USE IN TEACHING GEOGEBRA DIFFERENTIAL AND INTEGRAL CALCULUS: AN EXPERIENCE WITH STUDENTS IN HIGHER EDUCATION

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ABSTRACT

This work aims to socialize an experience of the authors with students who experience the experience of monitoring the course of Differential and Integral Calculus II of Undergraduate Mathematics, Chemistry and Physics on using Geogebra artifact as facilitator of the process of teaching and learning. We put two questions which referred to contents experienced in discipline and needing Outline graphs, asking students to solve them through the more traditional way, with the help of the frame. In the second used the feature to geogebra from there to understand how learning in the traditional way and bringing educational innovations. The study was conducted from a qualitative analysis of interview questions that docked on the experience of students with the educational software. In the speeches was notorious among many, the following questions: facilitates the assimilation of content helps in viewing after the calculation, makes it easier to understand the graph. It could be observed through this analysis that the use of Geogebra satisfactorily facilitated students' understanding about the content of the disciplines of Differential and Integral Calculus, providing spaces discussions new technologies and teaching of calculus.

Keywords: Differential and integral calculus. Higher education. New technologies educational software.

INTRODUCTION

New technologies are bringing a new reality in the social context in which we live. Every day we can glimpse how the human lives dependent on these resources in their daily lives. The world is surrounded by these new trends and it is these that point to new contexts in

the increasingly distinct. The school environment has strong features to focus on one teaching with the use of new technologies, as well as being a new way of constructing knowledge, sharpen students' curiosity in using these new tools. The teaching based on this approach has attracted the attention of many researchers (ABRANCHES, 2009; CAVALCANTE, 2009; PADILHA, 2009) that emphasize the importance of integration of technological resources in teaching practices for a diverse learning with satisfactory learning. Are digital resources (computers and internet), audio (radio, online radio, music, podcast), audiovisual (TV, video / DVD, movie) that contribute in new ways to educate according to the possibilities of each school context. The concern in the present scenario in the teaching of new technologies is the challenge that this proposed education because not everyone will have access to this area and educational innovation and it "will need, increasingly, the expansion of effective policies and actions that facilitate the digital inclusion for all citizens" (KENSKI, 2007, p.214).

Teaching calculation has brought great challenges in higher education, because due to an extensive curriculum that brings discipline, many students are having difficulties and often fail to arrive. In this sense, Mello and Fernandes (2001) focuses on this concern when reports that students end up considering a natural failure in these disciplines, and teachers set standards of disapproval "normal" . These patterns make seemingly superfluous any consideration of the problems facing the discipline, since they are "within normal limits". Among the various forms of teaching with the presence of new technologies, are educational software that remove an image purely abstract and complex calculation. Among the various software Geogebra is facilitating the creation of mathematical constructions and models for students that allow interactive explorations dragging objects and changing parameters. The Geogebra is also a tool that enables teachers to create interactive web pages.

This paper presents an experience of higher education students in the use of educational software Geogebra. In a space where the software is not used constantly was possible to see the various discourses which were notorious: lessons more interesting and dynamic, better assimilation of the contents, the resolutions of the expansion functions. Considering these, it is necessary, studies that emphasize: the importance of using the software in higher education, greater integration between new technologies and learning environments and training of educators who will work with this type technology, with thus deals more reflective spaces in the process of teaching and learning.

CHARACTERIZATION OF THE PARTICIPANTS

The study was conducted from a lecture with the resolution of two issues of the discipline of Differential and Integral Calculus and after an intervention with a semistructured interview. Attended by five students of Institutional Monitoring Program of the Federal University of Pernambuco, who experience the discipline of Differential and Integral Calculus II during their regular courses. Participants are the courses in Mathematics, Chemistry and Physics of the Academic Center of the Wasteland which cover the process of internalization of the university, as the shortage of professionals in the region in these areas.

