

Looking at Mathematics through the Lens of a Camera

Karina A. Rizzo^{1,2}, Laura S. del Río², Mónica E. Manceñido²

¹ ISFDyTN°24; INSPSocorro; ISFamilia, Argentina; karinarizzo71@gmail.com

² IMAPEC, Facultad de Ingeniería, Universidad Nacional de La Plata, Argentina;
laura.delrio@ing.unlp.edu.ar, mance@fisica.unlp.edu.ar

Abstract

In this paper, we share some reflections about a contest we've been organizing during the past three years that combines Photography, Mathematics and the GeoGebra software package. We show two examples of works presented by students to argue that it helps to engage students with mathematical content by relating it with art and with their surrounding environment, and that it allows students to think creatively, by inviting them to create up their own questions and problems.

Introduction

In this paper we share some reflections about a Mathematics, Photography & GeoGebra contest that we organize: Fotogebra. Its objective is to engage children in Mathematical tasks by making connections between this subject, their environment and arts. We invite students to 'catch' a mathematical concept in a picture, give it a motto, come up with a problem involving that concept and, finally, solve it. It is in concordance with the idea that "Creative activities may support students to recognize that doing 'real' mathematics is creative thinking; and creative thinking in mathematics means, that you do your own mathematics" [2].

A jury evaluates the works presented, taking into account: account the aesthetics, originality, compositional balance, dynamism and framing of the photography; and on the mathematics side, the creativity in the production of the problematic situation, the applied specific knowledge and the use of GeoGebra. Math aspects are given more weight than with the others.

There are several proposals integrating Photography in Mathematics teaching and learning, *i.g.* [3][4]. GeoGebra is a free software package that provides an environment to explore, conjecture and discover, all in a dynamic way. It allows the user to easily insert a picture, and to overlap different kinds of mathematical objects. This feature helps to perform further analysis, as explained in [1], and this is the reason why we chose this piece of software for this proposal.

Examples of Works

The contest is organized into four categories, according to the educational level of the participants, and the topics involved (Geometry or Functions). In this section, we share two of the works presented by students from the second category: secondary school students, looking for functions in their environment. We analyze in each case what mathematic and GeoGebra tools they used, how their work is related to school content, and what they had to learn *ad hoc* to solve the problem they had come up with.

The first one (Figure 1,a) entitled *Cumpleaños exponencialmente feliz (Exponentially Happy Birthday)* uses a picture of a dog to find out how long its beard would be, in order to make the dog a costume for a birthday party. To that end, they placed some points on the dog's face, and they fitted an exponential function to them. Then, they used the Length command to solve the problem. These students had studied exponential functions at School, but they didn't know about fitting curves nor calculating their length. These topics are usually taught at University in our country. They had to find out by themselves what mathematical tools were available to solve their problem, and how to implement them.

The second example (Figure 1,b) was entitled *Cuy Sediento (Thirsty Guinea Pig)*. The question formulated by students was how long the spiral paths are, to estimate how much time a Guinea Pig would need to get to the water inside it. To that end, they used GeoGebra sliders to fit a spiral and they used a formula in order to calculate the length. They researched the average speed of this kind of animal, and used this value to estimate the time to get to the water, using, besides Photography, Mathematics and GeoGebra, a basic Physics concept. As well as all of this, they used an animation to simulate the movement of the Guinea Pig (<https://www.geogebra.org/m/vhxnnfez>).



Figure 1: Two examples of works presented by students: (a) *Exponentially happy Birthday*, by: Milagros Candia, (b) *Thirsty Guinea Pig*, by Abril Oviedo and Danilo Fuentes.

In many of the presented works, as shown by the previous examples, students chose an image they could link with school content, but the question triggered by it exceeded what they had previously studied. This challenged them to learn new Mathematics and GeoGebra helped with calculations that were beyond their current capabilities. It is important to say that, even though the solutions are not strictly correct from a mathematical point of view (because they don't take into account the projection problem) we found them valuable from a didactic point of view, because they made their own questions, they linked them with mathematical concepts and they got an estimation of the result.

Summary and Conclusions

We noticed that, by taking part in this contest, students are enabled to think creatively both artistically and mathematically. They take pictures that they can relate with a mathematical school concept, but the questions they create are beyond what they have studied. This is not a reason for them to quit. They investigate new mathematical concepts, tools and procedures that help them to reach the solution, and they use GeoGebra to fit a model to the situation and make further calculations. This is concordant with the ideas mentioned in the introduction: students create their own mathematics, by creating their own questions and strategies to answer them.

References

- [1] J. M. Furner and C. A. Marinas. "Addressing Math anxiety in teaching Mathematics using photography and GeoGebra." *26th International Conference on Technology in Collegiate Mathematics*, San Antonio, USA, 2014, vol. 12, no. 1, 1979, pp. 134–143. <http://archives.math.utk.edu/ICTCM/v26.html>.
- [2] Z. Lavicza, K. Fenyvesi, D. Lieban, H. Park, M. Hohenwarter, J. D. Matecon and T. Prodromou. "Mathematics learning through Arts, Technology and Robotics: multi-and transdisciplinary STEAM approaches." *8th ICMI-East Asia Regional Conference on Mathematics Education*, Taipei, Taiwan, May. 7-11, 2018, pp. 110-121.
- [3] J. L. Muñoz Casado. "Creogebra. A vista de GeoGebra". *Suma*, vol. 88, 2018, pp. 73–80. <https://revistasuma.es/revistas/88-julio-2018/creogebra-a-vista-de-geogebra.html>
- [4] B. Sharp, J. Garofalo J and A. Thompson. "Digital Images in the Mathematics Classroom." *Learning & Leading with Technology*, vol. 31, 2004, pp. 30–32 <https://files.eric.ed.gov/fulltext/EJ695778.pdf>