

PLAYFULNESS AND MATHEMATICAL LEARNING: GAMES AS EDUCATIONAL TOOLS

LUDICIDADE E APRENDIZAGEM MATEMÁTICA: JOGOS COMO FERRAMENTAS PEDAGÓGICAS

LUDICIDAD Y APRENDIZAJE MATEMÁTICO: LOS JUEGOS COMO HERRAMIENTAS PEDAGÓGICAS



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ABSTRACT

This work presents the use of games as a pedagogical resource to make the teaching of Mathematics more dynamic, attractive, and meaningful, as well as to reduce resistance to the subject. The proposal was developed through a project entitled “Mathematical Challenges: Developing Logical Thinking through Games”, implemented in a 9th-grade class. Several activities were applied that promoted problem-solving, spatial visualization, decision-making, and the development of socio-emotional skills. Grounded in the works of authors such as Vygotsky, Grando, Kishimoto, Borasi, and Freire, the study demonstrates that playfulness, recreational mathematics, and mathematical modeling are effective strategies for bringing content closer to students’ realities, fostering a collaborative and enjoyable learning environment.

Keywords: Playfulness. Mathematical Games. Mathematics Teaching.

RESUMO

Este trabalho apresenta a utilização de jogos como recurso pedagógico para tornar o ensino da Matemática mais dinâmico, atrativo e significativo, como também a redução a resistência à disciplina. A proposta foi desenvolvida através de um projeto intitulado “Desafios Matemáticos: Desenvolvendo o Pensamento Lógico com Jogos”, numa turma de 9° ano. Foram aplicadas diversas atividades que favoreceram a resolução de problemas, a visualização espacial, a tomada de decisões e o desenvolvimento de competências socioemocionais. Fundamentado em autores como Vygotsky, Grando, Kishimoto, Borasi e Freire, o estudo evidencia que a Ludicidade, a Matemática Recreativa e a Modelagem Matemática que são estratégias eficazes para aproximar os conteúdos da realidade dos alunos, promovendo um ambiente de aprendizagem colaborativo e prazeroso.

Palavras-chave: Ludicidade. Jogos Matemáticos. Ensino de Matemática.

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RESUMEN

Este trabajo presenta el uso de juegos como recurso pedagógico para hacer que la enseñanza de las matemáticas sea más dinámica, atractiva y significativa, así como para reducir la resistencia a la disciplina. La propuesta se desarrolló a través de un proyecto titulado «Desafíos matemáticos: desarrollo del pensamiento lógico con juegos», en una clase de 9.º curso. Se aplicaron diversas actividades que favorecieron la resolución de problemas, la visualización espacial, la toma de decisiones y el desarrollo de competencias socioemocionales. Basado en autores como Vygotsky, Grando, Kishimoto, Borasi y Freire, el estudio evidencia que la ludicidad, las matemáticas recreativas y el modelado matemático son estrategias eficaces para acercar los contenidos a la realidad de los alumnos, promoviendo un ambiente de aprendizaje colaborativo y placentero.

Palabras clave: Ludicidad. Juegos Matemáticos. Enseñanza de las Matemáticas.

1 INTRODUCTION

This article addresses the use of games as a pedagogical resource to facilitate the learning of Mathematics in Basic Education. The proposal is based on the idea that play contributes to making the teaching and learning process more attractive and meaningful, stimulating logical reasoning and the active participation of students. The study presented was developed from the results obtained with the elaboration and application of a project linked to PROUPE – University for All Program in Pernambuco –, carried out as an educational counterpart provided by the program. The project was developed at the José Nascimento da Silva Municipal School of Basic Education, located in the municipality of Tavares-PB.

Mathematics, despite being essential for intellectual development and knowledge of the world, is constantly seen by students as an abstract, complex discipline that is very distant from daily reality. This perception influences school development and causes demotivation of students, especially elementary school students.