METHODOLOGICAL PROCEDURES

The authors have developed a class in which they were addressed two issues related to the discipline of differential and integral calculus, as shown in Table 1. The questions asked the student a geometric interpretation of the study of the first and second derivatives of functions given and soon after, the same design a graph craving a better understanding of the issues. The second part of the class was viewing with Geogebra, the same graphics sketched by students had the help of software.

Table 1 – Proposed activity

Activity
1 - Sketch the graph of the function $f(x) = x^2 - x - 12$, based on the geometric interpretation of the first and second derivative (maximum and minimum points of inflection and concavity).
2 - Find the tangent line at $x = 2$ for this function.

Source: Prepared by the authors

For the solution of the first question, it is first necessary to find the points that intersect the graph of the function in the coordinate axis "x", for it is the roots of this function. This:

$$f(x) = x^2 - x - 12$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ab}}{2a}$$

$$x = \frac{-1 \pm \sqrt{1^2 - 4 \cdot 1 \cdot (-12)}}{2 \cdot 1}$$

$$x = \frac{-1 \pm \sqrt{1 + 48}}{2}$$

$$x = \frac{-1 \pm 7}{2}$$

$$x' = \frac{-1+7}{2} = \frac{6}{2} = 3 \qquad x'' = \frac{-1-7}{2} = \frac{-8}{2} = -4$$

Calculating the first derivative, which has geometric meaning as the range of decrease of the growth and function. This:

$$f(x) = x^2 - x - 12$$

$$\frac{df}{dx} = 2x - 1$$

So that the interval where the first derivative of the function f assumes positive values increases, and where the first derivative assumes negative values f decreases. Therefore it is necessary to know these intervals, calculating the value of x. This:

$$2x - 1 = 0$$

$$2x = 1$$

$$x = \frac{1}{2}$$

Therefore, for values between (- ∞, 1/2], and the function decreases to between (1/2,+ ∞) the function grows.

Now it is necessary to examine the second derivative of the function whose geometric meaning toward the concavity of the graph of the function. this:

