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THE USE OF THE HORIZONTAL ABACUS: REFLECTIONS ON TEACHING WITH A CLASS OF THE 5TH YEAR OF THE EARLY YEARS

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ABSTRACT
This work aims to report an educational experience in the early years of elementary school. Thus, the objective of this study was to investigate the contributions of teaching with the abacus to represent operations of addition and subtraction of natural numbers from base ten conversions. In the methodology, a literature review was adopted on the contributions of the abacus in the teaching of the decimal numbering system. The approach used to treat the results was qualitative. As for the objectives, the research is characterized as explanatory. About the procedures, a theoretical and practical class was worked on in a 5th grade class on the content of the decimal numbering system. The results obtained showed that the abacus contributed more significantly to the representation of addition and subtraction operations, in addition to providing more pleasurable moments of learning in the teaching of Mathematics. It is also noted that some students were able to perform the operations directly on the abacus, while others tried to solve it first mentally and only then act on the instrument.

Keywords: Abacus. Educational Experience. Mathematics Teaching.

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INTRODUCTION

The studies of Mathematics in the early years of elementary school are essential for a mathematical "literacy" for children who occupy this initial phase of basic education. In addition, there is a concern to prepare them for the following years by well-grounding abstract decimal numerical learning.

For this, within the teaching context, the use of didactic resources such as concrete materials such as abacuses are relevant as tools for the representation of operations such as addition and subtraction. Within the decimal numbering system, these materials play an important role, contributing to the understanding of how conversions between the orders and classes of the numbering system work.

That said, this research proposed to investigate the contributions of teaching with the abacus to represent operations of addition and subtraction of natural numbers from base ten conversions. As a way to verify the learning and teaching with the abacus, a class was taught with a class of the 5th year of the initial years of elementary school.

A qualitative approach was adopted in the methodology. As for the objectives of the research, the explanatory form was used in the approach to the results achieved. Regarding the procedures used for the class, it was separated into two teaching moments, the first being reserved for a review of the decimal numbering system with the students. Where the frame was used to perform the conversion of some addition and subtraction operations. In the second moment, two horizontal abacuses were used to verify the assimilation of the concepts presented in the theoretical part of the class.

As a theoretical foundation of this research, authors who have already focused on the use of the abacus for the teaching of the positional decimal numbering system were consulted. Some of these authors we mention are Carvalho (2022), Melo (2021), Cruz et al. (2019), Barbosa (2019), Imenes and Lellis (2021). Discussing the historical aspects of the decimal numbering system, we also cite Boyer and Merzbach (2012), as well as the National Common Curricular Base (BNCC) that supports essential learning ideas for the early years of elementary school.

THEORETICAL FOUNDATION

The idea of a decimal numbering system, which we have today, goes back to a Mesopotamian origin. According to Boyer and Merzbach (2012), the Babylonians and Egyptians had a numbering system with symbols, which, given the difference between cultures, had the same meaning. Hence the idea of positional numbering, like this:

> [...] The ancient Babylonians saw that their symbols could be given values that depended on their relative positions in the representation of a number. Our number 222 uses the same digit three times, with different meaning each time. Once it is worth 2 units, then two tens, and finally 2 hundred (i.e., twice the square of base 10) (Boyer; Merzbach, 2012, p. 41).

Therefore, since Babylonian times the relationship between a number and its digits could already be verified, in which the repetition of them and their different meanings according to the position in which they occupy is applied. It is in these terms that the instrument of position reading emerges, that is, the abacus. According to Carvalho (2022), the abacus appears in Mesopotamia approximately in 5,500 B.C.

The abacus is a wooden instrument in a rectangular shape with sticks in a horizontal position (Carvalho, 2022). According to this author's studies, on the abacus, we can represent the positions and decimal places as units, tens, hundreds, units of thousands, tens of thousands, and hundreds of thousands.