In view of this, it is necessary to rethink the pedagogical practices adopted, which are often outdated, and seek strategies that make teaching more attractive, effective and accessible. In this article we seek to present didactic tools capable of transforming this reality through pedagogical practices that stimulate logical reasoning, creativity and autonomy of students.

The National Common Curriculum Base (BNCC) advises that:

[...] learning in Mathematics is intrinsically related to comprehension, that is, to the apprehension of meanings of mathematical objects, without leaving aside their applications. [...] Thus, didactic resources such as checkered meshes, abacuses, games, books, videos, calculators, spreadsheets, and dynamic geometry software play an essential role in the understanding and use of mathematical notions (Brasil, 2018, p. 218).

In addition to enabling greater involvement with the discipline, the proposal helps to strengthen essential skills, such as problem solving, critical and argumentative thinking. By integrating playful elements into the teaching and learning process, the teacher provides students with a journey of discovery, reflection and knowledge construction, making Mathematics a useful and significant tool for understanding and interacting with the world.

2 GENERAL OBJECTIVE

Promote the development of students' problem-solving skills, logical thinking and creativity, as well as the understanding of Mathematics as an essential tool through the use

of games and interactive activities, aligned with competencies and skills provided for in the National Common Curricular Base (BNCC), making the teaching and learning process more dynamic, welcoming and participatory.

3 SPECIFIC OBJECTIVES

- Stimulate logical reasoning and problem solving through challenging activities that encourage students to think logically, creatively and strategically in the face of problem-situations;
- Demonstrate the applicability of Mathematics in everyday life, relating the contents studied with real and practical situations, facilitating the understanding and appreciation of the discipline;
- Incorporate playful elements into the teaching of Mathematics using games, games and dynamics that make learning more engaging, arousing the interest and curiosity of students.

4 METHODOLOGY

The methodology adopted in this article was built from the development of a project linked to PROUPE, carried out with a class composed of 10 students from the 9th grade of Elementary School II of the José Nascimento da Silva Municipal School of Basic Education, in the municipality of Tavares-PB. The activities were carried out once a week, over six months, with the aim of making the teaching of Mathematics more dynamic, accessible and meaningful through playful and interactive practices.

The methodological proposal was based on bibliographic research and the analysis of academic articles, in addition to the guidelines of the National Common Curricular Base (BNCC), which reinforce the importance of pedagogical practices that stimulate logical reasoning, creativity and student protagonism. From this, activities were selected and applied that integrated the content of Mathematics into the daily lives of students, promoting the development of cognitive and socio-emotional skills. Among the activities applied, the following stand out: Mathematical Ludo, Monetary Quiz and Polygon Challenge.

According to Rêgo and Rêgo (2013), when well selected and used appropriately, the game can act as a highly effective pedagogical resource, contributing to the achievement of several educational objectives, including the development of students in the intellectual and emotional aspects.

The administration of the actions followed a schedule that included the survey of the class's curriculum, observation of classes, planning of the pedagogical proposal and

execution of activities in corregency. Four initial observation meetings were held to understand the profile of the class and identify its needs. Then, the other meetings took place on a co-ordination basis, with direct action in the mediation of activities.

The evaluation was carried out in a continuous and formative way, based on direct observations, participation records and self-evaluations of the students, allowing methodological adjustments according to the needs identified throughout the process. The results were systematized in partial reports and a final report and presented at AESET's Academic Week 2025.2, whose theme was "Education, health and society: meeting ancestral knowledge in the present and future that is built". The presentation highlighted the positive impact of the playful approach in the teaching of Mathematics.

The methodology applied proved to be effective in promoting a dynamic, collaborative learning environment aligned with the competencies provided for in the BNCC, contributing to the strengthening of students' cognitive and socio-emotional skills.

5 DEVELOPMENT

The project "Mathematical Challenges: Developing Logical Thinking with Games" was developed with the objective of transforming the teaching of Mathematics into a more dynamic, accessible and meaningful experience for elementary school students. The proposal arose from the need to face the recurring challenges in learning the subject, especially the lack of interest and difficulty in understanding by students.

