

**“PLAYING” TO LEARN: A PLAYFUL APPROACH TO TEACHING
FUNDAMENTAL OPERATIONS WITH NATURAL NUMBERS**

**“BRINCAR” PARA APRENDER: UMA PRÁTICA LÚDICA PARA O ENSINO DAS
OPERAÇÕES FUNDAMENTAIS COM NÚMEROS NATURAIS**

**“JUGAR” PARA APRENDER: UN ENFOQUE LÚDICO DE LA ENSEÑANZA DE
LAS OPERACIONES FUNDAMENTALES CON NÚMEROS NATURALES**

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ABSTRACT

This article presents the results of a didactic-pedagogical intervention project, of a qualitative nature, carried out as part of the subject Mathematics Teaching Practice I, during the Mathematics degree course. The proposal was applied to a class of 40 6th grade students from a public school located in the municipality of Moju, in the state of Pará. The main aim of the research was to help improve the learning of fundamental operations (addition, subtraction, multiplication and division with natural numbers) through playful practices. The study started from the realization, based on teacher observations and reports, that many students had persistent difficulties in performing these operations, even after completing the initial years of elementary school. The intervention involved the application of activities with a strong visual appeal and concrete manipulation, seeking to make the teaching process more meaningful and accessible, the impact of which was assessed by comparing the results obtained before and after the intervention. This article presents the results of a didactic-pedagogical intervention project, of a qualitative nature, carried out as part of the subject Mathematics Teaching Practice I, during the Mathematics degree course. The proposal was applied to a class of 40 6th graders from a public school located in the city of São Paulo. The data generated showed significant improvements in the students' performance, especially in solving content that previously had high error rates. The results suggest that the use of playful strategies can encourage the construction of mathematical knowledge and be an effective alternative for teaching operations with natural numbers in classes in the final years of elementary school.

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Keywords: Meaningful learning. Mathematics teaching. Pedagogical intervention. Natural numbers. Playful practice.

RESUMO

Este artigo apresenta os resultados de um projeto de intervenção didático-pedagógica, de natureza qualitativa, realizado no âmbito da disciplina *Prática de Ensino da Matemática I*, durante o curso de Licenciatura em Matemática. A proposta foi aplicada a uma turma de 40 alunos do 6º ano de uma escola pública situada no município de Moju, no estado do Pará. A investigação teve como objetivo principal contribuir para a melhoria da aprendizagem das operações fundamentais (adição, subtração, multiplicação e divisão com números naturais), por meio de práticas lúdicas. O estudo partiu da constatação, a partir de observações e relatos docentes, de que muitos alunos apresentavam dificuldades persistentes na realização dessas operações, mesmo após concluírem os anos iniciais do ensino fundamental. A intervenção envolveu a aplicação de atividades com forte apelo visual e manipulação concreta, buscando tornar o processo de ensino mais significativo e acessível, cujo impacto foi avaliado por meio da comparação dos resultados obtidos antes e depois da intervenção. Os dados gerados evidenciaram avanços relevantes no desempenho dos alunos, especialmente na resolução de conteúdos que anteriormente apresentavam altos índices de erro. Os resultados sugerem que o uso de estratégias lúdicas pode favorecer a construção do conhecimento matemático e configurar-se como uma alternativa eficaz no ensino das operações com números naturais em turmas dos anos finais do ensino fundamental.

Palavras-chave: Aprendizagem significativa. Ensino de Matemática. Intervenção pedagógica. Números naturais. Prática lúdica.