When dealing with the origin of the abacus, Melo (2021) inserts in his discussion that this instrument, known as a calculating machine, was invented by the Chinese, but that there were also records of similar instruments among other peoples such as the Russians, the Aztecs, and the Japanese.

For Melo (2021), the use of the abacus is born from a need that can be seen since antiquity. This need concerns the act of communicating a certain amount. Therefore, the abacus can serve as an important ally for teachers, both in teaching counting and teaching operations (addition and subtraction) in the early years of elementary school.

Contributing to this narrative, on the use of the abacus, Cruz *et. al.* (2019), when signaling the procedures and benefits of this teaching tool, describes that:

> Currently the use of the abacus is not necessary for a calculation as it happened in the past. Its main current utility is in mathematics classes, facilitating the understanding of the decimal system and providing a concrete approach to the representation of numbers, and also assisting in the operations of addition and subtraction (Cruz; Teodoro; Bonutti, 2019, p. 06).

The text above uses the expression "concrete approach" which, in other words, refers to the method adopted in the practice of teaching Mathematics in the school environment. Within the teaching and learning in mathematics, the methods with the use of visual and concrete resources are provided for by the National Common Curricular Base – BNCC (2018), as described in specific competence number 5, which aims to:

> Investigate and establish conjectures regarding different concepts and mathematical properties, employing strategies and resources, such as observation of patterns, experiments and different technologies, identifying the need, or not, for an

> increasingly formal demonstration in the validation of these conjectures (Brasil, 2018, p. 540).

Therefore, in order to fulfill this objective, the text of the BNCC points out some strategies such as the stimulus aimed at "research capacities and the formulation of explanations and arguments, which can emerge from empirical experiences" (Brasil, 2018, 540).

In this sense, for the development of this research capacity that must be developed by the student, the teacher needs to employ practical methods that help the interaction between abstract and concrete knowledge. It is at this point that the BNCC highlights the use of resources and materials in the use of Mathematics, thus proposing the use of "investigations and experiments with concrete materials, visual aids and the use of digital technologies" (Brasil, 2018, p. 540).

Regarding the use of the Abacus in the early years of elementary school, Barbosa (2019, p. 11) describes that "The abacus, being a manipulative resource, must be used in a way that is improved over time, and its use in the early years of Elementary School is indispensable". Therefore, the abacus is seen as an important concrete material in the teaching of Basic Mathematics, especially to work with operations and the decimal numbering system itself. In this sense, Barbosa (2019) also demonstrates that:

> With the use of the abacus in the classroom, the goal is to propose to students creative and even thought-provoking methods of dealing with numbers and their implications. Know how to represent the numbers on the abacus, be able to distinguish the absolute and relative place value of the digit. This internal procedure occurs right after the solidification of learning, as the abacus interferes in the process mentally, in order to perform the calculation several times, the knowledge is rooted and thus, the student leaves the support of the abacus and builds his reasoning in an agile way (Barbosa, 2019, p. 12).

Thus, the abacus helps to internalize in the student the idea of relative number and absolute number depending on the position that the digit occupies within a certain number. According to the BNCC proposal and the elementary school textbook of the early years, the abacus plays a more important role than the Decim or the Montessori material, both materials used to work the decimal system, thus:

> For an adequate work with these resources, it is essential to understand that both the decim and the Montessori material do not contemplate the most subtle aspect of our numbering system, which is its positional character. In this aspect, the abacus is superior to the two, as it represents the two main properties of the system, which are the decimal and positional characteristics (Imenes; Lellis, 2021, p. 51).

According to authors Imenes and Lellis (2021), Montessori material is also recognized as a golden material. The decim is a toy money that has a good acceptance among children.

Regarding the use of the abacus for the 5th year of the initial years, the BNCC describes that the objective of knowledge involves the "Decimal Numbering System: reading, writing and ordering of natural numbers (up to six orders)" (Brasil, 2018, p. 294).

