POETIC MATHEMATICS - A PROPOSAL FOR LEARNING MATHEMATICS

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Abstract

Our world is in constant change, which creates new situations and leads to the search of new answers. The education system field is without any doubt our best ally concerning the individual training, the relations between questions and answers, problem solving and strategies, goals and results, all this must be constantly analysed. Being conscious of the contemporary look, we realize the demanding challenges of this professional universe and the growing tendency of social relations development. This challenge must be given to social responsibility on that matter. School is expected to generate individual autonomy, cooperation, creativity, entrepreneurship and leadership, and no longer to be focused on the best grades or on the most competitive. In this perspective, teaching that privileges the knowledge by compartments and the technical and cognitive rigor, to the detriment of the affective-emotional dimensions, does not compete for the achievement of what is recommended in the students' essential learning and demanded by society. Despite being present everywhere, Mathematics has always been distant from the mother tongue language, which in turn played an even greater remoteness with this science. In order to fill in these gaps the present paper illustrates an interdisciplinary approach by crossing the poetical text potentialities with mathematical contents. It is in this mixture that mathematical poetry is born, without losing the playful and aesthetic sense of poetry; it intends to promote and to offer a new perspective in mathematics learning. Through poetry reading and writing habits are promoted, sensitivity is awakened and creativity is sharpened, all essential skills to mathematical reasoning. Reading and writing allow us to understand and communicate; the sensitivity allows us to be sensitive and critical of reading between the lines heading to abstract thinking; creativity allows us to be creative, to figure out other strategies and formulate new hypotheses. In this sense, this paper serves two purposes: the first one – to make a reflection about poetic text influence in childhood and its presence in school, defending mathematical poetry as a possible path to follow. The second one introduces some tasks that were conducted following this idea in the Kindergarten and in the 1st grade of Primary school in a context of teaching practice.

Keywords: Mathematics, poetry, teaching practice; kindergarten; primary education.

1 INTRODUCTION

Mathematics should be accessible to all, not just an elite. And reaching everyone, it calls for different ways of thinking and acting. In this sense, we believe that literature, especially the poetic text, may be one of these innovative ways. In [1] particular curiosity refers to the statement that Salomon Bochner, a well-known mathematician and student of linguistics, observed that the original meaning of the word mathematics referred to something that was made, manufactured - this meaning was changed in Plato's time, not only because this definition is extensive, but because it also resembled the meaning attributed to the poetic word, of its origin something that was made, manufactured, achieved. Such curiosity allows us to conclude that 400 BCE, poetry, and mathematics shared the same meaning. This article does not aim to prove the fact highlighted by [1], because, we believe, the attribution of the same meaning is not viable and is not justified currently but we already know.

However, it seems to us important to start it in this way, so that the idea that there are more similarities than the many differences attributed to them is visible. We thus reflect, at this point, on the connection between mathematics and poetry, briefly addressing what, from a reasoned point of view, can justify this relation and its positive presence in the classroom. But even before presenting this alternative called poetic mathematics, we turn to the current challenges in the teaching of mathematics.

This stage of analysis of the current panorama, perceiving the difficulties and analyzing the recent changes, is what leads us to propose a strategy that meets what is currently required. In order to trace this path, it is necessary to consider the influence of poetry in childhood, to reflect on its presence in
school, to perceive the benefits of this contact which, although not perceptible, begins in the first minutes of life. Finally, two practical examples of the application of this strategy are presented, one aimed at pre-school education and the other for the first grade.

2 POETRY - FROM BELLY TO FREEDOM

The child discovers the language world from the first instants of life, in [2] arguing that this language is essentially poetic, marked by the songs of wrapping and the structure of verbal intuition. Inspired by the myth-poetic nature of man, the author affirms that the mother-child charge is the antechamber of language, the first and fundamental step towards poetry, followed, of course, by a second: as songs and imitation, quite common in children's play.

