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Games in Mathematics Teaching: A Practice with Didactic Resources in the Final Years of Elementary School

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Abstract

Mathematics learning in Brazilian public schools faces persistent challenges, particularly in relation to students' mastery of the four basic operations. Traditional methods have often failed to generate interest or engagement, highlighting the need for alternative strategies such as mathematical games. This research analyzes the importance of using games in the mathematics classroom as resources that foster motivation, socialization, and problem-solving. The study adopted a qualitative approach in the form of a case study with sixth-grade students from a public school in Caucaia, Ceará, Brazil. The subjects were selected through convenience sampling, as this group represented students in a critical stage of mathematical development who frequently experience difficulties with arithmetic. Data collection included classroom application of the games Stop Math and Mental Bingo, a student questionnaire, and participant observation. Analysis was conducted through Bardin's Content Analysis in three stages: game exploration, practical application, and reflection. The results showed that 83% of the students reported feeling motivated by the games, most considered the activities easy to perform, and observations indicated higher levels of concentration, participation, and interaction during lessons. These findings confirm that playful methodologies can strengthen learning of basic operations and make mathematics teaching more engaging, particularly in under-resourced public schools.

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INTRODUCTION

Learning difficulties in mathematics are evident in Brazilian schools, both public and private. Teaching students mathematical content is becoming increasingly difficult, as social media is now closer to students than the school itself (Lins, 2019). In this context, we see that students spend more time on their cell phones for entertainment than on school material.

This research investigates playful possibilities in an attempt to streamline the classroom environment so that it doesn't become merely repetitive and often boring (for students). We consider incorporating mathematical games into the daily planning of the subject, that is, in accordance with the content taught in the classroom.

Therefore, games are seen as a facilitator of learning, coupled with a teaching method that fosters the development of knowledge in the four basic mathematical operations (addition, subtraction, multiplication, and division). The central question guiding this research is: How can the use of games such as Stop Math and Mental Bingo impact the teaching and learning of mathematics in the four basic operations for students in the final years of elementary school in a public school?

In this research, we investigate the potential of mathematical games, specifically Stop Math and Mental Bingo, as teaching resources for the final years of elementary school. The objective of the research is to: analyze the relevance of incorporating such games into Mathematics classes in a public educational institution outlined in the four basic operations.

The methodological design of the study aims to understand how the inclusion of these playful activities can influence the teaching and learning process of mathematics. The analysis of the collected data provides support for recognizing playfulness as a catalyst in the development of mathematical skills and student motivation. The case study was conducted in a 6th-grade class at a public school in Caucaia, Ceará.

The urgency of this research lies in the persistent learning difficulties in basic arithmetic operations among Brazilian elementary students, a challenge that directly affects their academic progression. At the same time, the increasing influence of digital entertainment has reduced student engagement with traditional teaching methods. By investigating the use of mathematical games such as Stop Math and Mental Bingo, this study offers timely evidence of how playful and low-cost didactic strategies can foster motivation, collaboration, and meaningful learning, contributing to the implementation of active methodologies aligned with the BNCC curriculum guidelines.

However, a gap remains between curricular expectations and classroom reality. While the BNCC encourages the integration of playful methodologies and previous studies highlight the potential of games for mathematics teaching, many classrooms in Brazilian public schools still rely almost exclusively on traditional, lecture-based approaches. As a result, students continue to struggle with mastering basic operations and often perceive mathematics as inaccessible or unmotivating. Few studies have examined the practical application of specific games, such as Stop Math and Mental Bingo, in real classroom contexts with detailed evidence of student motivation and learning outcomes. This research seeks to address that gap by investigating how these games can be implemented in a 6th-grade public school class and what impact they have on student engagement and mathematical understanding.

The next section describes the theoretical and practical foundations that justify the inclusion of playful activities in the mathematics curriculum resulting from the application of games, as well as the challenges and didactic considerations inherent to their implementation.

