

# ACTIVITIES WITH DESMOS AND GEOGEBRA FOR FORMATIVE AND AUTOMATIC FEEDBACK

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## Abstract

The study developed here was carried out within the scope of a National Meeting “19.º MatViseu” with secondary school mathematics teachers in a workshop entitled “Desmos and GeoGebra: activities with automatic and formative feedback”. The objectives were to articulate the mathematics curriculum and essential learning program, and to explore activities that use some of the strengths of Desmos and GeoGebra to provide feedback to students and develop some activities with feedback appropriate to the level of education they teach. This National Meeting was organised with plenary sessions (invited speakers) and parallel sessions (workshops). In-service teacher training is an essential element to help them to adapt to different curricula and new methods and resources in their professional careers. This study aims to understand how the use of these two platforms can allow a different approach in their classes.

The research methodology adopted consists of a case study, relating to a group of teachers who worked autonomously in this workshop. Essentially, a qualitative approach was adopted through the interpretation of data collected through observation, interaction on these platforms and a brief questionnaire.

We can conclude that using the GeoGebra platform requires prior preparation, essentially with GeoGebraScript and with the Desmos platform it was easier to work with the Computation Layer language, although GeoGebraScript and Computation Layer language are new for most of them. Thus, it is recommended that in future training, the creation of strategies and dynamics of preparation for work in the GeoGebraScript and in the Desmos language, to carry out a complete work.

However, it is important to keep in mind that the GeoGebra platform was known to most of the participants, but Desmos was not known for all the participants and the sample is not significant enough to draw general conclusions.

Keywords: feedback, formative, technologies, mathematic, in-service.

## 1 INTRODUCTION

Teaching is an increasingly rigorous, challenging and dynamic activity [1]. The development of knowledge and skills essential to the future success of students, therefore, requires progressively more sophisticated teaching strategies [2]. As such, teachers must have high-level knowledge as well as update and develop new teaching practices ([1], [3]). The Ministry of Education and Science of Portugal, through the Council Scientific-Pedagogical Continuing Education - by Decree-Law No. 22/2014 -, highlights the importance of training for teachers to reflect on their own practices, expanding their respective possibilities of objective understanding of the mechanisms and knowledge about the teaching professional identity and, consequently, bringing together contributions to the teaching of the Portuguese educational system.

The constant communication between teacher and student reveals the need for the evaluation of learning in distance education to be based on the monitoring and guidance of students' performance during the process of learning, with feedback provided by the teacher being the main source of teaching and guidance for students. The assessment must aim to guide learning, students' autonomy in relation to it and the verification of competences acquired. While in distance education written dialogue is the main form of teacher/student interaction, in this context, teacher feedback is the main source of guidance to students about learning. If formative assessment is taken into account, it is used to continuously improve and develop an activity. Formative feedback is one that offers clues on how to continue, descriptive, aimed at regulation, that is, it allows the student to identify what remains to be done and how to do it to achieve what is expected [4].

Digital tools that allow us to give automatic formative feedback are, for example, Desmos and GeoGebra.

Desmos is an online platform that allows teachers to develop remote lessons and activities for students to complete online. Desmos is light, intuitive, easy to use and brings a series of possibilities for working with algebraic and graphical representations of different functions and to add an extra layer of interactivity and feedback to the activities with the computation layer [5].

GeoGebra is a free, cross-platform dynamic geometry system for all grade levels that combines geometry, algebra, tables, graphs, statistics and calculus in a single application. In the context of remote teaching with the use of GeoGebra, not only as another technological resource, but as a resource that collaborates in the development of teaching practice, involving mathematical concepts and automatic assessment methods, creating possibilities for immediate feedback in their proposals for formative assessment [6].

Bearing this in mind, the workshop, "Desmos and GeoGebra: creating activities with automatic and formative feedback" developed at the conference on the "19.º MatViseu" was aimed to explore activities that use some of the strengths of Desmos and GeoGebra to provide feedback to students and to develop some activities with feedback and to understand how the use of these two platforms can allow a different approach in their classes.

## 2 METHODOLOGY

The research methodology adopted consists of a case study, relating to a group of teachers in-service who worked autonomously in this workshop. In this workshop, were enrolled 32 teachers in-service who teach Mathematics to students from the 7th to the 12th grade. The workshop was given in online mode because of the pandemic Covid19 situation. At the end of the workshop a short questionnaire was given where the main goal was to know the teacher's perception of the workshop.

## 3 RESULTS

The workshop was divided into two groups. One group worked with GeoGebra, and the other group worked with Desmos in two different breakout rooms, then switched so that in the end each group was allowed to work with these two features.