At that moment, intrauterine, the baby does not understand the words he listens to, but feels the sound waves sent by the mother's voice. This contact is usually the result of positive and tender emotions. In this perspective, in [3] it is emphasized that the moments in which the rhyme was present in the life of the baby, when associated with compensatory and gratifying situations, will be present in the memory of the child who, will progressively try to reproduce it. It is through this imitation and also of formal recreations, which results the linguistic development.

In chronological terms, the same author ([3]) states that interest in rhyme arises in the sensory-motor stage (up to two years) and that, once it is achieved, it adapts itself to the needs of language learning, the more complex the relations between movement, rhythm, sound, and words become. In the post-operative stage, verbal rhyme reproduction is increasingly accurate, the child already assigns it a subjective meaning and is curious to try to understand its meaning.

Poetic language, so full of expressive resources, arouses the interest of children, for just as poetry needs metaphors, the child also invents new words when he can not find in his lexical field the word or words appropriate to a situation or representative of a certain image ([3]). Poetry thus becomes of crucial importance in the early years of life.

3 POETRY IN SCHOOL – PRESENCE OR FAILURE JUSTIFIED?

Literature and, in particular, the poetic text helps in the development and consolidation of several competences: linguistic, cognitive and emotional. However, the place of poetry in school was, and remains, a topic of debate.

In [4] it is concluded that the dialogue with teachers showed that there is poetry in the classroom, especially when the mediators are also lovers of poetry, so that they can transmit the taste for it. They recognize that the presence of this artistic language is not yet desired, but it is already possible to verify a growing interest of the professors in embracing the cultural capital that the poetry includes, thus recognizing the pedagogical and educational values.

When thinking of poetry in the School one can think of this as a pedagogical tool. Poetry allows the creation of an intimate environment that can help in the overthrow of concrete walls, that is, the idea that education is based on the standardization of the individual. Poetic writing leads, naturally, the human being to his relaxation and happiness because only in these procedures it develops ([5]). It is considered, therefore, that the development of poetry in the school environment will serve as a lever for the deconstruction of fears, anxieties and anxiety. In this way, the child is completely permeable to the reception of new information, new sensations and, above all, allows to play.

In this way, the union between poetry and education can be considered as an enriching path to learn and teach, to express feelings and wishes, to live with others in a democratic way. This is because what education receives from poetry is invaluable, and is called art ([6]). Linked to the field of emotions and aesthetic values, art invites us to the imagination. To value imagination in school is to overcome the division that has been established between emotion and intellect. Thus, our emotional sphere is connected with our imagination and this, in turn, with our intellect. There is no way to construct knowledge, isolating it from our emotions ([5]).

4 POETIC MATHEMATICS

We believe that this link between mathematics and literature, imagination and reality can be a way to motivate and learn mathematics, meeting current challenges - promotes articulation among knowledge, stimulates creativity, awakens sensitivity, develops the language of everyday life, brings it
closer to scientific language, works on mother tongue skills so essential to understanding concepts and contributes to a humanistic view of mathematics.

Mathematics is a human endeavor, and for this reason it has always been with us, even though this term - humanistic mathematics - is very recent ([7]). Poetry can contribute to the learning of mathematics, for two purposes: the first, related to a new type of cognition, based on metaphors, which encourages students to explore, discover and reformulate mathematical ideas; the second, more directed to the writing, since in writing poems, the child feels the courage and confidence to express his ideas, namely, the mathematics, in approaching the scientific language, works the mother tongue skills so essential to the understanding of the concepts and contributes to a humanistic view of mathematics.

In this way, through these purposes, the child can understand the ideas in a way that had not previously considered, in itself, this fact, stimulates the creative capacities. Both poetry and mathematics serve a transcendent purpose in the sense that they both live on ideas, images, and metaphors, and either of them, though through words, serve to say exactly what words can not. ([8], [9]).