RESEARCH METHODS

The concept of games has long been linked to human culture and learning. According to Grando (1995), "etymologically, the word game comes from the Latin locu, meaning joke or mockery, and was used in place of ludu: toy, game, amusement, and pastime." Games have been present in human life for thousands of years, with evidence of their use in civilizations such as the Roman and Greek (Cabral, 2006). Although their recreational function has always been recognized, it was only in the last century that the most relevant theoretical contributions were consolidated, leading to pedagogical proposals that integrate games into teaching. In this perspective, games are no longer seen merely as amusement, but as didactic resources that allow students to take an active role in the learning process.

There is a noticeable and increasing pedagogical diffusion of mathematical games in educational settings, driven by the goal of making classroom experiences more engaging and facilitating a greater assimilation of content by students. This methodological shift is strongly supported by the National Common Curricular Base (*Base Nacional Comum Curricular*, BNCC) (Ministério da Educação, 2018), which marks a significant milestone for education. The BNCC transcends the conventional, narrow view of mathematics–one limited solely to numbers, operations, and geometric shapes–by establishing a comprehensive field that encompasses games, language, modeling of reality, structured thought, and the development of multiple essential skills. Therefore, the integration of mathematical games aligns directly with national educational guidelines that advocate for a broader, more practical, and skill-focused approach to teaching the subject.

This comprehensive perspective within national guidelines opens the door to the integration of active methodologies, such as the use of games, which can fundamentally redefine learning and make it more engaging and relevant for students. Specifically, the BNCC encourages the inclusion of games in mathematics teaching as a powerful pedagogical resource for developing various skills and abilities. By proposing that students become active protagonists in their learning process, the BNCC directly aligns with the premise that games can effectively foster logical reasoning, problem-solving, creativity, and social interaction. Furthermore, the BNCC suggests that games be utilized at different stages and for various age groups to explore concepts, practice mental calculations, understand probabilities and statistics, and develop strategic thinking, among numerous other curricular applications (Ministério da Educação, 2018).

The BNCC not only validates the inclusion of games in the mathematics curriculum but also emphasizes the importance of these activities having a clear didactic objective and allowing students to develop strategies and evaluate their results. In this way, games cease to be merely a pastime and become teaching and learning tools that challenge students, promoting autonomy and collaborative work.

This playful approach helps students see mathematics not as a dry subject, but as a universe of possibilities that stimulates curiosity and the joy of learning. For Moura (1996), playing is not the same as studying or working, because through playing, students learn, above all, to know and understand the social world around them. We believe that the application of mathematical games is highly relevant in such a dynamic and diverse society. Games, coupled with a methodology that fosters knowledge construction, can broaden learning possibilities.

We believe that games in mathematics teaching can boost students' understanding and the appropriate problem-solving skills presented in the classroom. They also strengthen the ability to use logical reasoning in problem-solving, in addition to strengthening traditional basic operations (addition, subtraction, multiplication, or division).

According to Leal (2014), a playful culture makes playful learning possible. That is, children who learn through mathematical games assimilate the content more quickly. The difficulty most students have in learning mathematics is quite noticeable, and unfortunately, many students already harbor the idea that mathematics is the bogeyman (something very complicated and inaccessible). The difficulties that arise from even a simple homework assignment involving solving mathematical problems are also very noticeable, both in society at large and within families.

The use of mathematical games can play an important role in developing social interaction for students who struggle to express themselves in the classroom. Through educational mathematical games, these students can feel more comfortable expressing questions and ideas. Thus, using mathematical games in the classroom can contribute to socialization, mutual cooperation, and the development of problem-solving strategies proposed by the teacher.

The main idea of teaching mathematics through games is to enable students to use logical reasoning to solve problem-solving situations, following the rules of the games and in tune with the class and the content presented by the teacher in the classroom. It is clear that such content must be combined with a methodology that enables the development of meaningful learning.

The effectiveness of incorporating games into mathematics education is strongly grounded in developmental theory, particularly the work of Vigotski (1998), who argued that play (game) has a significant influence on a child's development. It is through play that children learn to act, stimulate their curiosity, gain initiative and self-confidence, and foster the development of language, thought, and concentration. Thus, mathematical games play a fundamental role in student learning, serving as practical mechanisms that aid in problem-solving and interaction with peers, thereby enabling students' reasoning ability to achieve distinct and more elaborate results.