Regarding the skill to be developed by the students, it is possible to mention the skill (EF05MA01), which proposes as essential learning for students the act of "Reading, writing and ordering natural numbers up to the order of hundreds of thousands with understanding of the main characteristics of the decimal numbering system" (Brasil, 2018, p. 294).

METHODOLOGY

First, a bibliographic research was carried out on the importance of the abacus for the teaching of numbers and the positional decimal numbering system. Thus, for Severino (2016, p. 131) a bibliographic research "is one that is carried out from the available record, resulting from previous research, in printed documents, such as books, articles, theses, etc".

As for the objectives, the research is characterized as explanatory, as it seeks to analyze studied phenomena through the application of experimental and mathematical methods (Severino, 2016).

Regarding the type of approach used in this research, the qualitative approach was used. For Creswell and Creswell (2021), who talk about qualitative methods in a research, they describe that this type of approach has as one of its characteristics the identification of direct conversation with participants and through behavioral observations of those involved within their context.

Regarding the procedures adopted for this research, a class of the 5th grade of the initial years was chosen to develop an experimental class of decimal numbering system. As a teaching tool, two horizontal abacuses were used, each containing ten orders of base ten.

The class took place at a private school in the municipality of Canaã dos Carajás on January 16, 2025, and it was divided into two distinct moments. The first was reserved for a revision of the decimal numbering system, in which the blackboard was used to record information. In the second moment, the class was divided into two groups, each with an abacus to manipulate addition and subtraction operations.

RESULTS

For the construction of the results, a class on the decimal numbering system was applied in a class of the 5th year of the early years of elementary school. The chosen class has students aged between 9 and 11 years. It was noticed that the students already had a basis on the theme of the class.

In this way, the class took place in a dialogued way and was divided into two distinct moments, in which theoretical knowledge (use of beads on the blackboard) and practical knowledge (use of two horizontal abacuses) were worked on, where the performance of addition and subtraction operations was demonstrated.

Thus, the conversion of units, tens, hundreds, units of thousands, tens of thousands, and hundreds of thousands was explained. As a way to facilitate teaching, we use a table with some operations, as shown below:

Table 1: Operations applied during the class

Add Operation	Subtraction operation
$300 + 20$	$8 - 3$
$739 + 290$	$276 - 40$
$27 + 13$	$13 - 8$
$1720 + 390$	$3000 - 340$

Source: the author.

In the case of addition operations, it was explained that the sums of the installments must always start with the units and, for every 10 units, we must exchange or convert the 10 units for 1 (one) piece of the tens squares. Therefore, this procedure should happen in the other orders of the decimal numbering system like hundreds, units of thousands, tens of thousands, hundreds of thousands, and so on.

Regarding the subtraction operations, there was an explanation of their terms (minuendo, subtraendo and remainder) and the relationship with the factor 10. So, for example, in operation 13 – 8 = 5, it was found that we could not remove 8 units from 3 units. Therefore, a conversion process of 1 (one) ten into 10 (ten) units is required. However, this procedure only became clearer with the use of the abacus.

Next, in photos (1) and (2), some of the moments of the class that was applied in the 5th grade class of the initial years are shown. As mentioned earlier, in the first part of the class only the blackboard was used to explain the decimal numbering system. In this way, there was the explanation that a digit, for example, the number 2 can represent units, tens, hundreds or other orders, depending on the position it occupies within the number.

Photo 1: Explanation of the numbering system.

Source: the author.

The second moment was reserved for the manipulation of the abacus. To do so, the students were divided into pairs, and each of the pairs received a horizontal abacus, which contains 10 orders, as shown in photo number 3.

In this way, it was explained to the students that for every ten pieces of the same value (units, tens, hundreds, etc.) we must perform a conversion or exchange for the order next or before the one being worked on. In this sense, the addition 27 + 13 can be represented by 10 ones and 3 tens. In this case there is a need to convert the 10 units in the next order, that is, tens remaining 1 ten + 3 tens = 4 tens or 40.