RESUMEN

Este artículo presenta los resultados de un proyecto de intervención didáctico-pedagógica, de carácter cualitativo, realizado en el ámbito de la asignatura *Práctica Docente de Matemáticas I*, durante la carrera de Matemáticas. La propuesta fue aplicada a una clase de 40 alumnos de 6º grado de una escuela pública localizada en el municipio de Moju, en el estado de Pará. El objetivo principal de la investigación fue ayudar a mejorar el aprendizaje de las operaciones fundamentales (suma, resta, multiplicación y división con números naturales) a través de prácticas lúdicas. El estudio partió de la constatación, basada en observaciones e informes de los profesores, de que muchos alumnos tenían dificultades persistentes en la realización de esas operaciones, incluso después de completar los primeros años de la enseñanza primaria. La intervención consistió en la aplicación de actividades con un fuerte atractivo visual y manipulación concreta, buscando hacer más significativo y accesible el proceso de enseñanza, cuyo impacto se evaluó comparando los resultados obtenidos antes y después de la intervención. Los datos generados mostraron un progreso significativo en el rendimiento de los alumnos, especialmente en la resolución de contenidos que anteriormente presentaban altas tasas de error. Los resultados sugieren que el uso de estrategias lúdicas puede favorecer la construcción del conocimiento matemático y ser una alternativa eficaz para la enseñanza de operaciones con números naturales en clases de los últimos cursos de primaria.

Palabras clave: Aprendizaje significativo. Enseñanza de las matemáticas. Intervención pedagógica. Números naturales. Práctica lúdica.

1 INTRODUCTION

Brazilian legislation establishes guidelines that articulate theory and practice in the training of basic education teachers, recognizing the supervised internship as an essential component of this process. CNE/CP Resolution No. 2, of July 1, 2015, determines that undergraduate courses must ensure at least 400 hours of supervised curricular internship, to be completed from the second half of training, preferably in basic education institutions. In addition, Law No. 11,788/2008 defines the internship as a supervised school educational act, developed in the work environment and aimed at preparing for professional practice.

These guidelines reinforce the importance of teaching degree courses promoting supervised training experiences that allow future teachers to understand, plan and intervene in school realities from their initial training. In this context, reaffirming the need to integrate theoretical training and teaching practice, a didactic-pedagogical intervention project was developed within the scope of the discipline *Mathematics Teaching Practice I*, in the Mathematics Teaching Degree course.

During the development of the discipline, classroom observations and teachers' reports revealed that 6th grade students from the public school located in the municipality of Moju, in the state of Pará, had persistent difficulties in performing fundamental operations. Therefore, a qualitative intervention project was elaborated, developed through a field research, entitled *Operations with natural numbers: playing and learning in the teaching and learning process*, whose conduction was guided by the following research question: how does the use of playful didactic practices contribute to the learning of operations with natural numbers among students of the 6th year of elementary school?

In this sense, the main objective of the project was to contribute to the improvement of the learning of fundamental operations (addition, subtraction, multiplication and division with natural numbers), through playful practices inserted in planned pedagogical activities. Specifically, it sought to develop the teaching process in a more accessible way; to stimulate the understanding of operations through playful resources; and to present the contents in a visual and concrete way, resuming concepts already worked on in the classroom, but not yet fully assimilated by the students.

From this perspective, Santos (2010, p. 10–11) emphasizes that "mathematical knowledge in relation to the four operations (addition, subtraction, multiplication, and division) is important both in school life and in everyday life". However, several studies have pointed out that many students complete the initial years of elementary school without adequate mastery of these contents, which compromises their learning in the following years.

Based on these data, it is evident the urgency of reviewing the pedagogical practices adopted in public schools, especially in the North region, where performance in mathematics is markedly lower. Thus, it is necessary to adopt methodologies that provide students with more concrete, meaningful and contextualized experiences, capable of minimizing and overcoming the difficulties presented.

This study, therefore, describes the foundations and motivations that led to the application of the intervention project, analyzes the results obtained with the activities developed with the students and presents methodological recommendations aimed at improving the teaching of operations with natural numbers in the final years of elementary school.