The planning of the aforementioned workshop had the following steps:

### ✦ GeoGebra

It started with an introduction to GeoGebraScript then followed by some exploratory examples of the use of GeoGebraScript in real activities; Then a simple task was elaborated by the trainees where they had to use GeoGebraScript (Fig. 1), example of script "If (c= =a+b,"Correct","Incorrect. Tray again")"; Some of the tasks developed by the trainees were visualised and analysed.

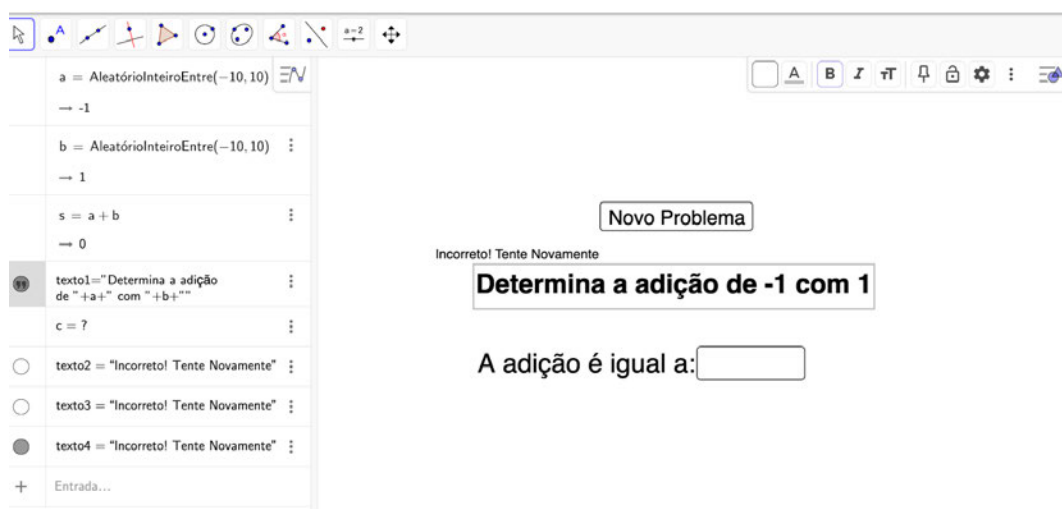


Figure 1. Teacher task.

★ Desmos

It started with the introduction to the Desmos Platform followed by some activities with automatic feedback to trainees trying with the role of students. On the left side of Fig. 2 it's asked to fill the table with the values of length and height of a rectangle knowing that area is 48 and the perimeter is 28. In the right side, it's a try with the wrong answer and that can be observed in the fact that the shaded area exceeds the height of the rectangle, and the length of the black line exceeds the size of the perimeter.



Figure 2. Activity as student.

The next step was the Introduction to the Desmos Computation Layer (CL) language. Session followed with a simple task to be elaborated by the trainees where they had to resort to the CL. The aim is to elaborate a scenario similar to Fig. 3 and when a student hits the button “Testar” it must show, simultaneously, the correct plot (plot of a function that crosses the origin of axes and has slope 2) and the plot of the equation introduced by the student.

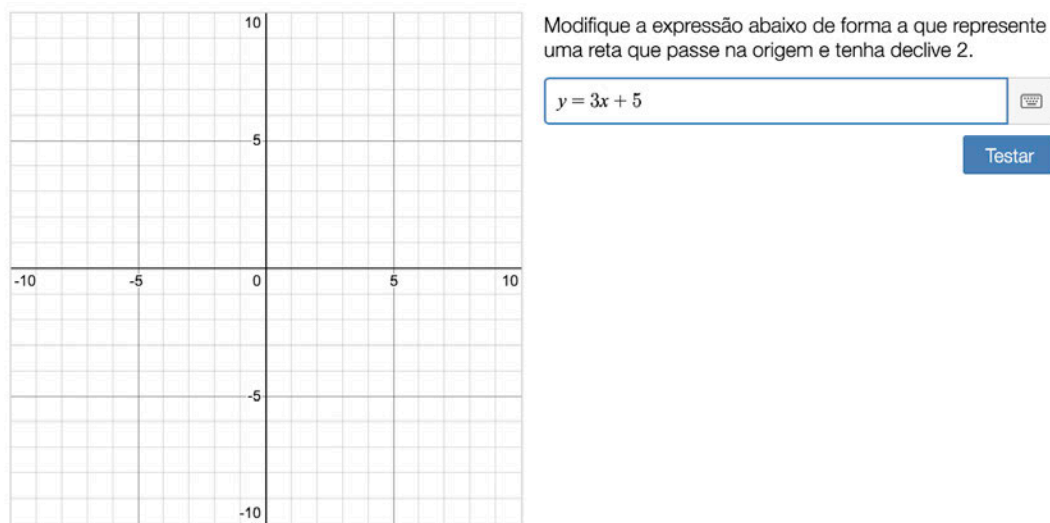


Figure 3. Teacher task.

