

GRAPHIC HUMOR TO PROMOTE MATHEMATICS LEARNING

¹LUIS MENEZES, ²ANA M. COSTA

^{1,2}CI&DETS, Polytechnic of Viseu, R. Maximiano Aragão, Viseu, Portugal
E-mail: ¹menezes@esev.ipv.pt, ²anacostalopes@esev.ipv.pt

Abstract - This paper presents an exploratory study, under development in Portugal, in which one intends to understand the role that mathematical tasks based on graphic humor (comic strips) can play in the learning of Mathematics, in particular, in the written communication, of students at the end of primary education (4th and 6th grades). For this purpose, two classes were chosen, in which mathematical tasks, based on graphic humor, were proposed, and students were encouraged to write about them. The study followed a qualitative methodology and data collection took place from: (i) task resolutions; and (ii) field notes. To analyse the impact of mathematical tasks based on graphic humor in the written communication of students, we consider: (i) Appreciation of the task's graphic humor; (ii) understanding and solving the task; and (iii) construction, organization and consistency of the text. The results of the study reveal that mathematical tasks based on graphic humor are welcomed by young students, who appreciate humor. Students respond to the request to produce written texts, which describe the comic strips, and solve with enthusiasm the mathematical problems present in the situations. Mathematical writing, well-structured and using mathematical language consistently, is decisive to promote reasoning, develop communication skills and for learning mathematics.

Keywords - Mathematics, Learning, Written Communication, GraphicHumor, Tasks.

I. INTRODUCTION

Learning mathematics is dependent on the activities that students can experience. Teaching that focuses on routine mathematical activities, such as exercises, leads to a learning process very different from that which results from teaching based on challenging mathematical tasks that surprise students and cause cognitive changes.

However, the simple fact of carrying out challenging tasks is not a sufficient condition for powerful learning to take place (Clark & Roche, 2018; Menezes et al., 2019; NCTM, 2014).

Written communication (through task resolutions) and oral communication (through collective discussions) play a fundamental role in transforming mathematical activity into mathematical learning (Martin, Polly & Kissel, 2017; Menezes et al., 2019; Morgan, 2002).

Humor, especially graphic humor (through cartoons and comicstrips), has shown potential for promoting mathematics learning, especially when it is the starting point for the construction of mathematical tasks. In the HUMAT project. Humor in Mathematics teaching we have designed mathematical tasks based on graphic humor (Menezes et al., 2019; Menezes et al., 2020). The design of these tasks is based on the assumption that graphic humor triggers positive emotions in students, develops cognition and promotes the learning of mathematics. In this text, in a way, we study the impact of tasks based on graphic humor in the written communication of students at the end of primary education (4th and 6th grades).

II. HUMOR AND EDUCATION

Humor and laughter are universal aspects of human activity, which can be found in all cultures, being

motivated by pleasant and fun situations (Martin, 2007; Marin & Ford, 2018; Meyer, 2015). Humor can be understood as the “quality of being amusing or comic; the ability to make other people laugh” (Lovorn&Holaway, 2015, p. 25). Humor, like communication, can be seen as a form of social interaction that can fulfil multiple functions, such as increasing group cohesion and helping people cope with stress (Banas, Dunbar, Rodriguez & Liu, 2011; Martin, 2007; Martin & Ford, 2018; Meyer, 2015). Martin and Ford (2018) considers humor as a form of social play, involving three essential psychological elements that result from a stimulus event: a cognition, an emotion, and a behavior. In figure 1, the authors illustrate the relationships between these elements.

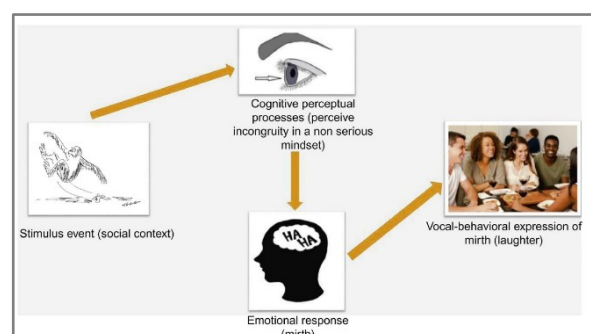


Figure 1: The essential elements of humor (Marin & Ford, 2018, p. 17)

These authors explain that humor is based “on two cognitive-perceptual processes activated by characteristics of a humor stimulus and the social context in which it is encountered: (1) perception of incongruity and (2) appraisal of incongruity in a nonserious humor mindset.” (p. 17).