Those who are not involved in mathematics have difficulty recognizing that it is, in the end, a creative effort and that, therefore, is based on a model that propitiates human activities, since it involves the three ingredients that distinguish us from other species: cognition, awareness and creativity. We are not just omnivorous, bipedal, homosapiens talkers, but creative and intelligent humans ([20]).

Poetry shares, with mathematics, the three supra-referenced ingredients: cognition, consciousness, and creativity ([7]). For this reason, mathematical poetry is a model to consider when we want a more humanistic understanding of mathematics. According to a more common definition, poetry is essentially linguistic. In the same way, mathematics depends on the use of language, although both can be conceived without or before language, only words can be transmitted in their fullness. Believing that scientific language is the only vehicle of knowledge becomes problematic, and for this reason it is urgent to explore the potential of other forms of representation in education ([8], [9]).

Poetic language involves and captivates the child because, in its composition, there is a privileged place for fun and for rhythm. ([4]). By the message that transports, poetry is considered dream-language, a complement of soul to the child because it is demarcated from simple recitation by recourse to memory ([5]). In its original source, poetry uses imagination and it can be said that imagination is not assumed exclusively as a resource but also as an end in itself: it is the goal of poetry to stimulate imagination. In childhood, the absorption of the real passes, several times, by transference to the imagined - the child has in himself the possibility of creating worlds parallel to his own and creating his own reality ([5]). With regard to education and, more specifically, to mathematics, poetry can function as a motivating factor and more active participation in the classroom context. This possibility is related to the fact that poetry is so linked to the field of emotions, rhythm, music, which will provoke positive feelings to those who experience it.

“What does mathematics have in common with poetry? One answer would be that both mathematics and poetry are searching for hidden patterns. The mathematician, like the poet, is trying to find concealed mechanisms beneath external appearances”. Both seek the inner logic of things “And what poetry does to emotions or human cravings, mathematics does to order in the physical world. It tries to find the internal logic of things” (p. 5 of [10]).

Beauty, as far as poetry and mathematics are concerned, is based on complexity. It is in the complexity that closeness and seduction become possible. And in this sense, he recalls that for this reason we do not get tired of reading certain poems we already know, listening to songs like Mozart’s, and being surprised by certain mathematical arguments. This ability to read between the lines, to think beyond the obvious is that it holds us, conquers us and makes us appreciate sublimely art and science.

The abstract face of mathematics and its challenges can receive clarity and originality that poetry, through emotions, evokes. Whether it be a poem as a motivator or to complete a math class, in either situation it may offer the class a different perspective on facing this science. Children's posture and receptivity to the contents explored are positively influenced.

It is important, however, to recall, as we have already said, that the consistency of poetic work in the classroom is enriched when the mediators of this contact are also lovers of poetry, in order to show this affection ([11]). The same authors therefore warn of the teacher's need to have reading habits and risk writing a poem, reading and being able to share it with the class, because this will transmit
confidence to those who listen to it. Poetry is needed to fine-tune the ability to see beyond, this implies, to observe with attention, to question, to formulate ideas, to explore sounds, to find images. And all these actions are fundamental, both for the child and for the adult.

The present society is abundant in information and the vehicles that lead it. As in no other age, we live in the age of communication and, therefore, the extreme need to look at literacy levels is also justified ([3]). For the author, writing and reading, more than instruments for working and enjoying, are the ways that most enable us to become informed and active individuals. In general, students have a tendency to only read what the teacher writes, without questioning, without participation ([12]). This fact reveals a communication problem, approaching the socio-historical perspective of learning, in which the teachers speak and the students listen ([13], [14]).

It is understood, therefore, the importance of communication in mathematics classes. The essential element in teachers' learner practices is precisely communication and that as far as mathematics is concerned, student knowledge is often influenced by the nature of the communication / interaction situations that occur in the classroom. In this sense, valuing this line of thought, a mathematical education characterized by the relations of the subjects with the world, with others and with themselves, in processes of social interaction ([15]) is considered.