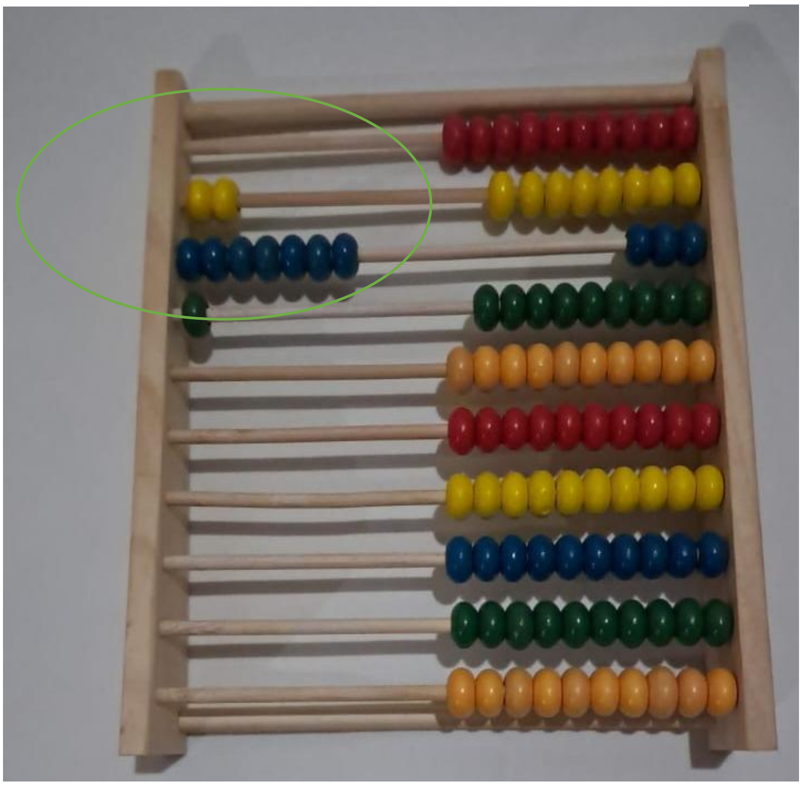
During the class it was verified that the students were able to represent numbers on the abacus, both in the first and second installments, but with some difficulty in performing the addition and subtraction operations just by manipulating the instrument.

Photo 2: Performing activities with the abacus.

Source: The author.

In this sense, in classes with manipulable materials such as the abacus, it is necessary to check if the students are doing the calculation directly on the abacus or just trying to represent a certain number with this tool. Another point we want to highlight is that the horizontal abacus can be used with the pieces on the right or left. For the purpose of explanation, in this study, we used the pieces on the right side, being moved to the left as a way to represent numbers. Therefore, to perform an operation such as addition 1720 + 390 using the horizontal abacus, it is necessary to represent and find the plot 1720 first, as shown below.

Photo 3. Representation on the abacus of the number 1720.



Source: The author.

In the abacus, the number zero has no representation in any of the orders in which it appears. Therefore, the absence of parts in the order of units is justified, as shown in the photo above.

To add the number 390 to the number 1720, we start with the order of the units, tens and hundreds until we reach the largest order, which, in this case, is the unit of thousand.