The proposal is based on the perspective of the playful teaching of Mathematics, where games are used as pedagogical resources capable of stimulating cognitive skills, promoting socialization and awakening the pleasure for Mathematics. In this context, Recreational Mathematics contributes by presenting challenges, curiosities and riddles that make learning more engaging and creative, while Mathematical Modeling brings the contents closer to the students' reality, allowing everyday situations to be translated into mathematical language and explored in a meaningful way.

Authors such as Vygotsky, Grando and Kishimoto argue that playing is an essential activity for the intellectual and emotional development of students, favoring the construction of knowledge.

During the development of the project, four initial observation meetings were held, aimed at monitoring the classes of the head teacher, with the objective of understanding the profile of the class and identifying its main needs. Based on these observations, the subsequent meetings took place under a correction regime, with direct action in the mediation of the activities.

The pedagogical actions were organized around playful activities that explore mathematical content in a contextualized and interactive way. Among them, the following stand out:

- **Battleship Math:** An original adaptation of the classic game, created especially for this project. The objective was to work on concepts of space and location, multiplication and division operations, in addition to developing the agility of reasoning. The class was divided into two groups, and a draw defined which group started. A player would choose a location on the board (always in letter-number form, such as B7 or E9). Each position could have a mathematical calculation or a bomb. If the calculation was answered correctly within 30 seconds, the group gets 1 point. If they made a mistake or did not answer, the opposing team had a chance to respond and, if they got it right, they earned 2 points. This activity stimulated quick thinking, strategy and teamwork, making learning more engaging and competitive in a healthy way.

To facilitate the application in the classroom, the link for printing the game board is available, allowing the reader to have access to the material:

(https://www.canva.com/design/DAG97m3fa_o/pLRWRh0L5aMe7TYwXYjNww/edit?utm_content=DAG97m3fa_o&utm_campaign=designshare&utm_medium=link2&utm_source=sharebutton)

- **Ludo Mathematician:** Traditional game adapted to work on basic operations and solution strategies, promoting logical reasoning and decision-making. The original rules were kept – such as the advance of the piece according to the number drawn on the die and the objective of getting all the pieces to the base – however, for each move, the student needs to solve mathematical operations correctly to be able to move his piece. And when the calculation is solved incorrectly, the part remains at rest, where it does not advance.

The link for printing the board and the pieces used in the game is available, allowing readers to have access to the material in an organized way and that the activity can be reproduced in different school contexts.

(<https://drive.google.com/drive/folders/1m3-4uituDfeWHVSU6ykO8CdUKmadDv1?usp=sharing>)

- **Monetary Quiz:** The activity aimed to review the Brazilian monetary system through an individual quiz, whose central idea was to perform calculations involving money and commercial or economic situations. The questions were elaborated based on banknotes and coins applied in everyday contexts. This proposal enabled the application of mathematical knowledge in real contexts, favoring the development of

calculation and interpretation skills. To support the realization of the proposal, the link for printing the banknotes and coins used in the quiz is available, ensuring access to the material in an organized way and that the experience can be reproduced in different classes:

(https://www.canva.com/design/DAG97hyqS24/ovXw_k0ZZgX6e2vUbgYTEQ/edit?utm_content=DAG97hyqS24&utm_campaign=designshare&utm_medium=link2&utm_source=sharebutton)

- **Polygon Challenge:** the students used four triangular pieces of the same size, which are part of the tangram, to form geometric figures such as square, rectangle, triangle, parallelogram and trapezoid. The challenge was carried out in pairs, one student against the other, where a geometric shape was presented to be assembled, the student won the game by assembling the figure in less time and using all the pieces on display. This dynamic favored the development of agility, stimulation of spatial visualization, creativity, competition and recognition of geometric properties. To support the realization of the activity, the link for printing the polygons used in the game is available, allowing readers to have access to the pieces in a practical and organized way, ensuring the reproduction of the experience in different pedagogical contexts.