2 REFERENCE

Mathematics Education plays a crucial role in the integral formation of students, especially in elementary school, by developing skills related to logical reasoning, problem solving and understanding of number systems. In this context, official documents such as the National Curriculum Parameters (PCNs) and the National Common Curriculum Base (BNCC), together with contributions from scholars such as Tizuko Morchida Kishimoto, offer a foundation for meaningful pedagogical practices.

The PCNs of Mathematics for elementary education (BRASIL, 1997; 1998) highlight that the work with natural numbers should go beyond the mechanization of algorithms, proposing experiments that involve counting, ordering and reading numbers in real contexts. The document also warns that, in the transition process between cycles, students often demonstrate difficulties with basic operations, especially addition and subtraction, which requires interventions that respect learning time and relate these operations to multiplication and division, facilitating the establishment of cognitive connections (BRASIL, 1998, p. 66, 107–109).

Thus, during the discipline *Mathematics Teaching Practice I*, it was observed that the 6th grade students had significant limitations in learning fundamental operations, showing difficulties in understanding mathematical procedures beyond simple mechanical execution. Such a diagnosis led to the proposition of an intervention project based on playful practices. In this sense, Lins and Gimenez (1997) argue that, instead of discarding traditional methods, teachers should integrate them into new strategies that favor the active and contextualized construction of knowledge.

Based on the previous contributions, it is possible to understand that the use of games, challenges and manipulable materials can enhance mathematical learning by involving the

student in a more concrete and reflective way. This position is reinforced by the BNCC (2018), which, by establishing the general competencies of the area of Mathematics, emphasizes the importance of developing the ability to reason, represent, argue and solve problems in different contexts (BRASIL, 2018, p. 265). Also according to the document, "the use of games and playful activities in the teaching of mathematics contributes to meaningful learning, allowing students to build knowledge in an active and contextualized way" (BRASIL, 2018, p. 268).

Complementing these guidelines, Kishimoto (2010) points out that:

"When playing, the child experiences the power of exploring the world of objects, people, nature and culture, to understand and express it through various languages. But it is in the plane of imagination that play stands out for the mobilization of meanings" (KISHIMOTO, 2010, p. 1).

This perspective emphasizes the importance of play as a tool for children to express themselves, learn and develop. However, although the official documents establish clear and up-to-date guidelines, there is still a distance between the curricular proposals and the reality of Brazilian public schools, especially those located in regions with structural limitations and lack of continuing education for teachers. As Fiorentini (2013) points out, one of the recurring challenges is the difficulty of implementing innovative practices in school environments marked by traditionally transmissive routines.

From this perspective, D'Ambrósio (1996) proposes an ethnomathematical approach that values the sociocultural context of the student and everyday knowledge, expanding the concept of mathematics beyond the school environment and reinforcing the role of mathematics education in the formation of critical and creative subjects. Similarly, Ponte, Brocardo and Oliveira (2005) highlight the role of mathematical investigations as a strategy to promote autonomy, reflection and knowledge construction, placing the student as the protagonist of the learning process.

In accordance with these conceptions, the intervention proposal discussed in this article sought to break with the instructionist logic centered on the teacher and promote an environment in which the student could explore, experiment and build knowledge in a visual, concrete and interactive way. According to Aguiar (2008, p. 1–2), "learning should not be centered on the teacher, but rather on the student's teaching and learning process, when, then, their active participation determines the construction of knowledge and the development of cognitive skills".

In summary, by integrating the principles of the PCNs and the competencies of the BNCC with the contributions of contemporary authors of Mathematics Education, the need for pedagogical strategies that break with repetitive teaching is reaffirmed, promoting meaningful experiences that consider the student's context, the use of playful resources and the articulation between different knowledges. Such elements are fundamental for the strengthening of lasting learning and for the appreciation of the role of mathematics in daily life and in citizenship formation.

3 RESEARCH PROCEDURES

This study is characterized as a **mixed-approach action research**, integrating qualitative and quantitative procedures, according to the typology proposed by Gil (2002). Action research is especially appropriate when it seeks to intervene in a concrete educational reality, with the aim of understanding a problem and, simultaneously, proposing and evaluating transformation strategies.