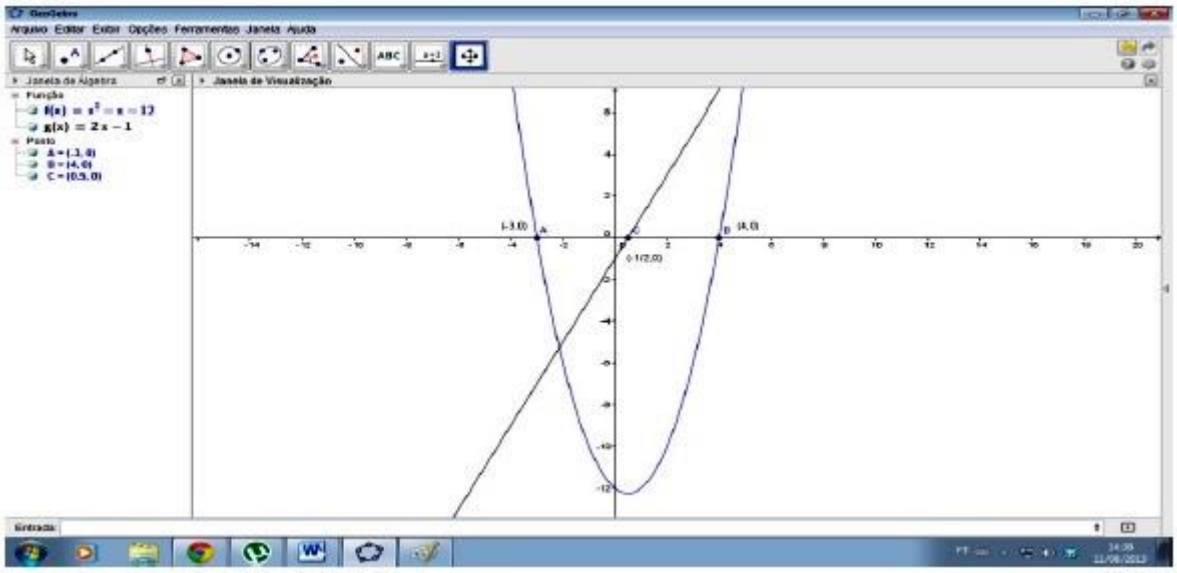
$$\frac{df}{dx} = 2x - 1$$

$$\frac{d^2f}{dx^2} = 2$$

So that the interval where the second derivative of the function assumes positive values, f is concave upward, and where the second derivative assumes negative values f is concave downward. Since the second derivative is a constant equal to 2, the whole graph of the function is concave upwards.

From these steps can sketch the graph of the function even with low precision, but with the help of the software Geogebra obtains more accurate graph of the function as shown in Figure 1, thus allowing better understanding by students.

Figure 1 – Sketch the graph of the function



Source: Prepared by the authors

In the second question, to obtain the tangent line to the point x = 2 is necessary to use the general equation of the line:

$$(y- y0) = m \cdot (x - x0)$$

Therefore it is necessary to know the value of the function f which assigns the value x = 2. This:

$$f(x) = x^2 - x - 12$$
$$f(2) = 2^2 - 2 - 12$$
$$f(2) = -10$$
$$y = -10$$

It is also necessary to calculate the value of m, where its geometrical interpretation can be seen as the slope of the point, which can be obtained by first derivative applied on the spot.

With:

$$\frac{df}{dx} = 2x\ - 1$$

Get:

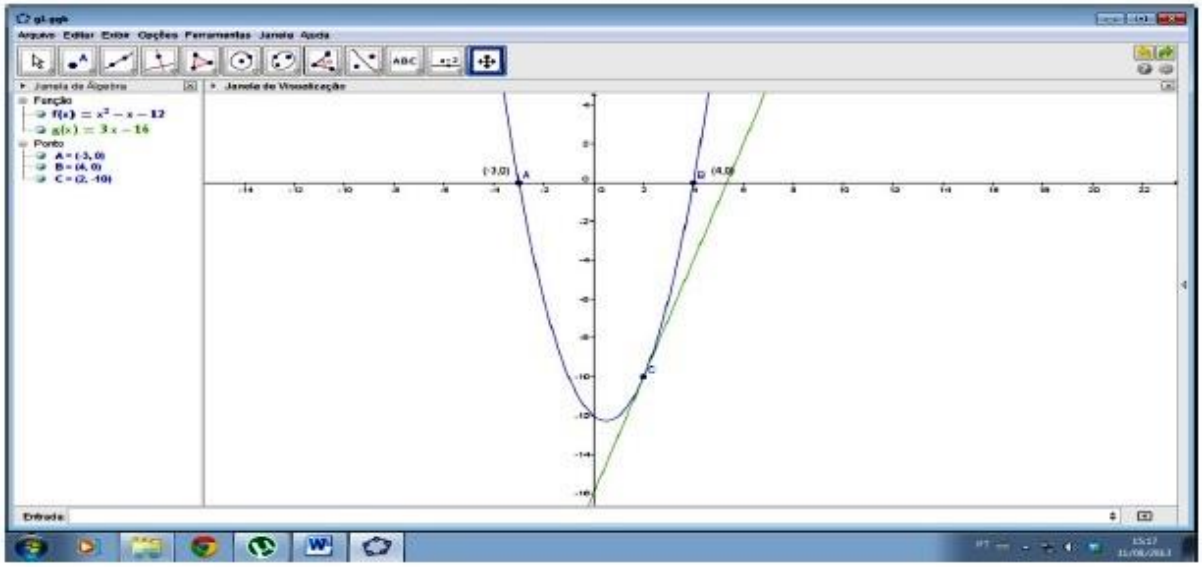
$$\frac{df}{dx}(2) = (2 \cdot 2) - 1$$

Therefore:

$$(y - y0) = m \cdot (x - x0)$$
$$[y - (-10)] = 3 \cdot (x - 2)$$
$$y = 3x - 6 - 10$$
$$y = 3x - 16$$

Thus, the equation of the line is tangent to the curve f (x) = x ² - x - 12 at the point (2, -10) and through Geogebra can sketch the graph of the function accurately enough that the concept of tangency is less abstract using tools offered by the software as shown in Figure 2.

