Geogebra in the First-Order and Degree Two Differential Equations

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Abstract

Currently, there are several studies that support the benefits obtained by using geogebra software for teaching mathematics at the university level (see [1] and [3]). Based on these results and with the support of some previous works about Differential Equations given in [2] and [4], we extended the idea of using GeoGebra applets as a motivational teaching and learning tool for differential equations of first order and grade two. This was implemented for engineering and pedagogy careers of the University of Antofagasta-Chile, in courses of differential equations of the second semester of 2020 and the first semester of 2021.

Keywords: Geogebra, Differential Equations, Tics

1. Introduction

Consider:

$$\left(\frac{dy}{dx}\right)^2 + P(x)\left(\frac{dy}{dx}\right) + Q(x) = 0$$

first-order and second degree differential equation. Where $P(x)$ and $Q(x)$ are polynomials of real coefficients.

We will show by examples with concrete expressions for $P(x)$ and $Q(x)$, the utility of Geogebra applets, which will give us the graphical solutions of these differential equations and that helped in the motivation and learning of the students.

2. Visualizing the solutions in Geogebra Applets

These examples that will be seen below can be downloaded or viewed in https://www.geogebra.org/m/n5xcw98x

Example 1

Be

$$\left(\frac{dy}{dx}\right)^2 - 2xy\left(\frac{dy}{dx}\right) - 8x^2 = 0$$

The solutions are given for $y_1 = 2x^2 + c$ and $y_2 = -x^2 + c$, which are shown in red and blue respectively in Figure 1.

The constant c is given by the slider that varies between (-5) and 5.

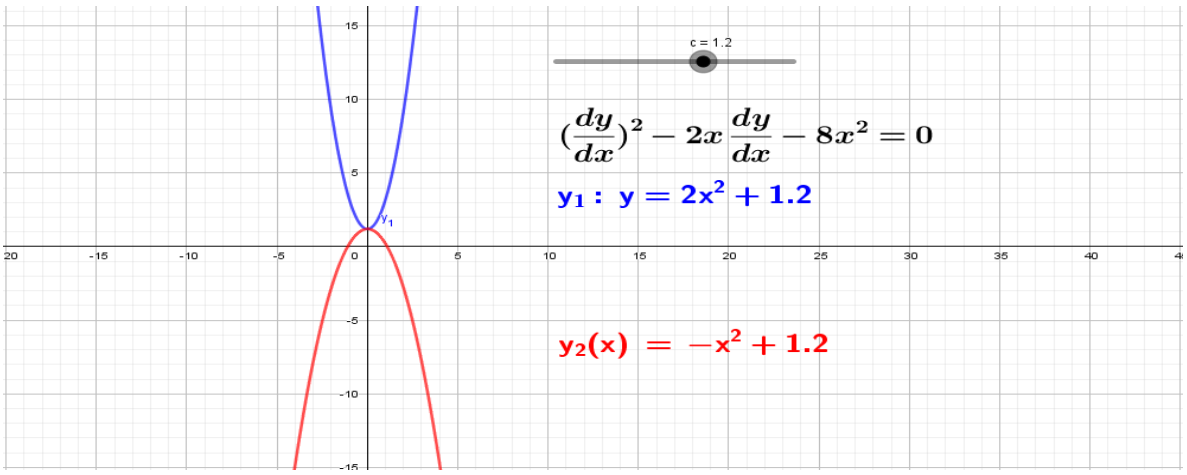

Figure 1. Example 1

Example 2

Be

$$\left(\frac{dy}{dx}\right)^2 - (x^2 + x)\left(\frac{dy}{dx}\right) + x^3 = 0$$

The solutions are given for are given $y_1 = x^3/3 + c$ and $y_2 = x^2/2 + c$,which are shown in red and blue respectively in Figure 2.

The constant c is given by the slider that varies between (-5) and 5.