According to the author, this modality of investigation "is developed in close association with an action or with the resolution of a collective problem and in which researchers and participants representing the situation or problem are involved in a cooperative or participatory way" (GIL, 2002, p. 44). In the present study, the qualitative approach allowed the interpretation of the meanings attributed by the students to the lived experience, while the quantitative approach was used to objectively compare the performances recorded before and after the intervention, giving greater robustness to the analysis of the results.

Based on this conception, the present investigation was carried out in the context of the discipline *Mathematics Teaching Practice I*, during the Mathematics Teaching Degree course, having as its field of application a class of the 6th year of elementary school of a public school located in the municipality of Moju, in the state of Pará.

The application of the research was structured in four distinct moments, respecting the methodological principles of action research and the logic of action-reflection-action.

At first, the class was observed together with the responsible teachers. The objective was to identify, in a diagnostic way, aspects of the students' performance in relation to fundamental operations and the challenges faced in the daily routine of pedagogical strategies.

Continuing the investigative path, in the second moment an initial diagnostic activity was applied in order to verify the main difficulties of the students regarding addition,

subtraction, multiplication and division with natural numbers. The activity consisted of a workbook containing four questions, organized as presented in Chart 01.

Table 1

Questions in the workbook given to students

Addition	Subtraction	Multiplication	Division
Consider the following numbers: 1576, 8916, 7435, 2050, 794. Find the addition of the two largest numbers	Solve the following subtractions: a) $189 - 86$ b) $856 - 799$	Solve the following divisions: a) $45 : 5$ b) $480 : 12$ c) $50 : 10$	Solve the following multiplications: a) 7×8 b) 46×10 c) 50×6

Source: Prepared by the authors.

The activities were applied individually, as illustrated in image 01.

Figure 1

Application of activities



Source: Prepared by the authors.

In the third moment, the elaboration and execution of the didactic-ludic intervention project was developed. The first part of the activity involved the characterization of some students with colorful clothes and signs with the mathematical signs of addition, subtraction and equality, as illustrated in Figure 02.

Figure 2

Application of the project



Source: Prepared by the authors.

The dynamic was organized with two Indian lines. The first student rolled a dice and chose one of the available signs; Then, the student in the other row rolled the second dice. The formed operation was then solved on the board by the two participants. This activity was focused on working with addition and subtraction.

In the second part of this moment, the proposal was directed to multiplication and division operations. A box containing a target number (e.g., 100) was used, which was changed each round. Values were assigned to the marbles (e.g., 5, 10, 2), and the students were challenged to determine how many marbles would be needed to complete the indicated total. In the case of division, the students deposited the balls one by one and counted until they reached the proposed value; In multiplication, the process was reversed: the number of balls and the value of each one were defined to obtain the product.

In the fourth and last moment, the diagnostic activity previously used was reapplied, with the purpose of analyzing the results obtained after the pedagogical intervention, considering the signs of learning and the transformations observed in the resolution of operations with natural numbers. The intention was not to establish a direct statistical comparison, but to reflect, based on the records, on the impact of the playful practice adopted on the development of the students.

For this stage, a mixed methodological approach was adopted, articulating quantitative and qualitative procedures. The quantitative dimension was present in the systematization of data regarding incorrect/correct answers to the activities, with the objective of identifying performance patterns in the four fundamental operations. The qualitative dimension, on the

other hand, had a descriptive-interpretative character, focused on the analysis of the strategies used by the students, the difficulties that were still evident and the possible learning throughout the experience.

In addition, a moment of collective feedback was held with the students, in which they were able to express their perceptions about the activities developed, reflect on their own learning process and attribute meanings to the practices experienced. This active listening reinforced the investigative character of action research and the relevance of the mixed approach, by enabling a broader and more contextualized reading of the data generated.

