WRITING TO LEARN: FROM STORIES WRITTEN BY CHILDREN TO MATHEMATICAL CONTENTS

H. Campos1,2, S. Oliveira1

1Universidade de Trás-os-Montes e Alto Douro (PORTUGAL)
2CIDTFF – Centro de investigação em Didática de Ciências e Tecnologia na Formação de Formadores (LabDCT – UTAD) (PORTUGAL)

Abstract

This work intends to encourage the practice of new and motivational approaches to learning mathematical contents. A negative connotation is commonly attributed to this area of knowledge, often defined as difficult, without connection to reality and excessively based on exercises, calculations through techniques and algorithms, whose common understanding is within reach of only a few. Therefore, aware that mathematics should be a science for all and in order to perform a paradigm shift, this paper deals with the use of stories written by children as a promising resource in learning mathematics. Learning mathematics, based on children's stories, offers students the opportunity to understand what they are studying by familiarising them with the mathematical language contained in stories, enabling cognitive relationships to be established between the mother tongue language, real-life concepts and the formal language of mathematics. Furthermore, it fosters the development of skills in the field of writing, critical thinking, mathematical vocabulary and problem solving. In this context, in addition to reading children's narratives, students should be involved in the production of stories that have mathematics as their theme, exploring their imagination and creativity. Writing is a means that allows students to improve knowledge and reflect on their understanding of mathematics, helping them to identify links and clarify concepts. Therefore, a study was carried out with 13 pupils of the 1st grade, in order to answer the following research questions: How do these students write a problem? What characters do they use? What vocabulary do they use? How creative are they? A qualitative methodology was used to study the participants’ writing of problem statements for which only one operation was given in one task which we called The Inventor student task. Those answers were subjected to content analysis. This study concluded that the participants demonstrated clear notions of the structure of a problem, creating well-organised statements, with a question properly formulated and contextualized with the data provided. One might argue that those students used simple, yet correctly appropriate vocabulary, even exceeding expectations for this age group.

Keywords: Interdisciplinary; mathematics; written communication; writing to learn.

1 INTRODUCTION

The failure in the area of mathematics is an old problem that troubles teachers and educators. Research in mathematics education points to complex causes, alluding to a fractured view of mathematics by teachers, leading to mathematics being presented as an area of knowledge apart and not accessible, not easily integrated into other knowledge([1]).

The solution to this failure involves a paradigm shift at the level of the education system itself, which passes, particularly, for a change in the methodologies adopted. In this sense, we obtain a greater motivation on the part of the students, admitting a more integrated learning, in which we understand the connection of mathematics with the other areas of knowledge.

In this way, the present article intends to explore, from a theoretical point of view, the relation between children's stories and the learning of mathematics, exposing the way in which children's stories can potentiate meaningful learning in the domain of this area of knowledge and, contribute to the development of transversal skills, more specifically, mathematical communication.
2 CHILDREN'S STORIES - A COMMON CHAPTER IN THE STORIES OF EACH ONE

The mystery, the fantasy and the symbolic nature reign in the world of stories, which allow the child to awaken to the world, become aware of their emotions and be able to manifest them. The child, in expressing his emotions, explores himself, those around him and the world in which he lives, which allows him to have a greater knowledge of his experience ([2]).

Children's stories are a common chapter in one's stories, they are part of childhood, and have important educational functions, since they constitute a universal cultural element ([3]). Children's stories are essential to the development of language, but also to delve into creativity and imagination. Moreover, they assume a global theme, insofar as they address different themes that can be explored in the different areas and curricular domains ([4]).

The interactions, communication, representation and expression of thoughts, feelings and experiences are enhanced through language. Stories play a communicative role with others and themselves in affective, social and cognitive dimensions and the use of stories and their languages allows richer and more varied communication procedure. In addition, the stories that awaken the development of cognitive functions for thought, such as illustration / text read or narrated, hypothetical thinking, logical reasoning, divergent or convergent thinking, spatial and temporal relations (principle, middle and end) ([5]).

One of the main advantages of telling children stories is that in this way they are able to contextualize their learning, giving them meaning([6]).

