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THE USE OF EDUCATIONAL GAMES TO LEARN MATHEMATICS

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ABSTRACT

The use of educational games in the teaching of Mathematics was configured as a theme of high relevance for improving pedagogical practices, since the traditional challenges of the discipline imposed the need for innovative approaches that promoted student engagement and the effective assimilation of contents. The general objective of this work was to analyze the effectiveness of educational games in promoting mathematical learning, while the specific objectives directed the investigation to the integration of these resources with the curricular contents, the evaluation of the impact of these games on the motivation and performance of students, and the identification of the potentialities and limitations of the methodologies applied in this context. The research was carried out through a bibliographic approach, which was based on collecting and analyzing academic articles, books, theses, dissertations and publications available in recognized databases, using the keywords. This methodology consisted of the act of collecting materials that enabled the systematization of theoretical references, as recommended by Santana and Narciso (2025), allowing the construction of a theoretical framework. The data organized and analyzed showed that the application of educational games promoted a dynamic and interactive teaching environment, facilitated the understanding of mathematical concepts and stimulated student involvement, concluding that the integration of innovative pedagogical practices and digital resources proved effective to overcome the challenges of traditional Mathematics teaching.

Keywords: Mathematics. Playfulness. Apprenticeship. Technology. Gaming.

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INTRODUCTION

The use of educational games in the teaching of Mathematics is a theme of high relevance for the improvement of pedagogical practices, since the traditional challenges of the discipline impose the need for innovative approaches that promote student engagement and the effective assimilation of contents. The discussion on this theme shows that interactive and playful strategies have the potential to transform the learning experience, contributing to overcoming the difficulties common in the various school levels.

The general objective of this research is to analyze the effectiveness of educational games in promoting mathematical learning. In parallel, the specific objectives direct the research towards: (i) the integration of digital resources with the curricular contents, to articulate the games with the pedagogical objectives; (ii) the evaluation of the impact of these games on the motivation and performance of students, evidencing the contributions of playfulness to the educational process; and (iii) the identification of the potentialities and limitations of the methodologies applied in this context, considering the challenges and contributions presented by the literature. Therefore, the following guiding question arises: 'in what way do educational games promote students' learning and interest in the subject of Mathematics?'

The methodology adopted is based on a bibliographic research, according to the precepts established by Santana and Narciso (2025), in the work "Pillars of Educational Research: Authors and Scientific Methodologies in Highlight". The data are collected through documentary analysis of the literature, using the technique of systematization of theoretical references to elaborate a panorama that encompasses both the need for systematic planning in the integration of games with instructional objectives and the evaluation of the impacts arising from the implementation of these strategies.

In the development of the work, the discussion about games in education highlights the importance of defining specific instructional objectives, the careful selection of resources (digital and non-digital) and the articulation of these elements with the syllabus. This approach emphasizes that the playfulness and interactivity inherent to games provide active and meaningful learning. Next, the analysis of the impact of educational games on pedagogical practice emphasizes that the integration of digital resources enhances the experimentation and visualization of mathematical concepts, which, in turn, streamlines the teaching process and favors the active participation of students. In addition, the investigation on the potential of games in the development of mathematical teaching

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highlights that, even in the face of the challenges associated with the application of these methodologies, digital games contribute in a relevant way to overcoming learning difficulties.

Finally, the presentation of a case study, which exemplifies the practical implementation of innovative strategies through the development of the *Matblox game* at the Olavo Bilac State School, enriches the theoretical and practical basis of this investigation. The reported experience demonstrates, in a concrete way, the results achieved and the challenges faced in the integration of educational games into the school environment.

Therefore, the present investigation integrates theoretical foundations with practical evidence about the application of educational games, allowing a deep understanding of the effects that such strategies exert in the promotion of the teaching of Mathematics. As a result, the results obtained support the development and implementation of innovative pedagogical approaches, which improve learning processes and strengthen the capacity of educators to transform the school environment.

METHODOLOGY

In the methodology, the selection of sources, the critical analysis of the materials and the organization of the references were carried out, to achieve the objectives outlined and subsidize the solution of the research problem. The materials and methods used included the collection of academic articles, books, theses, dissertations, and pages of *specialized websites*, as well as publications in renowned databases. The research was carried out in a bibliographic way, according to the precepts established by Santana and Narciso (2025) in "Pillars of Educational Research: Authors and Featured Scientific Methodologies", which explained that this methodology consisted of the act of collecting various materials to gather information that could support the solution of a research problem.

During the process, the theme was initially identified and then the search for sources was carried out using simple keywords, such as 'games', 'education', 'mathematics' and 'digital teaching'. The databases used included SciELO, which is characterized by being an electronic library that brings together a collection of highly relevant scientific journals, and CAPES Periódicos, which constitute a system that provides access to a wide variety of academic and scientific publications. The inclusion of sources was determined based on

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criteria of relevance and topicality, favoring recent publications of high academic quality, while exclusion occurred based on criteria of outdatedness and low relevance to the theme.

The instruments and procedures adopted involved the systematization of the theoretical references through a rigorous documentary analysis, which included the identification, selection and organization of the data extracted from the researched materials. Thus, the methodology employed allowed the construction of a consistent and grounded theoretical framework, which enabled the achievement of the proposed objectives. In summary, the methodological approach adopted adequately articulated the collection, analysis and organization of data, providing a solid foundation that contributed significantly to the discussion of the results presented in the study.