The application records were organized into pictures, Figures and observational descriptions, being interpreted in the light of the objectives of the intervention and the references that support the use of playful practices in mathematics teaching.

4 RESULTS ACHIEVED AND DISCUSSION

The diagnostic activities carried out before and after the intervention were the main instruments for generating data in this research, enabling the identification of signs of learning and the analysis of the strategies used by the students in solving the fundamental operations: addition, subtraction, multiplication and division. They were answered by 40 students from the 6th grade of the public school located in the municipality of Moju, in the state of Pará, and enabled the identification of signs of learning and the analysis of the strategies used by the students in the treatment of the fundamental operations: addition, subtraction, multiplication and division.

The numerical data obtained were systematized and organized in explanatory tables and graphs, which accompany this section. These visual resources, in addition to synthesizing quantitative information, support the interpretative analysis of each operation. The combined use of text and graphic elements favors comparative reading and reinforces the coherence of the mixed approach adopted.

Regarding the addition operation, it was initially observed that 70% of the students got all the proposed questions wrong, while only 30% got total correct answers (Table 02 and Figure 3).

Table 2

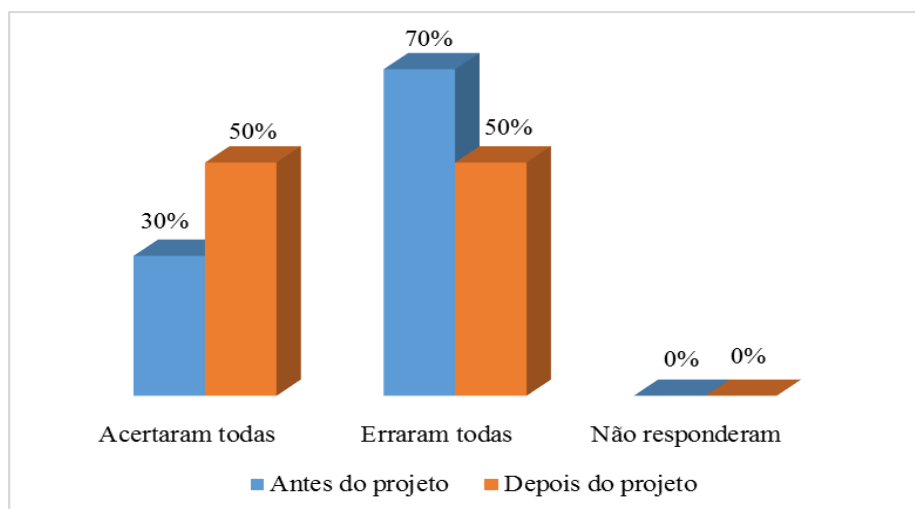
Issues involving addition operations, before and after the intervention proposal

Number of students	Addition Activity			
	Before the project	%	After the project	%
They got them all right	12	30	20	50
They all made mistakes	28	70	20	50
Didn't answer	0	0	0	0
Total	40	100	20	100

Source: Prepared by the authors.

Figure 3

Percentage of errors and successes of the resolutions of the addition operation



Source: Prepared by the authors.

After the didactic-pedagogical intervention, there was a significant improvement: half of the students got all the questions right, indicating a significant reduction in difficulties. This change in the results indicates that the playful practice contributed to making the process of understanding and executing addition more accessible. During the activities, it was possible to notice that the students started to use more organized strategies, such as decomposition of numbers and grouping, in addition to demonstrating greater confidence when recording the calculations.

Regarding the subtraction operation, the initial data revealed an even more worrying scenario. Only 5% of the students got all the questions right, while 60% got it completely wrong and 35% did not answer (Table 3 and Figure 4).