Children's stories support two functions: that of entertaining and developing the child's creativity and the formative one, in which the child is supposed to learn and preserve values ([7]). Moreover, the story is not just a vulgar form of distraction; it reflects an essential and powerful structure through which we attribute meaning to the world and to experience ([6]). In fact, the potential of children's stories operates at various levels, in particular, in the development of capacities such as imagination, freedom, autonomy and creativity, as well as a greater capacity for reflection regarding the ability to fulfill civic duties, through active participation in today's society ([8]). It should be added that stories allow the child to fantasize and deal with some of the anguish of everyday life, learning to reflect and accepting varied situations, and also to develop his logical thinking and critical spirit through manifestations of humor and satisfaction of your natural curiosity ([9]).

Children who regularly listen to stories refine their attention, develop oral and written language, broaden their vocabulary, and learn to search the books for new stories for their entertainment. Each book presents itself as an indispensable tool for the intellectual, moral, affective and aesthetic formation of the reader and for the development of the capacity for understanding and expression. In the child, the habit of reading awakens and stimulates the imagination, fosters and educates the sensibility, provokes and guides reflection and cultivates intelligence ([10]).

Having the habit of reading offers better writing, greater ease of expression, more accurate textual interpretation, and sharper argumentation. In this sense, the stories function as a kind of launch pad that encourages children to enter the world of reading and writing, and above all, to do it well ([3]).

3 FROM CHILDREN'S STORIES TO MATHEMATICS - A STORY WITH A HAPPY ENDING

Mathematics and literature are two areas that in school terms have rarely been interconnected. This is not very understandable since, during the first four years of schooling, there is only one teacher, who is responsible for teaching both areas. If learning depends on the capacity of the connections that the learner is able to establish between their knowledge and the different areas they are studying, and also between them, then, promoting a fractional teaching, disarticulating the mother tongue of mathematics, inhibits this necessary connection of knowledge and, consequently, weakens learning ([11]).

On the other hand, mathematics and literature are, undoubtedly, in connection and provide one another with fundamental capabilities. If mathematics provides the literature with the structuring of thought, logical organization and articulation of discourse, literature, in turn, provides it with communicative capacities, namely, reading and interpreting texts, and also provides expressive abilities at writing, orality and, distinctly, discourse ([11]). In [2] the links between the mother tongue
and mathematics are endless, so storybooks are a means of facilitating the communication of mathematical ideas. Imagination, time, and a natural taste for reading present themselves as the necessary prerequisites for using children's stories in math classrooms.

Reading is a complex process and the ability to read is fundamental in learning mathematics. Some of the obstacles that students encounter when solving problems, and other mathematical tasks, result precisely from difficulties in the reading and interpretation of statements ([11]). Stories help students learn and do math, as well as explore places, traits, and events in history, allowing math and language skills to be developed together ([12]).

Through the use of children's books for math work, the teacher can initiate clear content, allowing the student an interpretation of problems, an understanding of the concept of space and quantity, stimulating speech, a socialization, a concentration, among others fundamental skills ([13]).

The connection of mathematics and children's literature, in the opinion of [14], gives students the opportunity to develop skills in writing, thinking, and knowledge of mathematical vocabulary, whether formal or informal. In addition, it develops problem-solving and problem-solving skills while constructing mathematical concepts. The use of children's stories can trigger group discussions and problem solving involving children, offering them the opportunity to expand their creativity, think of different ways to solve a given problem, and develop the flexibility of their thinking ([15]).

Linking children's stories to learning mathematics allows the teacher to create situations in the classroom that encourage students to understand what they are studying, familiarizing them with the mathematical language contained in children's literature, enabling the student to establish cognitive relations between mother language, real life concepts and the language of formal mathematics ([16]). Children, who learn mathematics through children's stories, demonstrate interest and motivation for learning, develop problem-solving ability, establish relationships between mathematical ideas and personal experiences, and consider mathematics a tool to be used in real life ([17]). In this sense, children's stories are recognized as a favorable resource in the promotion of taste and interest in this area of knowledge.