(<https://drive.google.com/drive/folders/15k85ho11cf60jQgVPFO9BLi1WA5sssbg?usp=sharing>)

All the playful activities developed throughout the project were created or adapted exclusively for this pedagogical proposal. The elaboration of each dynamic was based on the objectives of the project and the needs observed in the class, seeking to integrate the mathematical contents into the daily life of the students in a meaningful way. The adaptations and traditional games were strategically designed to stimulate logical reasoning, creativity, autonomy and student engagement. In addition, the activities have a replicable character, and can be applied in other classes of Elementary School II, with adjustments according to the level of learning and the profile of the students, applying their reach and pedagogical impact.

These activities were planned based on the principles of playfulness, which according to Grandó (2007), is not limited to the use of manipulable materials, but involves the performance of actions that provide satisfaction and engagement. The BNCC (2018) also reinforces that resources such as educational games are essential for understanding mathematical objects and for developing skills such as critical thinking, problem solving, and argumentation.

The use of games in the teaching of Mathematics, far from being a waste of time, proves to be an effective and transformative pedagogical strategy. The project carried out demonstrated in practice how games can enhance the teaching and learning process.

The idea that games are just moments of distraction or pastime is deconstructed when one observes the positive impact they generate in the school environment. The games stimulate logical reasoning, concentration, creativity and the pleasure of learning Mathematics. In addition, they favor socialization, cooperation, and the development of cognitive and emotional skills.

The teacher, by incorporating games into the teaching process, assumes the role of mediator and advisor of learning. It not only organizes the activities but also creates an environment where students feel challenged and motivated to participate. The mediation of the learner is essential for games to go beyond the dimension of entertainment and become meaningful pedagogical experiences. As Vygotsky (1998) does, "learning awakens several internal developmental processes that can only occur when the individual interacts with other people", evidencing the importance of teacher intervention to increase the social and cognitive development of students.

In addition, the teacher plays a strategic role by selecting and adapting the games according to the learning objectives and the class profile. This pedagogical intentionality ensures that each dynamic is aligned with the curricular content and the needs of the students. In this way, the teacher acts as a protagonist in the construction of an innovative educational space, in which the pleasure of learning is combined with academic rigor, favoring both the intellectual and emotional development of students.

The BNCC and the National Curriculum Parameters (PCN) recognize games as essential didactic resources, as they allow the simulation of problem situations, encourage the development of strategies and promote meaningful learning. Authors such as Vygotsky (1989), Grando (2007) and Kishimoto (2012) reinforce that playing is an essential activity for social and intellectual development, thus creating a development zone where the student learns with more autonomy and engagement.

In addition to promoting the learning of the contents, the work focused on the development of socio-emotional skills and the appreciation of the students' experience as protagonists of the educational process. By experiencing the games in teams, the students were encouraged to make decisions, deal with mistakes, respect the rules and collaborate with their classmates - elements that go beyond Mathematics and collaborate for the integral formation as citizens.

In the teaching-learning process, error should be seen as an integral part of the construction of knowledge. When the teacher values the mistakes of students as opportunities for reflection, he creates an environment in which the student feels safe to take risks, experiment and learn without fear of judgment. This attitude favors autonomy and resilience, as the student begins to realize that making mistakes is a necessary step to achieve more consistent successes. As Borasi (1994) points out, "errors can be seen as starting points for new investigations and discoveries", reinforcing that error is not an obstacle, but a pedagogical resource.

In addition, the role of the teacher is essential in this process, since it is up to him to guide the student in the analysis of his mistakes and propose strategies to overcome them. The teacher acts as a mediator, helping to transform error into meaningful learning, stimulating critical thinking and the ability to revise. This approach helps students develop metacognition skills, learning to evaluate their own practices and seek creative solutions. In this way, the mistake is no longer a sign of disability and is recognized as a fundamental stage in the cognitive and emotional development of students.

Playfulness, in this context, was not treated as mere entertainment, but as a methodological strategy that favors the construction of knowledge. As Grando (2007) argues, the game is an activity that has value in itself, as it provides pleasure in the realization and spontaneous engagement. This perspective was incorporated into the project, which sought to create a light, challenging and meaningful learning environment.