Table 3

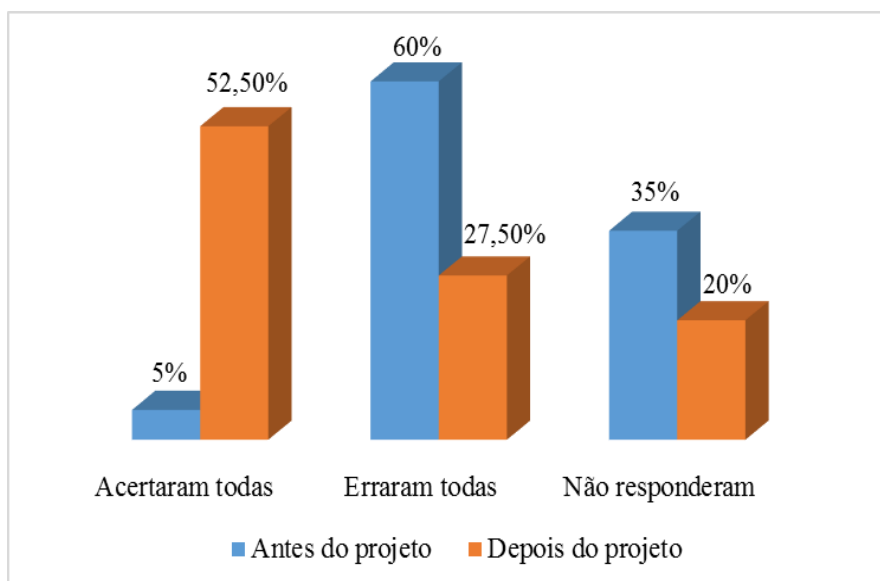
Issues involving subtraction operations, before and after the intervention proposal

Number of students	Subtraction Activity			
	Before the project	%	After the project	%
They got them all right	2	5	21	52,5
They all made mistakes	24	60	11	27,5
Didn't answer	14	35	8	20
Total	40	100	20	100

Source: Prepared by the authors.

Figure 4

Percentage of errors and successes of the resolutions of the subtraction operation



Source: Prepared by the authors.

After the implementation of the playful practice, there was a significant advance, with 52.5% of the students obtaining total correct answers. From direct observation, it was found that many students, who previously resorted only to the countdown or informal strategies, began to apply the "borrow" method with greater fluidity, evidencing conceptual progress. In addition, the feedback obtained reinforced this movement, since some students reported having better understood subtraction when they used marbles to physically represent the withdrawal process.

Regarding the multiplication operation, the initial diagnostic data showed that 37.5% of the students got all the questions wrong, while only 15% got all of them right (Table 4 and Figure 5).

Table 4

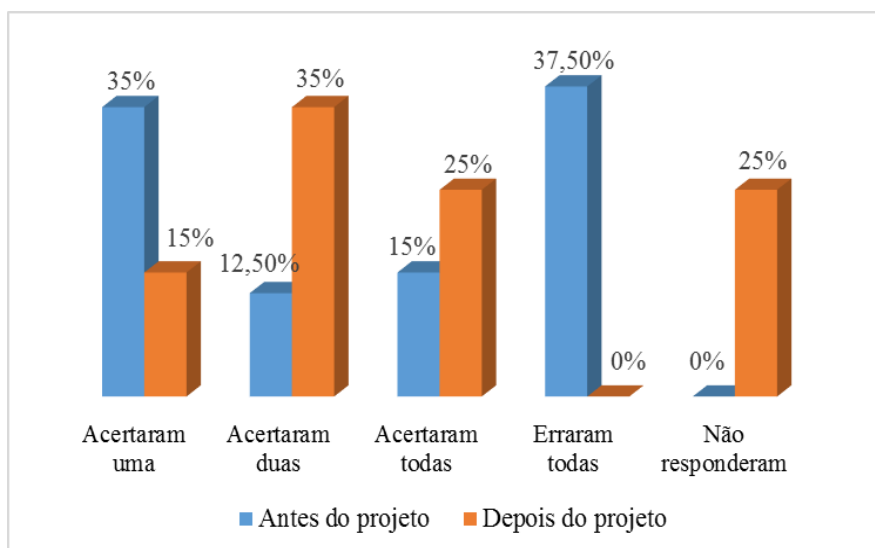
Issues involving multiplication operations, before and after the intervention proposal