Mathematical games can also assist teachers by making classes more dynamic and engaging, fostering greater interest and satisfaction in students learning the content taught in the classroom, thus breaking away from the traditional school routine. During classes, the teacher must observe the participation, interest and ability of each student to resolve and assimilate each question.

This study explores games in mathematics teaching, including a qualitative approach. This choice is justified by our aim to understand the nuances and meanings participants attribute to the learning experience through games, rather than simply quantifying results. As Minayo and Deslandes (2007) state, qualitative research explores the universe of meanings, motives, aspirations, beliefs, values, and attitudes, which corresponds to a deeper realm of relationships, processes, and phenomena that cannot be reduced to the operationalization of variables. Thus, we will delve into students' perceptions to uncover how games transform their relationship with the subject.

Our research design is configured as a case study, as it allows us to investigate a contemporary phenomenon in its real-life context, especially when the boundaries between phenomenon and context are not clearly defined. According to Yin (2014), a case study is an empirical investigation that investigates a contemporary phenomenon in its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. Thus, the focus will be on a specific class, providing an in-depth analysis of the interaction between games, the teaching and learning process, and sixth-grade students.

The research sample will consist of sixth-grade students in the final years of elementary school at an educational institution, with mathematical literacy in the four basic operations (addition, subtraction, multiplication, and division). This age group is particularly relevant, as they are at an important transition in cognitive development and can significantly benefit from more dynamic and engaging methodologies for consolidating mathematical concepts. Student participation was guaranteed by a Free and Informed Consent Form (FICF), guaranteeing the ethics of the research.

To make sense of the collected data, we will use Content Analysis (Bardin, 2011). This technique allows us to organize, categorize, and interpret the information obtained, transforming raw data into valuable feedback on students' experiences with mathematical games. Content analysis helps us identify patterns, emerging themes, and student perceptions, enabling a rich and detailed understanding of the phenomenon under investigation.

Interventions using mathematical games will be structured in three distinct stages, designed to maximize engagement and learning. The first stage will be the presentation and exploration of the game, where students will have initial contact with the rules and dynamics.

The second stage will consist of practical application and challenge solving, during which students will use the game to solve mathematical problems and develop logical reasoning.

The third stage will be dedicated to reflection and discussion, where students and the researcher will discuss the strategies used, the concepts learned, and the difficulties encountered. This sequence aims to ensure that the game is not just a playful activity, but an effective pedagogical tool, as highlighted by Grando (2000), who states that the game is not just a toy, but a source of enrichment and development of mathematical skills and knowledge.

To capture the essence of how games impact mathematics learning, our classroom journey involved a didactic approach. We believe that the discussion about the information was based both on what the students expressed and what we observed. At the heart of our data collection was the administration of a carefully crafted questionnaire.

The questions were designed to go beyond right or wrong, seeking to uncover students' perceptions of the game, the mathematical concepts involved, and how they felt about learning differently. After all, their words are the most direct reflection of their experiences and help us understand the impact of playfulness on the teaching and learning process.

To complement the questionnaire feedback, we conducted participant observation. This means we were actively present in the interactions, moving around the room, recording not only what was said but also the students' behavior:

their facial expressions, their level of engagement, their collaboration, and the strategies they developed to solve the game's challenges.

This immersion allowed us to capture nuances that a questionnaire alone could not, offering a more complete and vivid picture of classroom dynamics. The combination of these two tools gave us a richer, more human perspective on how games can truly transform mathematics teaching.

First Game: Math Stop

The "Math Stop" game has the same idea as "Letters Stop," also known as "adedanha" or "adedonha," which is a group game in which players must be quick with words. Basically, to play "Letters Stop," people gather and determine different categories such as name, city (state or country), actor, human body part (HP), etc. Then, they draw a letter of the alphabet. Once the letter is drawn, the game begins. For each theme, players must find a word that begins with the drawn letter.