Another differential was the flexibility of the activities developed, all of which have the potential to adapt to different levels of learning and age groups. The use of simple materials, clear rules and contexts close to the students' reality allows the games to be replicated in other classes, expanding their pedagogical reach.

During the meetings, it was observed that the students were motivated, as well as better participation and confidence when dealing with content. The playful approach contributed to reducing resistance to discipline, transforming the classroom environment into a space for dialogue, discovery and collective construction.

Paulo Freire (1996) states:

"Dialogue is the meeting of men, mediated by the world, to pronounce it, and is therefore not limited to the I-thou relationship. It is an act of creation. Dialogue is the encounter in which the reflection and action of its subjects are expressed in solidarity with the world that must be transformed and humanized. This encounter cannot be reduced to an act of depositing ideas from one subject to another, nor can it become a simple exchange of ideas to be consumed by the exchangers. It is an act of transformation and creation. Dialogue is an existential requirement. And if it is the

encounter in which reflection and action are solidarized, it cannot be reduced to an act of pure reflection, nor to an act of pure action, but is action and reflection."

The project reinforces that teaching Mathematics with games is not a waste of time, but an effective way to make the content more attractive, accessible, contextualized and pleasurable. By integrating theory and practice, emotion and logic, playful teaching proves to be a powerful and effective tool for transforming students' reality with Mathematics and with the very act of learning.

In this sense, we also have recreational mathematics that dialogues with playfulness, as it seeks to present mathematical content through challenges, curiosities, riddles and games that arouse the interest of students. Unlike the traditional view, in which Mathematics is perceived as abstract and rigid, Recreational Mathematics aims to transform learning into a pleasurable experience, bringing content closer to reality, stimulating students' creativity.

In this way, the games applied in the project not only fulfilled the function of reviewing or introducing concepts, but also aligned with the spirit of Recreational Mathematics, by proposing challenging situations that required logical reasoning, decision-making and cooperation among the participants. Each activity was planned so that the student learned while having fun, not perceiving Mathematics as an obligation, but as an engaging and meaningful practice.

Recreational Mathematics, when articulated with games, favors the development of skills such as: problem solving, logical reasoning, socialization, cooperation, autonomy and protagonism. This approach demonstrates that Mathematics can be taught in a light and pleasant way, without losing its conceptual depth. By uniting playfulness and Recreational Mathematics, the project demonstrated that it is possible to transform the classroom into an environment of dialogue, discovery and motivation, where learning becomes an engaging and meaningful experience.

Mathematical Modeling is a contemporary trend in Mathematics Education that seeks to bring the studied theme closer to the reality of students. It consists of translating everyday situations into mathematical language, allowing students to build models that represent and explain phenomena, favoring analysis, prediction, and decision-making. In this context, modeling is not limited to the use of ready-made formulas or calculations, but involves the creation of strategies and representations that make learning more meaningful.

In the project, this trend of teaching Mathematics was explicitly present in several activities carried out. The Monetary Quiz, for example, led students to model buying and selling situations, using calculations with banknotes and coins to solve practical problems.

The Polygon Challenge, using tangram, stimulated spatial visualization and the construction of geometric models, favoring the understanding of the properties of the figures.

In the Mathematical Battleship, it is also related to modeling, as it required students to interpret the space of the board, locate coordinates and solve multiplication and division calculations in limited time. This activity promoted the construction of strategic game models, in which students needed to plan their actions and predict possible results.

In this way, Mathematical Modeling, when integrated with playful practices, reinforces the contextualized character of teaching. The students not only solved exercises, but also experienced simulated daily situations, developing skills such as logical and critical reasoning, the ability to abstract, autonomy and interdisciplinarity.

This approach demonstrates that this tendency, combined with playfulness, is not an isolated practice, but a methodological strategy that expands the pedagogical reach of games. By integrating theory and practice, the project demonstrated that it is possible to transform the teaching of Mathematics into something attractive, engaging, effective and easy to understand, as well as into a living tool, capable of dialoguing with the reality of students.