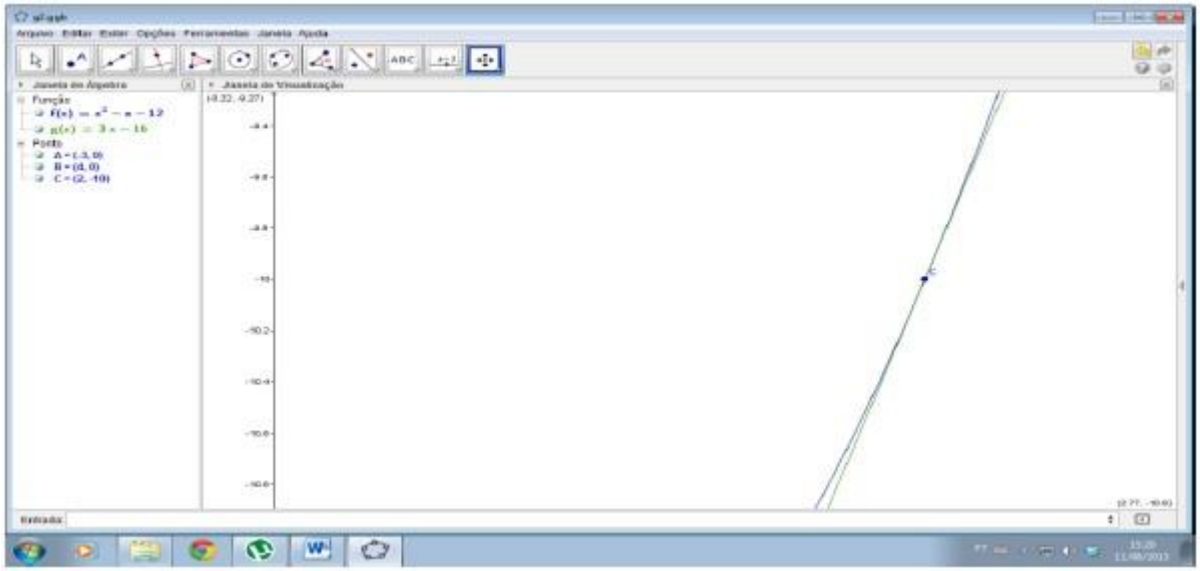
Figure 2 – Sketch the graph of the tangent line x = 2



Source: Prepared by the authors

It is displayed by Figure 3, that no matter how they approach the curves, they only touch at a single point.

Figure 3 – Zoom curves f with tangent line x = 2



Source: Prepared by the authors

Craving analyze speeches by students in higher education , the authors made use of semi-structured interviews regarding the use of the software Geogebra as a facilitator of the process of teaching and learning . The discourse analysis constitutes an important factor, as it enables a formative evaluation from the constant (re) articulation of discourses found in this space. According to Laclau e Mouffe (2004 apud FERREIRA, 2011) the discourse structure is not homogeneous grouping of elements organized, but rigorously composed of antagonism between elements in a continuous process of articulation, and a new shift linkage.

RESULTS AND DISCUSSION

A few decades ago, scholars point to learning experiences planned and that the results can be satisfactorily gives through teaching methods that encourage reflection by the student. Schools and universities are organized not only to teach the knowledge concerning what, how and for what purpose, required by our society , but they are organized in organizational system that is constantly put forth the need to promote an academic, social and political.

Thus, the authors realize that it is relevant to the analysis of discourses of higher education students on the teaching of Geogebra in Differential and Integral Calculus. Based on semi-structured interviews, it was possible to group the speeches found in this work, as shown in table 2.