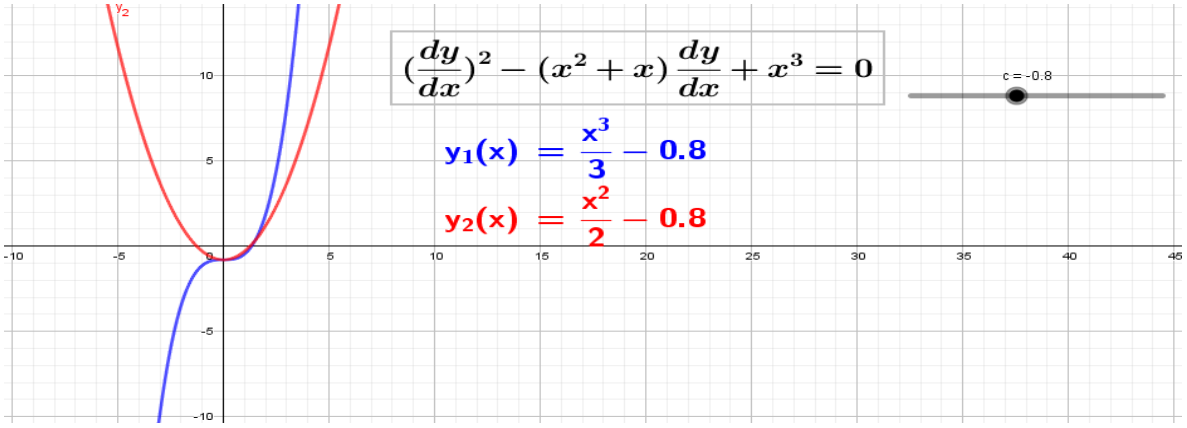

Figure 2. Example 2

Example 3

Be $\left(\frac{dy}{dx}\right)^2 - (y + x)\left(\frac{dy}{dx}\right) + xy = 0$

The solutions are given for $y_1 = x^2/2 + c$ and $y_2 = ce^x$,which are shown in red and blue respectively in Figure 3.

The constant c is given by the slider that varies between (-5) and 5.

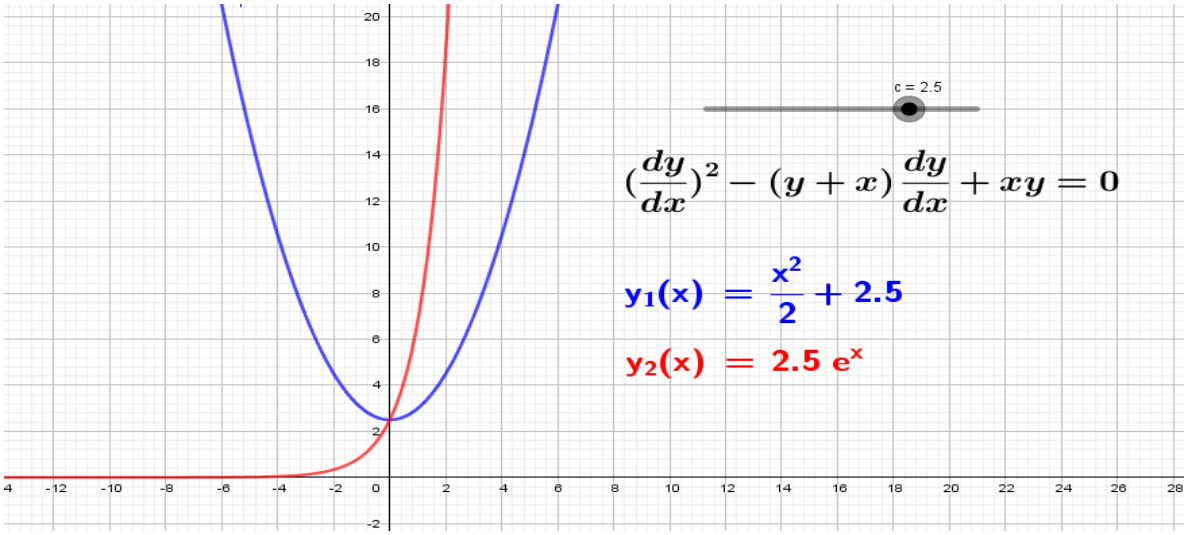

Figure 3. Example 3

Example 4

Be $\left(\frac{dy}{dx}\right)^2 - yx\left(\frac{dy}{dx}\right) - \frac{3}{4}x^2 = 0$

The solutions are given for $y_1 = 3x^2/4 + c$ and $y_2 = -x^2/4 + c$, which are shown in red and blue respectively in Figure 4.

