experience social elements, knowledge and problems to be solved through computational use (Valente, 1993).

Computational use requires the user to practice very pertinent ly in the process of knowledge construction. With this, the student is interacted with that technological environment, in order to manipulate concepts that lead him to solve everyday problems, and this has a direct impact on mental development, because at the same time that he acquires concepts, interacts with objects of the world (Papert, 1980). Thus, it becomes evident that computational aid positively impacts on the absorption of contents, regardless of what they are.

Dithas it is found that information technology in the field of school education can help in a more effective and comprehensive (fixed) way of certain content, in view of the possibilities that this technological mechanism can provide through educational software. Thus, it is notorious that with these computational means of teaching the students' learning becomes more interesting, besides speeding up the teaching-learning process. Thus, Nascimento (2007, p. 44) states that:

> Computer science can be an excellent pedagogical resource to be explored by teachers and students when used in an appropriate and planned way. Thus, the importance of defining objectives and the elaboration of the pedagogical project of the school is reiterated, which must take into account local characteristics, interests and needs, so that the integration of the computer into the educational process can be effected in a positive and effective way.

Therefore, it is logical to think that this new tendency to use educational technology, positively help both the student in understanding the subject, as well as the teacher when teaching the programcontents in a didactic way.

Aware of the discussion outlined so far in this topic and considering the importance of the school along with the technological advances (computers, software and others) present for the individual's education, as well as to the professional when proposing to his students this applied teaching methodology. Thus, one can mention the GeoGebra software in the applied teaching of mathematics, and the program provides the user with several possibilities with regard to mathematical teaching, considering that the application is easy and practical. Statement made according to This sense, Hohenwarter (2007, p. 1) which states:

> On the one hand, GeoGebra is a dynamic geometry system. It allows to perform constructions with both points, vectors, segments, lines, conical sections and with functions that can change later dynamically. On the other hand, equations and coordinates can be interconnected directly through GeoGebra. Thus, the software has the ability to work with variables linked to numbers, vectors and points; allows you to find derivatives and integrals of functions and offers commands such as roots and extremes. These two views are characteristic of GeoGebra: an algebra expression corresponds to a concrete object in geometry and vice versa.

Moreover, according to geogebra itself says the following about: students love it because: "it makes mathematics dynamic, interactive and fun. GeoGebra offers students a new and exciting way to learn mathematics that goes beyond chalkand chalk"; teachers love it because: "it gives teachers the freedom and autonomy to create classes that they know students will find interesting" and schools love it because: "students who use GeoGebra are more motivated students who get better results."

Thus, it has to be based on the positive results on the GeoGebra software and it is possible to approach a variety of mathematical subjects. Thus, the flat geometry in specific, remarkable flat figures fit this item.

In a sense, it is logical to think that currently and indispensable the use of GeoGebra software in the teaching of flat geometry and other mathematical contents, this is affirmed by a series of authors referenced in this topic, who defend the idea of reconciling technology with education, and that this fact is essential for a better social and intellectual development of the student , in order to form a critical individual, who knows how to solve through technology, everyday problems.

6 CONCLUSION

As presented throughout the research, it is possible to reinforce the importance of the subject addressed, since it can strongly impact the student's learning in a didactic and methodological way, considering that the process of constructing geometric figures through computational aid stimulates the student's intellect, providing a better assimilation of the content seen theoretically in the classroom. The information and data presented in this work contribute significantly in the field of mathematical study, because the applications of flat geometry with GeoGebra software, and said positively by a series of authors who were referenced in this research, because the program provides the user with a visual experience of the theoretical concepts seen in class, and this is an important factor for the teaching of geometry. Thus, the construction of flat geometric figures in the GeoGebra software proves to be an indispensable tool for the higher elementary school today, so as to form a student more prepared the future grades. The contents presented here demonstrate that many other studies can still be carried out on geogebra software in basic concepts of flat geometry: a teaching methodology for the major elementary, due to the importance of the theme and numerous contributions to the academic environment, with the purpose of proposing a field investigation, aiming to expand the study to high school grades, in order to collect own results on the subject and from this discuss again about the relevance and benefits of the GeoGebra utility for the teaching-learning of students.

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