Number of students	Multiplication Activity			
	Before the project	%	After the project	%
They hit a	14	35	6	15
They got two right	5	12,5	14	35
They got them all right	6	15	10	25
They all made mistakes	15	37,5	0	0
Didn't answer	0	0	10	25
Total	40	100	40	100

Source: Prepared by the authors.

Figure 5

Percentage of errors and successes of the resolutions of the multiplication operation



Source: Prepared by the authors.

After the intervention, the percentage of total correct answers rose to 25% and no student presented total error. It was observed, however, that 25% did not respond to the activity, which suggests that, although there have been advances, difficulties persist in the internalization of multiplicative logic. Qualitatively, it was noticed that students who partially got it right showed familiarity with simple multiplication tables, but had greater difficulty with multiplications involving two-digit numbers. The use of the number box and the balls during the intervention contributed to some students understanding multiplication as a repeated addition, favoring the understanding of the concept.

Regarding the division operation, the initial results showed that 37.5% of the students got all the questions wrong and none got total correct answers (Table 5 and Figure 6).

Table 5

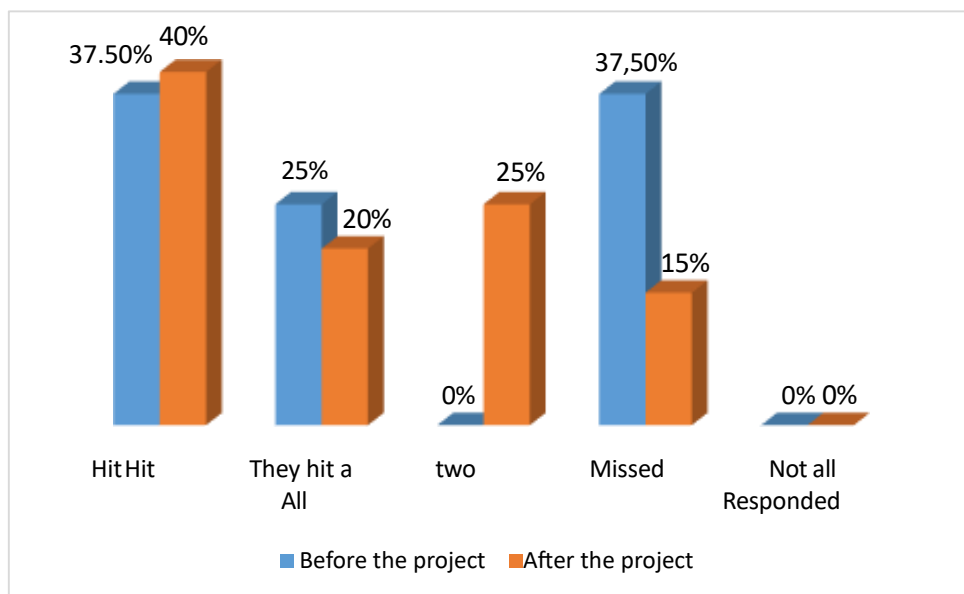
Issues involving division operations, before and after the intervention proposal

Number of students	Division Activity			
	Before the project	%	After the project	%
They hit a	15	37,5	16	40
They got two right	10	25	8	20
They got them all right	0	0	10	25
They all made mistakes	15	37,5	6	15
Didn't answer	0	0	0	0
Total	40	100	40	100

Source: Prepared by the authors.

Figure 6

Percentage of errors and successes of the resolutions of the division operation



Source: Prepared by the authors.