Table 2 – Discourses of students

Speeches of students through experience with the software Geogebra	D.1 The traditional way is more difficult to visualize the points on the graph construction and the geogebra greatly facilitates the understanding and visualization. D.2 Very good, easy viewing after calculation. D.3 With the traditional way is more complicated to sketch the graph and with the

	help of geogebra facilitates more understanding of the graph. D.4 With the help of the software, the display resolution is much more practical and easier to understand, the "things" make sense! D.5 In the traditional way, depending on the teacher or the student's prior knowledge, it can feel very difficult to learn, but with the help of software geogebra greatly facilitates graphical interpretation for the student, facilitating the assimilation of content.

Source: Prepared by the authors

Through the speeches of students who indicate a better learning using the software, the authors note that it is essential to integrate technology and teaching in undergraduate Calculus, providing discursões these spaces. Howeve, this requires that the teacher be prepared to match teaching methods and theories work with technologies, making them an integral part of the reality of the academic (MISKULIN et al., 2006, p.107).

In this sense, it is the teaching spaces the introduction of information and communication technologies and driving the process of change to the teacher that provides the student get the correct information sources of various types and be engaged in the process , aware of the real capabilities of technology, its potential and its limitations , so you can select which is the best use to be explored in a given content, contributing to the improvement of the teaching-learning process through a renewal of their teaching.

CONCLUSIONS

It was possible to intuit that the results of the analysis point to the need for a closer dialogue between the teaching of calculus and the tools of new technologies, because they

found that students seem to miss these educational resources to facilitate the process of teaching and learning. Moreover, it is possible to discern in the speeches that they feel the lack of courses that address the topic of new technologies in their courses making up review the curricula of academic and especially in undergraduate courses.

Several studies and some experiments consisting of authors have that are relevant to the actions of training of education professionals regarding the use of technological resources, it is apparent that these fears have yet how to implement in their classes and are limited to traditional resources. Thus, providing opportunities to enhance creativity, investigative methods, commitment to training not only academic, but also social, becomes relevant with regard to respect the process of teaching and learning.

Importantly, the value of this resource to equip the teaching process. The Geogebra makes the class very productive because the dynamism of the software, when properly exploited, motivates students, holds the attention and facilitates their understanding, and promote interaction between teacher and student.

REFERENCES

FERREIRA , F. A. To understand the discourse theory of Ernesto Laclau. **Magazine Academic Space,** v . 11, n. 127, p. 12-18, dec. 2011.

JOVER, R. S. V. Calculus: an experience of teaching using Geogebra applications and Graphmatica. In: NATIONAL MEETING OF MATHEMATICS EDUCATION, 11., 2013, Curitiba. **Proceedings…** Curitiba: [s.n.], 2013.

KENSKI, V. M. Future directions in the relationship between new technologies and educations. In: SILVA, A. M. M. et al. (Ed.). **Educational policies, technologies and training educator:** effects on the teaching and practice of teaching. Recife: ENDIPE, 2006. p. 213-226.

MATHIAS, I. R.; BORCHARDT , T. T. , CORREA, M. M. The Geogebra as a teaching tool for the teacher. NATIONAL MEETING OF MATHEMATICS EDUCATION, 11., 2013, Curitiba. **Proceedings…** Curitiba: [s.n.], 2013.

MISKULIN, R. G. S.; SILVA, M. R. C. Undergraduate courses in mathematics at a distance: a reality or utopia. In: JAHN, A. P.; ALLEVATO, N. S. G. (Ed.). **Technology and mathematics education:** teaching, learning and teacher education. Recife: SBEM, 2010.

PADILHA, M. H. S.; CAVALCANTE, P. S.; ABRANCHES, S. P. **Terms of education and technology.** 2. ed. Recife: University Press, 2009.

REZENDE, W. M. **Teaching calculus:** epistemological difficulties. Disponível em: <http://www.scielo.com>. Acesso em: 30 jul. 2013.