Making use of children's stories, the teacher / educator transmits and discusses mathematical concepts in a way that is more understandable to students / children. In this sense, when using children's narratives, it must take into account some important aspects, to know children's literature, becoming familiar with the diversity of the stories and updating themselves of the new works that are being published. In addition, it should make time for reading and talking about books, giving use to the library that should have several genres, namely information books. It should also allow time for children to explore and talk about them and to plan moments with literature, in a large group, in a small group, and individually.

They should also read the book in advance, as it is important that you get to know the story in order to explore better. In this way, it identifies topics, topics or issues addressed in the book, which will guide you in the experiences you want to provide students / children. It is also considered that the teacher / educator organize activities for three moments of exploration: before, during and after reading and, in addition, establish a climate of confidence for the students / children to feel comfortable communicating.([18]).

There is a wide range of children's literature available to introduce and explore specific mathematical ideas, and it is the responsibility of the teacher / teacher to select appropriate books for their group ([7], [18]). In this line, we present table 1 that consists of a set of criteria, supported in the studies developed by several authors ([18], [19],[20]).
Table 1: Criteria for selecting stories([18]).

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical Correction</td>
<td>The text and illustrations present the mathematical concepts clearly and do not contain any inaccuracies ([19], [20]).</td>
</tr>
<tr>
<td>Visual and verbal appeal</td>
<td>The book is attractive, featuring easy-to-interpret illustrations and simple vocabulary. It holds children's attention and allows them to become involved in the imaginary of history ([20]).</td>
</tr>
<tr>
<td>Diversity of contents</td>
<td>It is possible to identify, in history, a great diversity of contents related to the domain of mathematics and also with other domains ([18]).</td>
</tr>
<tr>
<td>Promotion of problem solving and mathematical communication</td>
<td>The text and illustrations provide opportunities for problem solving / formulation and subsequent resolution, fostering mathematical communication ([19]).</td>
</tr>
<tr>
<td>Factor – suspense</td>
<td>The book is marked by suspense, and the unfolding of the story is neither predictable nor expected. New ideas and visions are presented that children have never had contact with ([20]).</td>
</tr>
<tr>
<td>Connexions</td>
<td>The presented history enables connections not only within the domain of mathematics, but also between this domain and others, as well as between the domain of mathematics and real life ([19], [20]).</td>
</tr>
</tbody>
</table>

This use of children's stories in the mathematical approach reveals a change in teaching, it involves connecting mathematical ideas to reality; mathematical ideas with other areas; the topics, the representations and the mathematical concepts; and also explore problems and describe results, relating different mathematical models or not ([7]).

Mathematics is present in everyday situations, and it is therefore important for students/children to understand that mathematical concepts are necessary to solve real world problems. In this way, a relationship between mathematics and reality is determined, transforming real problems into mathematical problems that can be analyzed in the context of the classroom.

Mathematical stories are organized taking into account the criterion of identification and intentional use of mathematical models. The story is written, intentionally around a certain mathematical model, and the exploration is reduced to this model. Then the story is built on this clearly stated mathematical model, which is explored in whole or in part, throughout history. The author, in the history, also proposes ideas of continuity for the creation of new problems. History will then involuntarily include episodes in which contexts, for their mathematical value, are favorable to the formulation of problems, or mathematical investigations, meaningful to children. Also the illustration contains, independently, a mathematical model or suggests mathematical models to be explored, being or not in the intention of the illustrator. In addition, the illustration expresses, or complements, the text of the story, being closely linked. Thus, history and illustration potentiate interesting and significant activities from the mathematical point of view.

Of course, in addition to reading children's stories, an alternative is to propose to students the production of their own stories, because the appropriation of mathematical language is done through the development of oral and written communication skills. In this process of construction, it is fundamental to know the meaning of scientific terms, the symbols of the written mathematical language, as well as the meaning of common words and phasic structures used in communication ([21]).

4 WRITING TO LEARN - WRITTEN COMMUNICATION IN MATH CLASSROOMS

In today's society, society requires good oral and written communication. Due to this need, the schools need to enable the formation of reading, linked to the student's social context, for its effectiveness in knowing how to act, organize, criticize and appropriate knowledge ([22]). However, this task is not easy, because writing invokes a series of knowledge that relates to orthographic and grammatical aspects, with the choice of the subject that the student has to master in order to write, with the structuring of the discourse, with the organization and the progression of ideas. Faced with these factors, textual production in schools is often considered a complex and sometimes annoying task, especially when there is no reason to write. In schools it is written for the simple reason of exercising...
the writing, devaluing that its importance resides in the use that is made of it. The school should therefore consider the functions that writing represents: inform, convince, ask, emotion, act or interact, in order to motivate students and promote the taste for this activity (23).