Marin and Ford (2018) introduce the second psychological element, stating that “our response to

humor is not just intellectual. The perception of humor invariably also evokes a pleasant emotional response, at least to some degree.” (p. 18). Finally, a third element of a neuro-physiological nature, laughter. These authors point out that “the mirthful pleasure accompanying humor also has an expressive component, namely laughter” (p. 19) or “at low levels of intensity, this emotion is expressed by a faint smile”(p. 19).

In figure 2 we present a comic strip from the Toon Hole¹ blog, created by the American graphic illustrator Ryan Kramer, with which we try to illustrate the way this mechanism of the humor works.



Figure 2: Comic strip from Ryan Kramer.

The stimulus event is the comic strip, based on a common daily situation: the use of numbers to determine our place in a waiting queue. The unexpected twist in this situation is that the last person to be called is not a whole number and therefore the time he has to wait can be much longer than he was expecting. The cognitive perceptual processes perceive the incongruity of the 4th vignette and work to resolve this incongruity. When this happens, the joke is understood and the emotional mechanisms work and the laughter or smile appears.

Humor can take different forms, such as conversational, supported by oral speech, and written, namely in the form of cartoons and comicstrips, as illustrated in figure 2 (Flores, 2003; Flores & Moreno, 2011; Martin, 2007; Martin & Ford, 2018). In this paper, as we will explain later, we are mainly interested in the second form, called graphic humor (Flores, 2003; Flores & Moreno, 2011; Menezes & Flores, 2017; NCTM, 2007, 2013).

Humor can fulfil several important social functions, called serious ones, in different domains of human activity, such as health, finance and education (Adão & Oliveira, 2011). Martin and Ford (2018) classified these psychological functions of humor according to three categories: “(1) emotional and interpersonal benefits of mirth, (2) tension relief and coping, and (3) social functions in group contexts” (p. 33). Non-aggressive humor works as a generator of

positive emotions, which favors social well-being. In this way, it is usually a good response to stressful situations and facilitates social relationships and communication (Banas et al., 2011; Martin, 2007; Martin & Ford, 2018).

In the educational field, research has shown mixed results, depending on the type and form of humor used by the teacher (Banas et al., 2011; Martin & Ford, 2018). In general, written and planned humor has better results than oral humor (Guitart, 2012; Menezes, Fernandes, Viseu, Ribeiro & Flores, 2020). In all cases, non-aggressive humor creates a good classroom environment, facilitates student communication and helps to recall information.

III. MATHEMATICS LEARNING AND COMMUNICATION

Learning mathematics is a complex activity, in which students are the real protagonists. The teacher's mission is to provide students with the necessary ingredients for this learning, which must necessarily include problem solving, mathematical reasoning and communication (Clark & Roche, 2018; Menezes et., 2019; NCTM, 2014). Through the proposal of challenging mathematical tasks, the teacher provides these elements, especially if he organizes a classroom environment in which communication, both written (in task resolutions) and oral (in collective discussions) is valued. In this study we are interested in written communication.

Writing is a form of communication that takes place in the mathematics classrooms, in close articulation with oral communication. This mathematical communication includes mathematical symbolism, representations such as diagrams, tables, drawings, and the students' native language (Martin, Polly & Kissel, 2017; Morgan, 2002, NCTM, 2014). It is the students' native language that supplies the specialized vocabulary of mathematics that students progressively learn.

Like oral communication, written communication can vary widely in mathematics classes. In some classes, mathematical writing is limited to solving exercises. In other classes, mathematical writing is a way of solving problems through short answers. In some other classes, written communication is more extensive, supporting students' reasoning and communication with others. In these cases, students produce more developed texts, revealing more powerful, reflective and creative learning (Martin, Polly & Kissel, 2017; Morgan, 2002). Although differently, in all cases, teachers believe that written communication can play an important role in learning.

Many authors identify the main contributions of writing to the learning of mathematics; developing mathematical understanding; Producing a lasting record; Promoting self-confidence; Generating positive attitudes towards Mathematics; supporting

¹ <http://toonhole.com/>

the assessment of mathematical learning (self and by the teacher) (Martin, Polly & Kissel, 2017; Morgan, 2002).

To develop the competence of mathematical writing, several strategies have been identified: Solve problems; Explain why something works; Describe what one has done; Produce written reflections; Create a wall journal/newspaper; Write stories about Mathematics; Describe images (Burton & Morgan, 2000; Martin, Polly & Kissel, 2017; Morgan, 2002; Ntenza, 2006).

IV. METHODOLOGY

This study adopts a qualitative methodology. Students' resolutions / answers to the proposed mathematical tasks and field notes were used as data collection instruments.