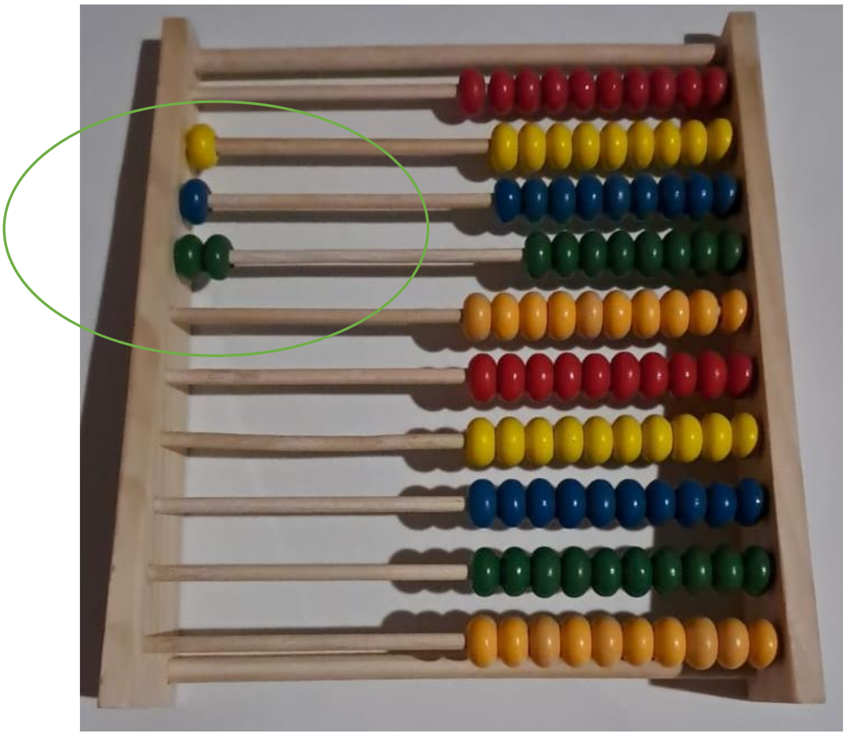
Thus, the procedure will be to leave the order of the units unchanged, since the number 390 has zero units. Then add 9 more to the 2 tens, however, as there are only 10 pieces, initially the student must add the remaining 8 pieces to the 2 tens resulting in 10 tens. These 10 tens must be converted into 1 hundred, thus representing 8 hundreds on the abacus.

As there is still 1 ten to be added, students must move a piece of the tens to the left of the abacus.

Finally, add 3 hundreds to the number of 8 hundreds. However, it is only possible to add 2 tiles from the orders of hundreds. Thus, with the sum, the ten hundred must be converted into 1 unit of thousand, leaving 2 units of thousands when added to the unit of thousands of the number 1720. One piece of the hundreds is still to be added, as only 2 of the 3 tiles were added due to the need for conversion.

Thus, the result of the addition operation between 1720 and 390 will be 2110, which can be represented on the abacus, as shown in the following photo:

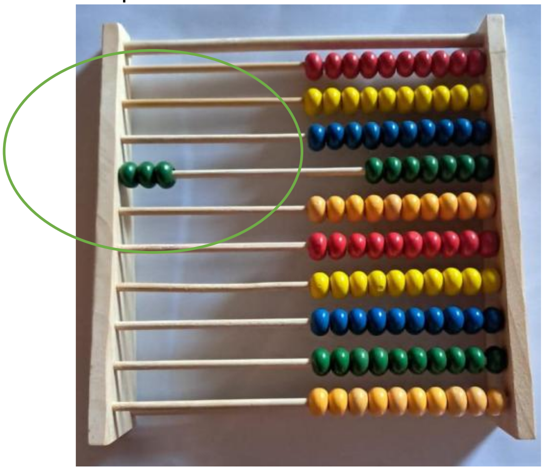
Photo 4: Final result of the addition between the numbers.



Source: The author.

It is observed that the students were able to assimilate the objective of the class, which was to manipulate the abacus and solve addition and subtraction operations with this tool. It was also noticed that the students had a greater facility to manipulate the abacus in solving operations with addition. In subtraction operations, there was a need to perform some conversions before actually performing the operation. Regarding the operation of subtraction, the following steps of resolution on the abacus were explained to the students, as indicated in operation 3000 – 340. Where, first, the students should locate the 1st digit on the abacus, in this case, the number 3000, according to the following representation:

Photo 5. Representation on abacus of the number 3000.



Source: The author.