The current paradigms of teaching and learning in the classroom have become paradigms of interaction. The negotiation of meanings has gained ground, both verbal and written. In this way, mastering how communication is developed, identifying opportunities for students to develop this ability, and knowing how communication is being used to promote learning in this symbolic and abstract area is extremely important (24).

We recognize the importance of communication because when students communicate mathematically, they remember, understand, and use prior knowledge in the acquisition of new ones, and oral and written languages are the means for students to reflect on their understanding of mathematics, assisting them to establish connections and clarify concepts (25).

Along with oral communication, in which students are expected to show their ideas, criticize the statements of colleagues, and the teacher, and express doubts, written communication appears as an integral part of mathematical activity. In this sense, students should be prompted to appropriately write their answers, adequately explaining their reasoning and presenting their findings clearly (26).

In order for students to acquire mathematical communication skills, it is necessary to give them time to confront arguments and to mobilize various strategies for solving mathematical tasks. It is by writing and talking about mathematics, making use of language, not only to express your thoughts, but to share meanings, understand arguments of colleagues and teacher, that these skills are achieved. Thus, the development of an oral language leads to the explication of the negotiation of meanings and written language leads to textual production (25).

Written communication requires the registration of ideas, through words and representations appropriate to the situation. Individually or in groups, it is fundamental that students can solve tasks that appeal to the development of their written production skills in mathematics, registering their ideas clearly, correctly and logically, appealing to different representations, justifying their reasoning and revealing understanding topics (27).

The writing plays several functions: the communicative, that was in its origin; the representative one, since we use writing to better identify the representations we make of the world; and the epistemic that, in an active interaction with the own thought, promotes the construction of the knowledge. These functions are fulfilled in a writing process to learn (28).

As with other areas of knowledge, textual production in mathematics offers students the opportunity to use skills such as reading, listening, observing, questioning, interpreting, and evaluating. Writing admits metacognition, insofar as the student reflects on one's own thinking and becomes more aware of what he or she accomplishes and learns (28). However, writing in mathematics classes should not be designed in an arbitrary or improvised fashion, but in a way that is articulated with the texts read by the students, so that students can increase their learning (29).

Speaking and writing mathematics, in order to share interpretations and meanings, discuss arguments, whether with the teacher or with colleagues, allows students to develop mathematical communication skills. In this way, the challenge passes through the gradual appropriation of the language proper to this science. Whatever the year of schooling, students should be encouraged to communicate mathematically with each other and with the teacher so opportunities arise to explore, organize, and compare their knowledge and opinions with new insights and insights about the same mathematical content (30).

It is noteworthy that the use of writing in mathematics classes makes it possible to organize reasoning, insofar as it allows one to elaborate definitions using his own words and to construct examples, that is, "to structure what we have already mastered, to expand understanding, to create connections and to confer new meanings to already established concepts (31).

Proper writing in mathematics classes should be explored in an interdisciplinary way to promote a stimulating and continuous work and should also contribute to demystify the idea that mathematics is a cold science, distant and without space for creativity, and therefore, to elicit in students the same, or shore, enchantment than other areas of knowledge (32).

Analysing the textual productions of the students allows the teacher to intervene assertively, since the students’ perceptions about the subject they write reflect their achievements and their incomprehension, which is part of the representative role of writing (28)). In this sense, written
communication in the area of mathematics is a didactic tool to consider, which has gained prominence in recent years in research in mathematics education ([20], [24], [33], [34]).

5 THE PRODUCTION OF STATEMENTS OF MATHEMATICAL PROBLEMS BY STUDENTS OF THE FIRST GRADE

Problem solving, theorized by Polya ([35]), integrates a fundamental aspect of mathematical activity. For the teaching of problem solving to be enriching, it is essential that it be combined with the teaching and development of mathematical problem-solving capacities ([35], [36], [37]). In this context, problem solving is an extremely important activity, insofar as it contributes to the understanding of the processes involved in solving problems, as well as the deepening of the mathematical concepts involved ([36]).