The constant c is given by the slider that varies between (-5) and 5.

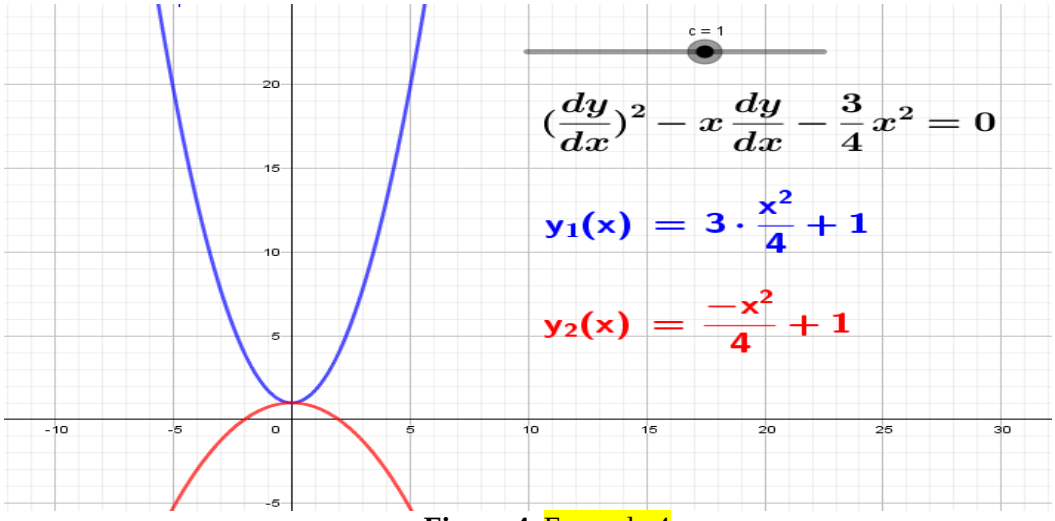

Figure 4. Example 4

Example 5

Be

$(\frac{dy}{dx})^2 + (x-1)\frac{dy}{dx} - x = 0$

The solutions are given for $y_1 = x + c$ and $y_2 = -x^2/2 + c$, which are shown in red and blue respectively in Figure 5.

The constant c is given by the slider that varies between (-5) and 5.

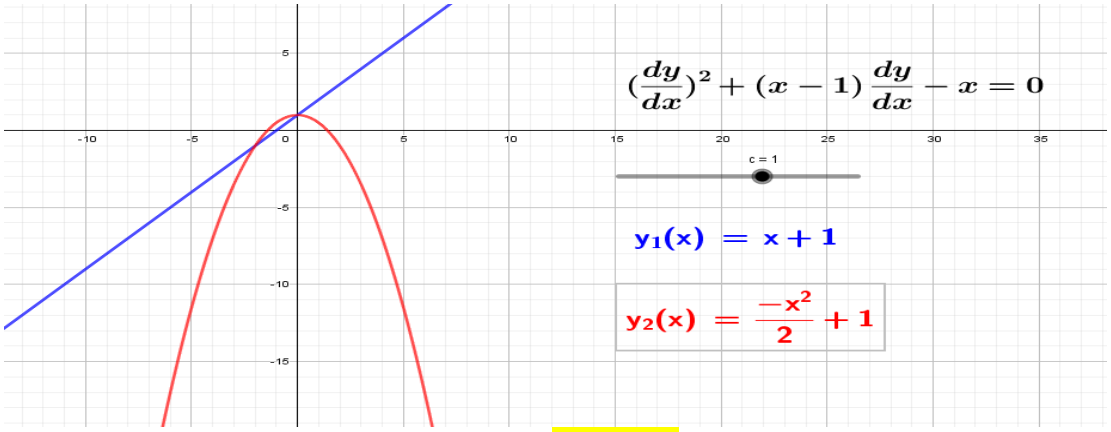

Figure 5. Example 5

3. Conclusion

The examples presented here can serve for students motivation in their educational process. The applets of Geogebra created can help to various contents that are presented in the subjects of mathematics of the University of Antofagasta and other national or foreign universities.

It should also be noted what is expected of these Geogebra apps can encourage the development of scientific initiation of students of engineering or pedagogy in mathematics.

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