Thus, recognizing communication as fundamental in teaching, it becomes relevant to rethink the teaching of mathematics and to combat the myth that communication practices are mere instruments for the teacher. Communication is inseparable from learning mathematics ([15]).

Poetry, in turn, spans a communication, since it allows an aesthetic experience that expands its existence and, as it refers [16], with this, it interweaves the knowledge and the sensitivity for a construction of an open, living knowledge, which propels the imagination to something new and that, awakens us to things that are not seen or said.

5 A POSSIBLE PATH

One of the projects that allowed this efficiency to be completed was Michelle Piwko as a promoter. A teacher of basic education at a school in Michigan, she conducted an investigation into the link between literature and mathematics. Using a book that described the properties of objects, simply and in verse, it was able to capture students' attention and inspire them to write their own poems. The style of language aroused the interest and the will to reproduce something similar “When Michelle read the book aloud, the children were immediately attracted to its patterned language (…) They wanted to use short phrases, like the author did, and they wanted their first lines to be repeated in the last lines” (pp.2-3 of [17]).

Each child had a geometric concept, on which he should gather a list of properties, before moving on to the construction phase of the poem. After the writing, the revision phase was given, promoting the debate of ideas and the correction of felt difficulties. Finally, the students used the computer to compose the poems, illustrating them later. The study allowed us to conclude that learning language and mathematics is much more effective when it occurs through meaningful experiences and that “This kind of integrated curriculum and learning is essential for long-lasting understanding” (p.8 of [17]).

Another experiment was carried out by [7] who, through poetic mathematics, emphasized the humanistic aspects of mathematics, and observed in students a posture of interest and enthusiasm in the face of experience. In 2013, at the seminar he taught entitled “Can Zombies Do Math?”, he invited his students to write, individually or in teams, mathematical poems.

The motivation was visible during the creative process, and the involvement in the writing phase as well as the reading, made some students discover the taste for poetry. Poetic math can thus be the ambassador of humanistic mathematics, because it combines inspiration and emotion with the discoveries of the mathematical world. He considers that this union demystifies the view that mathematics is a sad and unattractive science ([7])

Poetry and mathematics, poles said opposites. In the first instance, they live in distant universes. The first is linked to emotions, symbolism and metaphor. The second is based on rules and equations. But by analyzing in detail, both have in common the language skills, whether the language of the verse or the language of symbols and signs.
6 EDUCATIONAL EXPERIMENT IN THE CLASSROOM

Two practical examples of the application of poetic mathematics are presented, the first one directed towards pre-school education and the second one destined for the first grade.

6.1 Poem In my big heart

Summary: The poem In my great heart reflects on the different emotions that we experience. In order to work on this theme, so crucial to the healthy development of each child, we decided to write the poem by combining it with the development of mathematical notions. To do this, with inspiration in the different emotions that we feel and resembling them to animals and objects, we created metaphors that were illustrated, by the children, through figures constructed with tangram.

In my big heart
There is a small house
In my big heart
where does a bird live
Called emotion
When I’m sad
The bird becomes a grinning cat.
What a mucky scratch
my heart
When I’m angry
the cat becomes a sulky duck
that in the middle of so much quack
leaves my heart angry
so angry
That I get seasick
like I were in a boat
shaking on one side
to the other side
on one side
to the other side
with so much shaking
I get confused and ashamed
and the boat becomes a fish
in a little skill fish
and when I get scared
the fish
becomes a rabbit
that hides everywhere
I’m like this
a child full of many emotions
each with its value
I learn to deal with all of them
because I’m educated with great love

Description: The children listened attentively to the poem, read aloud, and shown on a block of A3 sheets. Each sheet corresponded to an emotion and, therefore, to an image that only had the outline, so as to guide the children to complete it. For this process, several complete tangrams with colored papers were constructed.

After reading and interpreting the poem, each one shared the emotions he had already experienced. All the children felt comfortable to share with us, both the positive and the less good emotions, giving concrete examples of the day to day.