In the formulation of problems, the student is encouraged to problematize everyday situations, using his own language, experiences and knowledge. There are some strategies that aim to facilitate the process of problem formulation: What if instead of related to the modification of problems by students; and, accepting the data, directed to the creation of problems by the students ([36]).

The teacher, during their professional practice, uses these strategies for different purposes: for example, to promote extensions of a particular problem adapting it to specific goals and contexts. Also, to simplify or enrich a situation, to evaluate the quality of the problems formulated by the students, using the attributes of the problem, the problem structure and the conventional language used, as criteria ([36]).

In this last purpose, we carried out a study, based on the Students inventor task, carried out in the context of the 1st year of schooling, in which the students invented the statement of a mathematical problem, using some indications.

To do this, we selected the following research questions: How do these students, from the first year of school, write the statement of a problem? What characters do they use? What vocabulary do they use? How are they creative?

The realization of primary education as objectives: to understand students’ conceptions of problems; find out how they build or enunciate; check the instructions given and how they do it; analyze whether to write a direct utterance or use more elaborate text; and check creativity.

6 METHODOLOGY

The study was carried out with 13 students from the first year of schooling. The methodology used was of a qualitative and interpretive nature, resorting to case study design ([38], [39], [40], [41]). In the data processing, related to the analysis of the statements, the content analysis was used, formulating categories of analysis a posteriori([38]).

The data collection was done from the statements produced by the students, in the referred task. After the collection, we continue to process the information collected, which represents the situation in question. In case of doubt about what the students wanted to write, we asked them to clarify the situation. In this phase, the data were identified, organizing the database, from which the following phases were developed.

From this study, two categories of analysis resulted. The first, Direct statement with at least one character (see example, Table 2), brings together two subcategories: with an emphasis on text and with emphasis on calculations. The second, Statement with a more elaborated text (see example, Table 3), groups three subcategories: From the end to the beginning; direct; and, decomposed, as shown in table 4. In addition, there is also the relative and absolute frequency of each of the categories and subcategories, allowing a simple statistical treatment.
Table 2: Element representing the direct enunciated category with at least one character

<table>
<thead>
<tr>
<th>Indications</th>
<th>Statement produced</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Characters:</strong> Martim.</td>
<td></td>
</tr>
<tr>
<td><strong>Theme:</strong> Penguins</td>
<td></td>
</tr>
<tr>
<td><strong>Operation:</strong> 2 + 13</td>
<td>Martim has 2 penguins and her mother has 13. How many penguins do they have?</td>
</tr>
</tbody>
</table>

Table 3: Representative element of the category enunciated with a more elaborate text.

<table>
<thead>
<tr>
<th>Indications</th>
<th>Statement produced</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Character:</strong> Hugo.</td>
<td></td>
</tr>
<tr>
<td><strong>Theme:</strong> bananas.</td>
<td></td>
</tr>
<tr>
<td><strong>Operation:</strong> 5+13</td>
<td>Hugo went to the store to buy 5 bananas and asked for another 15 to the neighbor. Then he ate 2 bananas. How many bananas did Hugo have?</td>
</tr>
</tbody>
</table>

Table 4: Categorization of the statements of the problems produced by the students.

<table>
<thead>
<tr>
<th>Categories</th>
<th>%</th>
<th>Subcategories</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct statement with at least one character</td>
<td>53,8 %</td>
<td>With emphasis on text</td>
<td>46,2 %</td>
</tr>
<tr>
<td>(7 in 13)</td>
<td></td>
<td>(1 in 13)</td>
<td></td>
</tr>
<tr>
<td>Statement with more elaborate text</td>
<td>46,2 %</td>
<td>With an emphasis on calculations</td>
<td>7,6 %</td>
</tr>
<tr>
<td>(6 in 13)</td>
<td></td>
<td>(6 in 13)</td>
<td></td>
</tr>
</tbody>
</table>

7 ANALYSIS AND DISCUSSION OF RESULTS

The Students inventors task required, on the part of the students, abilities of written communication, namely the organization and phasic construction. In order to elaborate, the students were based on their conception of mathematical problem and the indications provided, creating a statement.