This way, whoever fills in all the categories first says "stop," and all other players stop the game. Whoever scores the most points wins. Now, in the case of its mathematical counterpart, we will obviously draw numbers, and the blanks, which are usually names of cities, foods, adjectives, etc., will be replaced by basic operations.

After organizing the class, the game can be played individually or in groups of four. The teacher may call out the number they drew or rolled, and each child or group will say "stop." All calculations will then be performed using the number they thought of. The first child to finish will say "stop," meaning that when all the operations and the total of the row are completed, the game stops.

Participants can check their results with the other participants, and answers can be evaluated as follows: a correct answer is worth 10 points, an equal answer is worth 5 points, and a wrong answer is worth zero.

At the end, the points are added up, and the final result of all rounds is displayed on the board. Worksheets can be created covering the four operations, or just addition or multiplication, depending on the content covered in class.

Some objectives of this game are: 1) to develop oral and written language; 2) to practice basic operations; 3) to enhance the development of logical reasoning; 4) to contribute to students' socialization and to introduce mathematics in a playful way.

Second Game: Mental Bingo

In this game, students can remain at their desks, as it is an individual activity. The objectives of this game are: to work with the four fundamental operations; to develop estimation, mental calculation, and multiplication tables.

The game instructions are: 1) the cards with the operations are placed in a bag; 2) the teacher draws an operation and informs the players; 3) the players solve the operation, obtaining the result that will be on some of the cards; 4) whoever has the result marks it on their card.

Now, if there are two identical results on the same card, they mark them simultaneously. The winner is the player who marks all the results on their card.

The math games were administered to a 6th-grade class at Raimundo José dos Santos School, a public municipal institution in Caucaia, Ceará, located in the Garrote region. The class consisted of twenty-seven students; on the day of the

study, only 18 students participated due to classroom attendance. We noticed that at first some students had difficulty answering, as the game requires attention and knowledge of multiplication tables, but from the second stage onwards the students noticed that it was not as difficult as they initially thought and the game became attractive and also very competitive.

Figure 1. Group discussion about mathematical games

It is worth noting that, when we insert games into the context of Mathematics classes, we do not mean to say that the game alone can transform such a complex teaching problem, which we experience in our region or country.

Figure 2. Application of the game of the four basic operations of mathematics

On the other hand, the research aims to support the improvement of education, particularly mathematics teaching. Our research invests in games as a dynamic

element of teaching and learning, linked to a methodology that facilitates the true understanding of mathematical content.

RESULTS AND DISCUSSION

In a class prior to the math games, we reviewed the content, with proposed exercises and solutions involving the four elementary operations, also using multiplication tables. Initially, the students were unfamiliar with the games in question, but they paid close attention to the explanation. We then provided an example as a model for the students to better understand the game's purpose. Soon after, we began drawing numbers (one at a time) using a die.

Thus, let's say the number drawn was five, then they would have to fill in the columns with the words: predecessor, successor, double, triple, Roman numeral, addition, subtraction, multiplication, division, and finally, a numerical expression. In total, we had five rounds, and in each round, the points were counted, where we also verified the score achieved. In other words, in each round, we added up the total points. At the end of the game, we checked the total points and elected the student with the most points as the winner. This was the Math Stop game. For the mental bingo game, cards were printed with the results of adding and subtracting certain numbers (in a personalized box containing two numbers on each slip). When drawn, the students would add or subtract the numbers. The results would be marked on the cards, and the student who filled out the card completely would win.

Soon after the games, a questionnaire (attached) was given to the students about the math games they had participated in. The results were as follows: 22% were ten years old, 61% were eleven, 11% were twelve, and 6% were over twelve. Regarding the gender of each student, 56% were female and 44% were male. Regarding participation in the activities, 26% participated only in Stop Math, 52% only in mental bingo, and 22% participated in both math games. In the questionnaire item that asked which mathematical operations were present in the activity, 67% said they used addition and subtraction, 33% multiplication and division. Thus, students used more than one skill (operating with numbers) to solve the problems that arose in the game.