This dialogue has also helped us to draw up strategies for resolving conflicts. We divide the children into groups and, taking care to always create heterogeneous groups, so that, for example, always having older boys with younger boys so that some can help others. Each group illustrated a figure,
functioning almost like a puzzle, since they had to figure out where to fit each geometric shape. We worked the count, by the number of pieces that each one took, the sizes, the forms and the colors. (see figure 1).

Figure 1 - Illustration of the poem with tangram

6.2 Circular Poem

Abstract: The Circular poem arises with the intention of approaching the money with the children. It is a simple poem that summarizes the main aspects to know on this subject: its usefulness, its function, its management, notes and euro coins.

It's to sell
It's to buy
Circulating banknotes and coins

- It's to trade
- It is to save
- Want to win
- And do not miss it!

There are seven banknotes
Of different colors,
Circulating, Circulating, Circulating
They're not the same
Some are worth less
And others are worth much more!
5, 10, 20
50, 100
200, 500
This one knew well, well, well!
Eight coins,
All different,
Cents and Euros
That make us happier!

We already know how to count money,
Let's save it in the piggy bank

Description: The activity began with the oral presentation of the poem Circular, related to unit of measurement - money. We gave a poem and then explored, in a large group, the concepts / ideas expressed in the poem, outlining the answers the students gave to the questions:

What is money for?
What shape does the money have?
What notes and coins are there?
What distinguishes notes and coins?

Then we explained to the group that the circular poem could be sung and for this we showed a video clip with the music constructed through the poem. The reaction of the children was very positive, since
they easily recognized the melody used and appreciated the fact that the trainees are the protagonists of the video. We played the song twice, taking a few pauses to teach the students each part of the song. They quickly decorated the lyrics and were excited to sing. The second stage of this activity consisted of the game We already know how to count money. On a scoreboard were 21 cards with different colors and letters (see figure 2).

![Figure 1 - Game We already know how to count money](image1)

On each card was a challenge that each student should read and solve, orally. After the challenge was resolved, each pupil was assigned a "piggy bank" (with assorted coins) and a sheet with the representation of the various coins. The task consisted in identifying and distinguishing the different currencies and their counting (figure 3).

![Figure 2 - Cube Piggy Bank](image2)

It was also realized a game with the name of buy and sell that passed to the following week. At a table, different school supplies were arranged, with corresponding prices. In pairs, one student represented the buyer and the other the seller. Using the money from the piggy bank, each student bought one of the exhibits.

The children question the prices, count the money, check if they can buy one or more objects, receive the change and confirm if it is correct. In this way, we address the importance of managing money, of setting priorities. Some of the children bought only a more expensive object (for example, the notepad), others preferred to bring only a pen. We explained that in real life we should be concerned about checking the money we have and what we really need to buy. Finally, with all the cubes a score is made, as you can see in figure 4. The children verify that the cubes have all a letter and that, together, formed the phrase We already know how to count money.

7 CONCLUSIONS

Poetic Mathematics was the result of many uncertainties, but also a lot of affection for the theme. Initially, doubts were related to the aesthetic and playful vision of poetry, fearing to damage such attributes by connecting it with the rigor of mathematical knowledge. However, the union became perfectly plausible, without compromising any of the parties involved.

It is important to reflect on two prisms: that of the educator / teacher and that of the child / student. In the first case, we consider that our delivery was based on motivation and enthusiasm, not only for the sake of trying something different, but also because of the affective approach we nurture through poetry. In the case of the pupil/child, we observe the curiosity and the growing interest in discovering new ways of interpreting the mathematical contents, through the rhythm, the sonority and the ideas in the words.

We also realize that it is not necessary to write mathematical poetry, at the risk of forcing something so natural, but rather to explore the mathematics that may exist in poetry. And we conclude that yes, mathematics exists in poetry, because both resort to images and creative thinking. In this way, poetic
mathematics extended to all areas because in it there was always the concern to observe the poem as a whole, made of many parts

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