Two Portuguese classes of mathematics participated in the study, one from grade 4 and the other one from grade 6, respectively with 21 and 24 students.

Classes performed 5 tasks based on graphic humor. The 4th grade class performed the tasks in pairs and the 6th grade class performed the set tasks individually. In this article, we chose only two tasks. The first task, taken from the book "Humor in mathematics teaching" (Menezes et al., 2019), was applied to the 4th grade class (Figure 3), based on the comicstrip in Figure 2, with an adaptation: the teacher, to make the task more accessible to students, changed the number of the fourth vignette, from 0,001271 to 0,1271.

1. Describe the situation presented in the comic strip. Do you think the situation is amusing?
2. Assuming that on that day numbering started at 0, how many people might already have been assisted?
3. If this numbering was to continue as suggested in the panel, how many people are to be assisted until they reach number 1? And number 2?

Figure 3. Text of the 4th grade task: "When number 2 is not that big a deal...".

The second task, taken from the book "Humor to learn mathematics" (Menezes et al., 2020), based on a comic strip of Bill Amend, was used in a 6th grade class (Figure 4).



Figure 4. 6th grade task: "Geometry, what I want you for!".

1. Describe the situation presented in the comics. Why can the situation be funny?
2. Is Paige right about the usefulness of mathematics?

3. What do you think about Paige's solution to the mother's problem?
4. How to solve the problem posed in the last vignette?

To analyze the impact of mathematical tasks based on graphic humor in the written communication of students, we consider 3 aspects: (i) Appreciation of the task's graphic humor; (ii) understanding and solving the task; and (iii) construction, organization and consistency of the text.

V. RESULTS

The results show that most students appreciate the humor that supports the tasks and this contributes to their active involvement in their resolution. As more tasks were presented in the classroom by the teacher, students showed more enthusiasm and curiosity in the proposals.

Most students, some in pairs and the others individually, reveal that they understand humor (question 1 of all tasks: "Describe the situation presented in the comics. Why can the situation presented be funny?") and are able to solve the tasks. We present, below, illustrative answers of what students wrote about solving the tasks. First, we transcribe the answers of two pairs (Pn) of students (4th grade, P7 and P9):

1. In this situation, we see a young man who wants to get his new driving license. The DMV lady gives him the number 2. The young man is glad to have this number, but when he looks at the number of the person who is being assisted (0, 1271) he is surprised because there are still 18729 persons who will be assisted before him. In fact, number "2" can be read in several ways, like "2,0000", for instance. We found the situation funny and very entertaining. (P7.G4)
2. In the first image, the boy was waiting for his new driving license. In the second image, we see that the clerk gave him the number 2. He thought it was a good number. In the third image, the boy was happy. In the last image, as he was heading for the queue, he realized that the person who was being assisted was number 0,1271. We found the situation funny because he thought number 2 was good, but it was not a big deal after all. (P9.G4)

Because resorting to these numbers is unusual, the students experienced surprise and some difficulties, for a few moments, in solving the task (especially questions 2 and 3).

In question 2, several pairs followed the same strategy as the P5 pair: they established a correspondence between this rational number and the sequence of whole numbers. Thus, they concluded

that 0,1271 corresponds to 1271 people (Figure 5). This strategy allowed them to answer question 3.

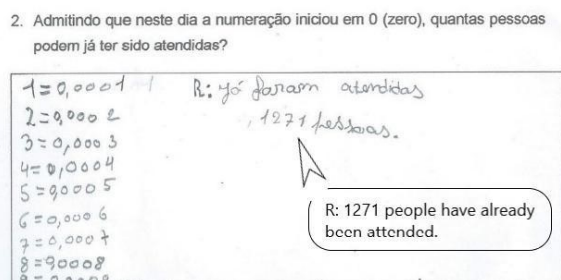


Figure 5. Answer of the P5 pair (grade 4) to question 2.

The following student's answer (Sn) illustrates the type of answers of most grade 6 students to the task "Geometry, what I want you for!".