After the intervention, performance improved significantly: 25% of the students correctly solved all the questions and only 15% kept the incorrect answers. Observations made during the practice indicated that the work with manipulable materials was fundamental to favor the understanding of the reasoning involved in the division. Through the activity with the box and balls, the students visualized the process of dividing a total amount into equal parts. In the collective reports, it was common to mention that this dynamic helped them to "see" the operation, which confirms the potential of playfulness in mathematical learning.

Considering these analyses, it is possible to affirm that the result achieved with the proposal of didactic-pedagogical intervention was, to a large extent, achieved. For this stage, a mixed methodological approach was adopted, articulating quantitative and qualitative procedures. The quantitative dimension allowed the systematization of the data obtained in the diagnostic activities and the identification of performance patterns among the students. The qualitative dimension, in turn, had a descriptive-interpretative character and made it possible to analyze the strategies used, the persistent difficulties and the advances perceived throughout the teaching and learning process.

In addition, a moment of collective feedback was held with the students, in which they were able to express their perceptions about the activities developed. Many reported that learning through games and manipulable materials made the mathematical object easier to understand and more interesting. This active listening of the research subjects reinforces the

pedagogical value of playfulness, not only as a motivational factor, but as a pedagogical strategy that contributes to the conceptual construction of mathematical operations.

In this way, the experience demonstrated that pedagogical practices, based on playfulness, contribute to student involvement and promote real advances in learning. Although challenges persist, especially in the operations of multiplication and division, the data obtained indicate that the use of playful strategies favors the autonomy of students, broadens the understanding of mathematical concepts and strengthens the link between theory and practice in the teaching of mathematics.

5 FINAL CONSIDERATIONS

This research started from the following question: how does the use of playful didactic practices contribute to the learning of operations with natural numbers among students in the 6th grade of elementary school? Based on this questioning, it was established as a general objective to contribute to the improvement of the learning of fundamental operations through the application of a didactic proposal based on playfulness. The specific objectives were to diagnose the initial difficulties of the students, implement an intervention with playful resources, and analyze the signs of learning and the strategies developed by the students throughout the experience.

The conduction of the action research, structured in four moments, allowed not only the application and analysis of the intervention proposal, but also a critical reflection on the pedagogical processes involved. The fourth moment, in particular, was essential to identify and understand the effects of the didactic practice adopted. Through the reapplication of the diagnostic activity, we sought to analyze the data generated in the classroom, not with the intention of promoting a statistical comparison, but to interpret the signs of learning and the transformations observed in the students' resolution strategies.

For this stage, a mixed methodological approach was adopted, which articulated quantitative data (incorrect/correct answers in the activities) and qualitative data (student reports, observations and records). The collective feedback carried out with the students provided an active and meaningful listening, in which the students were able to express how they understood the contents, what strategies they used, and how the playful practice helped them. This stage not only enriched the data analysis, but also reaffirmed the participatory and investigative character of the proposal, in line with the fundamentals of action research.

Thus, it can be stated that the research question was satisfactorily answered and that the objectives of the study were fully achieved. The results pointed to concrete advances in the learning of operations with natural numbers, greater involvement of students in the

activities and greater autonomy in the teaching and learning process. It was observed that the use of manipulable materials and playful dynamics facilitated the understanding of the mathematical object in question and favored the active participation of students, especially those who previously showed disinterest or insecurity.

Additionally, the experience proved to be valuable for initial teacher training, as it provided undergraduates with the experience of real pedagogical practices, the analysis of the effects of interventions and the reflection on the challenges of educational practice. Projects like this contribute to the formation of more critical and prepared teachers, capable of planning intentional pedagogical actions, aligned with the needs of students and the contemporary demands of the school.

Finally, this study not only responded to the proposed problem, but also offers relevant subsidies for the field of Mathematics Education, by showing that active and playful practices, when well structured, can be replicated and adapted to different school realities. Such proposals demonstrate potential to strengthen the teaching and learning process, promoting more meaningful and contextualized experiences, both for students and for future teachers involved.

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