The use of games in the teaching of Mathematics should not be visited as a secondary practice or as mere entertainment, but as a methodological strategy that favors the construction of knowledge. According to Grando (2007), "the game is much more than a simple manipulable material. It corresponds to what we call playful activity." This perspective was incorporated into the project, which sought to create a light, challenging and meaningful learning environment, in which students could learn in a pleasant and engaged way.

Recreational Mathematics was also present in the proposed activities, because, according to Borin (2004, p. 89), "the use of games in Mathematics classes is an important factor that contributes to reducing the blocks presented by many students who fear Mathematics and feel incapable of learning it." By transforming so-called abstract content into practical and fun challenges, the games allowed students to spontaneously engage with the discipline, developing logical reasoning, creativity and autonomy.

Another important aspect was the use of Mathematical Modeling for playful practices. According to Smole, Diniz and Milani (2007), games can be used as problem-solving instruments, because "the possibility of using games is related to learning, to the very construction of mathematical knowledge, therefore, to problem solving". In the project developed, the activities allowed everyday situations to be translated into mathematical language and explored in a meaningful way.

Playfulness, in this context, was not treated as mere entertainment, but as a methodological strategy that favors the construction of knowledge. As Vygotsky (1989, p.

130) points out, "play creates for children a zone of proximal development that is nothing other than the distance between the current level of development [...] and the level of potential development". This view reinforces that games, when applied in the classroom, expand learning possibilities, allowing students to advance in their knowledge with the support of colleagues and teachers.

In addition, the BNCC (2018, p. 218) advises that "didactic resources such as checkered meshes, abacuses, games, books, videos, calculators, electronic spreadsheets, and dynamic geometry software play an essential role in the comprehension and use of mathematical notions". This guideline legitimizes the use of games as pedagogical tools, recognizing their importance for the development of skills such as critical thinking, problem solving, and argumentation.

During the project meetings, it was observed that the students were more participative, motivated and confident when dealing with the proposed contents. The playful methodology helped to reduce resistance to discipline, transforming the classroom environment into a space for dialogue, discovery and construction. Freire (1996, p. 86) states that "the good teacher is the one who manages, while speaking, to bring the student to the intimacy of the movement of his thought".

In this context, games have become tools that have brought students closer to the discipline, making the teaching and learning process more meaningful and human. The flexibility of the activities carried out reinforces the innovative character of the project, which can serve as an inspiration for future practices in different school contexts.

Therefore, the project reaffirms that teaching Mathematics with games is not a waste of time, but an effective way to make the content more attractive, accessible, contextualized and pleasurable.

6 FINAL CONSIDERATIONS

The development of the project highlighted the potential of innovative pedagogical practices that incorporate games as methodological instruments in the teaching of Mathematics. The experience demonstrated that playfulness, Recreational Mathematics and Mathematical Modeling can be effectively integrated, contributing to a more dynamic, attractive and meaningful teaching and learning process, regardless of the students' learning level.

Despite the advances, it is important to emphasize that the use of games is not yet a widely disseminated pedagogical practice in Brazilian schools. As Batista, Soares, and Bezerra (2023) point out, even with the existence of accessible materials, such as software

and low-cost games, many institutions still do not systematically incorporate playfulness into their pedagogical practices. This reveals the need for greater investment in teacher training and in projects that encourage the use of innovative methodologies.

It is concluded, therefore, that the teaching of Mathematics through games is an effective and necessary strategy to transform the relationship of students with the discipline. The project demonstrated that it is possible to make learning more pleasurable, contextualized and meaningful, contributing to the integral formation of students.

It is hoped that this work will inspire teachers and researchers to reflect on the relevance of games in the teaching of Mathematics, expanding their use in different school contexts. More than an isolated practice, games should be understood as an integral part of school culture, capable of promoting not only the learning of content, but also the development of cognitive, social and emotional skills that are fundamental for life in society.

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