- 1) Paige and her mother are two characters who are in the kitchen because the mother is trying to share a pie according to the request made to her, and is wearing an apron. On the strip, Paige is complaining because she considers that the mathematics that requires her to study at school, will not be useful to her in the future. The mother wasn't even paying attention to Paige, because she was worried about trying to share her pie. In Paige's thought, mathematics is not important and does not apply, except in a profession related to the area. But, unintentionally, she solves, for her mother, a mathematical problem of everyday life. She realized that by using mathematics, she has helped her mother. For this reason, she tries to disguise it, but, soon after, she is faced with another problem that she has to solve. The situation is funny because, without realizing it, she is already responding and helping her mother, using mathematics.
- 2) Paige is not right because mathematics is important in everyday life, since we are confronted with it everywhere.
- 3) The solution found is correct, because if the pie is in the shape of a circle, that has 360° . and if we divide it into 5 equal parts, each part will have 72° .
- 4) In order to ensure that Peter's slice is twice the size of others' slices, Paige's mother will have to divide 360° by 6, which is 60° and then multiply by 2. Thus, she would have four slices with 60° and Peter's slice would have 120° . (S11.G6)

Analyzing the written communication produced in the resolution of the two tasks, like with the others tasks, we noticed that students produce very long and cohesive answers to the first question "Describe the situation presented in the comics. Why can the situation be funny?". The structure of the comics

description provided by the teachers, based on the book "Humor to learn Mathematics" (Menezes et al., 2020), strongly contributed to this result:

- Environment (in what context / scenario do the events occur? What are the elements of the comic strip that make us identify this scenario?);
- Subjects (who are the characters? What is known about them? What do they represent?);
- Action (what happens?);
- Shock of expectations / unexpected ending (what causes humor? What is the circumstance that makes the situation funny?) (p. 7).

In describing the situation, students identify the environment / scenario in the two tasks presented, as being familiar to them, the same applying to characters and to the action. The shock of expectations / unexpected end is acknowledged by the majority of students in the proposed tasks, a fact that leads them to identify the humorous situation and to consider the situations funny.

In all tasks presented by teachers, mathematical knowledge is essential for students to interpret situations and "to solve" the unexpected end, which leads them to have fun and laugh. That is, the students had to be mathematically competent to laugh.

This mathematical competence of the students is noticeable, both in the first task (4th grade), as far as numbers are concerned and in which students are able to establish a "bridge" between whole numbers and rational numbers, and in the second task (6th grade), in Geometry, which consists, initially in dividing a circle into equal slices (central angles).

Differently from what happens with many school mathematical tasks, in which the mathematical contents are explicit, the comicstrips books portray hypothetical situations of everyday life (some of which are absurd, for humorous purposes) in which students must be able to identify and use mathematical ideas.

The 6th grade task: "Geometry, what I want you for!", helps students to appreciate and to value mathematics and to change their mind about mathematics not being useful in our daily lives, when led to reflect and to write about an absurd idea, but that is shared by many students all over the world.

So, in neither case, do the tasks correspond to a simple exercise. Due to the fact that they pose an unexpected situation to students, which causes strangeness and surprise, it leads them to a more in-depth interpretation, which results, largely, from the fact that students started by writing about it.

As we know, research has shown that most of the difficulties that students experience in problem solving arise in the first phase, which involves/requires an understanding of the statement of the task. This work of writing about the

understanding of the situation, can be a great help to the activity of solving mathematical problems.

VI. CONCLUSION

In this exploratory study, we focus upon the impact of tasks based on graphic humor in the written communication of students at the end of primary school (4th and 6th grades). Assuming the close link between communication and learning mathematics, we are also interested in the consequences of graphic humor in learning mathematics.

The first conclusion to be drawn is that the students welcomed the proposed mathematical tasks based on graphic humor (comicstrips), which resulted in their great involvement and in the mathematical writing of highly expressive texts.

Secondly, despite the fact that the students were unfamiliar with the first humor-based tasks, because they were not familiar with mathematical problems based on comicstrips, and even less with humorous situations, they were progressively showing that they found it funny (laughing and writing that they appreciated the humor).

It is emphasized that the use of humor did not cause any special embarrassment to teachers, because the proposals were written. Research shows that the fear that some teachers have in resorting to humor in their classes stems from the fact that it is often only oral, that it may not work and that teachers feel they have no sense of humor (Banas et al, 2011; Martin, 2007; Martin & Ford, 2018).

Third, the description of the images, as Burton and Morgan (2000) point out, contributed to the writing of the texts and this was important to enhance students' mathematical understanding (Martin, Polly & Kissel, 2017; Morgan, 2002). This understanding provided by writing, supported by the description structure Environment – Subjects – Action – Shock of expectations / unexpected ending (Menezes et al., 2020), proved to be decisive for the resolution of the tasks. Finally, we think that the use of tasks based on graphic humor, which surprises students and leads them to communicate (in writing, firstly, and then orally, in collective discussions), to reason and to solve problems, involving different mathematical content, is a powerful way for the learning of mathematics.

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