Before trainees are moved to the main breakout room some of the tasks developed by the trainees were visualised and analysed.

At the end of the session, there was a debate on the potential of using these tools in student learning.

Teachers were asked to answer a short questionnaire in order to assess how the training had gone. The questions were about Planning/Execution (*Legend: 1.1- The proposed objectives were met; 1.2- The methodology was adequate for the participants, at a theoretical level; 1.3- The methodology was adequate for the participants, at a practical level; 1.4- The action contributed positively to their professional activity; 1.5- The duration of the action was adequate; 1.6- The resources used were effective; 1.7- The space/online platform where the action took place was adequate. A 5-point Likert scale was used, where 1 is week and 5 is excellent*) (Fig. 3); Materials; Overall appreciation of the session (Fig. 4) and Comments/suggestions (Fig. 5).

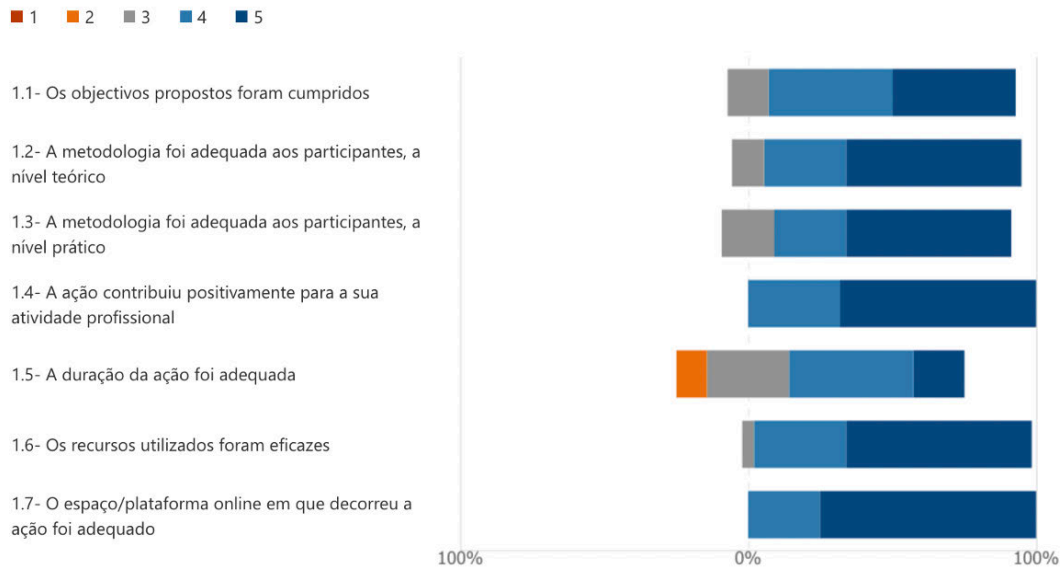


Figure 3. Planification



Figure 4. Global appreciation (Legend: Excelente= Excellent; Muito Bom= Very Good; Bom= Good; Razoável= Reasonable; Fraco= Weak)

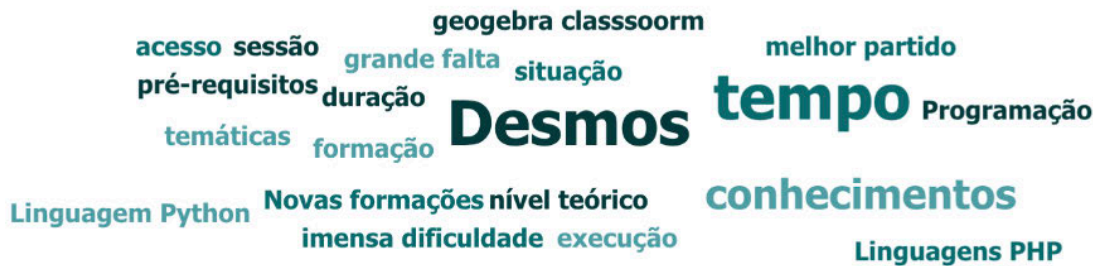


Figure 5. Comments/suggestions.

## 4 CONCLUSIONS

In conclusion, according to a trainee “New sessions with more depth on this topic”, because the investing in continuing teacher training is essential for building students' knowledge. Although students have a lot of access to content/information on the internet and in books, the school is still the main source of learning. With the evolution of technology, the teaching and learning process is not just about having a teacher in the classroom who uses a blackboard and books to explain the subject. This change brought new ways of teaching and created a very different profile of student. Investing in the education of students will then be urgent and a priority, as well as in teacher training, aiming to innovate teaching and the profile of the 21<sup>st</sup>-century teacher.

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