In item 5 of the questionnaire, which asked about the motivation of the game, 83% responded that they felt motivated by the activity, 17% responded that it was somewhat motivating, and 0% responded that it was not motivating. Therefore, for the vast majority of students, the practice involving games was motivating. And motivation is a relevant factor for learning.

Regarding the level of difficulty, 83% considered it easy, 17% responded that the difficulty level was medium, and the difficult level did not receive any points. Therefore, based on the data obtained, we can conclude that the proposed activity was widely performed and achievable by the students. During the implementation of both games, we observed the students' interest and commitment to developing the proposed tasks. We also observed increased motivation, concentration, and engagement during the math games.

The next day, we clearly noticed during class that the students who participated in the games were more attentive to the explanations, more interested, and more interactive with one another (Miranda, 2012). Based on the data analysis and our

participant observation, we can conclude that the use of the games in our math classes contributed to the learning of the proposed content.

Furthermore, we found that the class was more enjoyable, and the level of interaction with the content was greater and more meaningful. Finally, this methodology had a positive effect on the teaching and learning of mathematics.

Our findings that 83% of the students felt motivated by the games are consistent with Grando (2000), who emphasizes that games transform the classroom environment into a more dynamic and participatory space. Similarly, Leal (2014) highlights that playful learning accelerates content assimilation, reinforcing the role of motivation in learning processes.

The initial difficulties observed in solving the operations align with Moura (1996), who argues that games help students gradually construct mathematical meanings in a more accessible way. This reinforces Lins (2019) observation that diversified methodologies are essential to overcoming resistance to mathematics.

The observed increase in interaction and collaboration among students resonates with Miranda (2012), who found that playful practices foster greater cooperation in the classroom. Cabral (2006) similarly argues that games enhance socialization and the exchange of problem-solving strategies, both of which were evident in our case study.

CONCLUSION

The research found that sixth-grade students in the final years of elementary school had difficulty learning the main basic arithmetic operations. Most of the class struggled with addition, subtraction, multiplication, and division.

At this stage of school life, knowledge of the four mathematical operations is essential for continuing into the final years of subsequent classes, and the teaching method used was insufficient to address classroom doubts. Therefore, it became important to study games for teaching mathematics.

The research sought to historically contextualize the practice of games and their relationship to humanity, as well as to base the didactic perspective on research based on reference research. Therefore, a case study was included in a class in the final years of elementary school.

The objective was partially achieved, as the main difficulties were addressed using a methodology distinct from the traditional one. Thus, we observed the integration of knowledge of the four basic operations into problem-solving practices in the school context through educational games. During the research, two games were used: Stop Math and Mental Bingo. A questionnaire was administered to the students and, based on the analysis of the data obtained, it was concluded that the game facilitated the teaching and learning process.

In addition to these aspects, our participant observation found that the students involved were more motivated, participatory, and open to the proposed methodology. The increased commitment and engagement of the class was clear. Even working with a small number of students, with limited time and a lack of printed materials, in addition to the common challenges of a public school, we believe that our case study can offer an important contribution to the complex issues we face in mathematics teaching.

Finally, we view our classroom intervention as positive. In no way was it intended to reduce such complex teaching problems to the mere application of games in class. On the other hand, we demonstrate that the use of games in teaching Mathematics, combined with a methodology that favors the apprehension of meanings, can streamline the teaching-learning process, thus contributing to the assimilation of content.

Beyond confirming that mathematical games can motivate and engage sixth-grade students, this research also carries practical implications for mathematics teaching in Brazil. The study demonstrates that low-cost and easy-to-apply resources, such as Stop Math and Mental Bingo, can be integrated into daily classroom practices, promoting not only content assimilation but also collaboration and student autonomy. For teachers, this offers an alternative didactic approach that responds to the urgent need for active methodologies aligned with the BNCC curriculum guidelines.

In the broader context of Brazilian education, where students often present significant difficulties in mastering basic operations, our research contributes by showing that playful strategies can bridge learning gaps and stimulate interest in mathematics, even in under-resourced public schools. This contribution is particularly relevant for teacher training programs and educational policies that seek effective, accessible, and motivating practices to improve mathematics learning outcomes nationwide.

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