In this activity, the students had to invent the statement of a mathematical problem and, later, to effect its resolution and illustration. However, this study aims only at the analysis of the statements. In this way, observing the written productions of the students, we see that the students have divided, almost equitably, by the two categories. While some produced a more direct statement, using one, or in some cases, more characters. Others were more literary, creating a more elaborate text.

The characters that the students used in their productions were: themselves, they and a relative; family members; they and a close friend; they and the trainees; and they are a neighbour. This analysis allowed us to conclude that, although these students are still in a stage of development marked by egocentrism, in which the self is very present, there are already changes in this behaviour in everyday situations; students use their own language, experiences and knowledge.

Analysing the productions of these students, we found that they revealed knowledge of reality, since the situations they created correspond to possible situations. With respect to the language used and the phrasal construct we found that the students demonstrated competences in writing, constructing well-structured and cohesive statements. In general, the students used the given indications, creating a situation in the real context. The presentation of the data and the question to the problem were well elaborated and clear for interpretation and resolution.
By problematizing everyday situations, students use their own language, experiences and knowledge. Analysing the productions of these students, we found that they revealed knowledge of reality, since the situations they created correspond to possible situations. With respect to the language used and the phrasal construct we found that the students demonstrated competences in writing, constructing well-structured and cohesive statements. In general, the students used the given indications, creating a situation in the real context. The presentation of the data and the question to the problem were well elaborated and clear for interpretation and resolution. In written communication, knowledge is needed at orthographic, grammatical, structuring and organizing levels of ideas. In this context, we recognize that these students revealed competences in writing, producing interesting, creative statements with different degrees of complexity.

In math classes, students' written communication can be distinguished by five usage patterns, taking into account the degree of importance to learning. In this context, we identified that the participants used three patterns: the direct use of language; the applied use of language, and the creative use of language.

This activity aimed at the development of imaginative and creative action, through the production of a statement. Observing the material, we found that creativity was present in all statements; however, there was a greater accentuation in the statements, in which students did not follow only the suggested indications.

Although these students often solved mathematical problems, the activity Inventors was the first contact with the formulation of statements. In this way, we expected the students to be guided only by the suggested indications, but they surprised with their capacity of imagination and creativity.

In their productions, the students used, in addition to them, close friends, family members, trainees and, as a neighbour, characters. This selection led us to conclude that, although they belong to a stage of development marked by egocentrism, it is perceptible that this behavior is dissipating, because they use a wider context, not being limited to themselves.

We recognize that these students of the first year of schooling demonstrated clear notions of the structure of a problem, creating well-organized statements with the question duly formulated and contextualized with the data provided. The students used simple vocabulary, however, correctly adequate, even surpassing expectations for this age level. Statistically, 53.8% (7 out of 13) of the students wrote a direct statement, and 46.2% (6 in 13) of the students produced a statement with a more elaborate text. Thus, we conclude that almost half of the participants formulated a more detailed statement, bringing to the context experiences, knowledge and creativity.

8 CONCLUSIONS

Mathematics is increasingly present in our day-to-day life, and it is therefore important that students/children have the possibility to know and appreciate this way of thinking. From a young age, in contact with the world, the child is related to this science, albeit in an unconscious and rudimentary way. Whether through play, observation, or communication, the child produces mathematical reasoning early. In this context, the child's exposure to favourable and stimulating environments is fundamental for an effective development of reasoning, logical-mathematical thinking, problem solving and the communication of ideas.

Communication is a fundamental axis in the teaching and learning processes, providing moments of argument and discussion. Through communication, the student interacts with the teacher and the other elements of the class, exchanging opinions, exposing their ideas and reconstructing meanings.

The development of students' communication skills, both oral and written, is an important curricular objective in the field of mathematics. When students communicate mathematically, they remember, understand, and use prior knowledge in acquiring new ones, thus acquiring meaningful learning. In addition, analysing the textual productions of the students allows the teacher to intervene assertively, since the perceptions they have about the subject they write reflect their learning and misunderstanding. That said, written communication should be a common teaching tool in math classes.
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