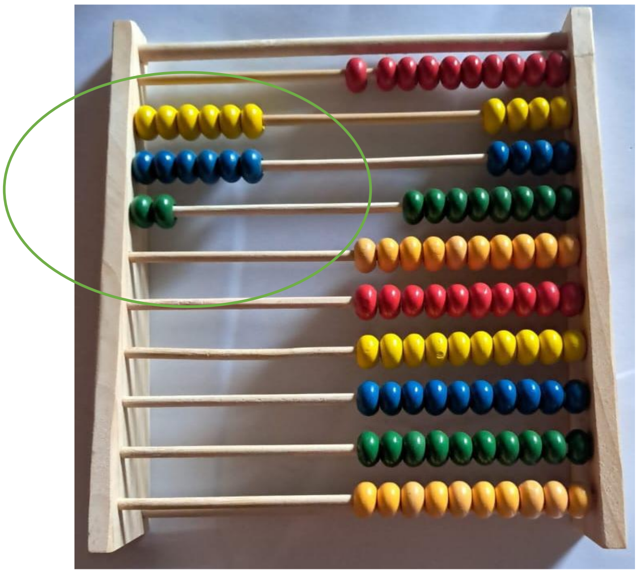
To carry out this operation, it was shown that the students should first convert one of the 3 thousand units into 10 hundreds. Then convert one of the hundreds into 10 tens. As the number 340 has zero units, it will not be necessary to change this order. After these steps, the abacus should look as follows:

Photo 6: Partial representation of the operation.

Source: The author.

After these steps, the 3000 – 340 operation can be completed satisfactorily because, from the photo above, when removing 4 tens and 3 hundreds, the result will be as follows:

Photo 7: Representation on abacus of the result 2.660.



Source: The author.

DISCUSSION

The addition and subtraction operations are very interesting to be worked with the abacus. In our case, which uses a horizontal abacus, it is necessary to emphasize that students can use them both from right to left (as demonstrated in the explanations in the classroom and also in the body of this article), and from left to right.

Regarding the use of the horizontal abacus, it is characterized as a practical tool. As its bases and sides are fixed to the same structure, there is no danger of losing the pieces. There are only a few recommendations in their use, such as, when handling them, it is necessary to be careful with sudden movements so as not to mix the pieces and thus lose the reasoning of the operation being performed.

Regarding the use of the abacus in the classroom, it was noticed that the students felt more comfortable and challenged to solve the proposed operations. In view of these observations, we can highlight what Melo (2021) mentions in his studies when describing that one of the functions of Mathematics is to stimulate logical reasoning, relating ideas and puzzles through games, thus awakening teaching and learning strategies.

It is noted that the students tried to solve the operations in two ways. Some have first solved the operations in the activity itself in order to represent the final value on the abacus. Others sought to discover the final value by manipulating the abacus itself and making notes on the sheets.

In general, the use of the abacus contributed significantly to explain the decimal numbering system and replace the inappropriate language for teaching in the early years, such as the traditional "borrow". To do so, we used a more appropriate language as a conversion between the pieces of higher or lower order, which were demonstrated on the horizontal abacus.

CONCLUSION

This work sought to report an educational experience in the early years of elementary school, with the objective of investigating the contributions of teaching with the abacus to represent operations of addition and subtraction of natural numbers from base ten conversions. In this sense, a dynamic class was prepared with a 5th grade class, where the content of the positional decimal numbering system was addressed.

We understand, therefore, that the application of resources as concrete materials are well liked by students since they hold their attention and give them the opportunity to manipulate tools that contribute to mathematical and associative thinking.

The results showed that the students were able to interact better during class when manipulating the horizontal abacuses. In this way, it is expected that playful activities with these instruments will arouse more interest in Mathematics classes. However, we can say that, as mathematics teachers in the early years, we must be careful about how students manipulate the abacus, that is, if they handle this material only as a tool for representing numbers or as a calculation instrument that makes it possible to perform operations such as addition and subtraction.

In this way, the practice with concrete materials in the early years, within the scope of the Mathematics discipline, becomes significant for students, when they are challenged to understand in a practical way the abstract meanings of numbers through these instruments.

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