GAMES IN EDUCATION

It is observed that the implementation of educational games in the teaching process requires systematic planning, which involves the definition of specific instructional objectives, the appropriate selection of resources (whether digital or non-digital) and the articulation of these with the syllabus. In addition, educators must establish a sequence of activities, determining the exact moments for the application of the games, to ensure coherence between the proposed challenges and the pedagogical goals. In addition

> In this context, the use of educational games (digital and non-digital) as a teaching strategy has become an innovative tool, so that they enhance active and more meaningful learning, where students (players) build knowledge based on his own experiences (Ramos; Lorenset; Petri, 2016, p. 2)

Subsequently, the operationalization of games in pedagogical practice requires a clear definition of the rules and restrictions that will govern the activities, allowing students to engage in competitive and collaborative dynamics. In this way, the games are integrated into the classroom routine through specific moments that dialogue with the different phases of the content to be taught.

In addition, the adaptation of games to the particularities of groups of students and the pace of formal education is an essential aspect for the effectiveness of the strategy, as explained by Oliveira and Hildebrand (2018, p. 107) "In recent years, the use of computer games and games for learning in formal and non-formal education has provoked many discussions". Furthermore, to highlight the fundamental structure of educational games, the

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definition of the authors, Ramos, Lorenset and Petri, (2016, p. 2), which summarizes the essential elements of this instructional strategy, is presented:

> We can define an educational game as any activity with an instructional format or that stimulates learning, that involves competition and is organized by rules and restrictions to achieve a certain educational objective.

Consequently, it is found that the structuring components of the games — such as the competitive organization, the defined rules and the integration with the curricular contents — must be incorporated in an articulated way into the pedagogical practice. In other words, the systematization of games in the educational environment implies adapting their operational elements to the demands of teaching, so that the playful activity is inserted coherently and functionally to the development of mathematical contents.

THE IMPACT OF EDUCATIONAL GAMES ON PEDAGOGICAL PRACTICE

It is found that educational games have a significant potential to motivate students, since the playful aspect can favor engagement in didactic activities. In addition, it is verified that, according to the authors, "Among the reasons for its use in supporting education, the playful aspect stands out, which can motivate the learner to engage in didactic activities" (Brandão *et al*., 2018, p. 736). Thus, the encouragement of active participation is considered a primary factor for the effectiveness of pedagogical practices.

In addition, the integration of educational games in the teaching process provides an experience that favors practical experimentation and the visualization of abstract concepts. In continuity, it is observed that "educational games contribute to student learning, enhancing the experimentation and visualization of concepts, in addition to creating environments that awaken students' creativity and interest" (Ramos; Lorenset; Petri, 2016, p. 2). Therefore, the practice of games in the school environment can be understood as a resource that streamlines the teaching process and facilitates the understanding of the contents.

In addition, the incorporation of technological resources, when integrated into educational games, presents an additional potential to improve learning. In other words, it is suggested that the use of technologies in the classroom, when combined with playful activities, contributes to the creation of a more interactive and dynamic environment, favoring the assimilation of content and the overcoming of cognitive challenges (Romio;

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Paiva, 2017). Consequently, the articulation between games and technological resources can offer a more complete approach adapted to the needs of the school context.

In addition, the planning and execution of activities involving educational games require the clear definition of objectives, the organization of steps and the systematization of the rules that govern each activity. In this way, educators can promote integration between games and curricular content, ensuring that each playful experience is aligned with the teaching purposes. In addition, this systematization facilitates the evaluation of results and the identification of learning processes, contributing to the continuous improvement of pedagogical practice.

Thus, the use of educational games, associated with the integration of technological resources and the meticulous definition of their guidelines, reveals itself as a strategy that not only promotes experimentation and visualization of concepts, but also stimulates students' creativity and interest. Thus, studies indicate that the harmony between these pedagogical approaches can transform the teaching environment into a space conducive to innovation and the development of essential skills in the educational process.

POTENTIAL OF GAMES IN THE DEVELOPMENT OF MATHEMATICAL EDUCATION

The learning of mathematics presents significant challenges at various school levels, which makes it imperative to search for innovative strategies that can help overcome these difficulties. In addition, it is possible to indicate "that the learning of mathematics presents difficulties at various school levels." (Brandão *et al.*, 2018, p. 736), a fact that justifies the need to explore differentiated teaching methods that break with traditional models and promote more effective learning.

In addition, digital games have stood out as tools of great potential in the teaching of Mathematics, since they can stimulate the interest of students through interactive and challenging dynamics. In this way, "digital games are promising tools for teaching Mathematics, contributing significantly to increasing students' interest in mathematical content" (Araújo *et al.*, 2024, p. 2). In this sense, the use of these technological resources can be seen as an alternative to transform the learning environment, making it more attractive and connected with contemporary demands.

In addition, the analysis of educational games reveals that there is a predominance of the procedural aspect, especially related to the solution of equations, in comparison with the conceptual aspect, which emphasizes mental calculation. Consequently, "In the

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analysis of the games, it was observed that the procedural aspect, related to the solution of equations, was the most predominant, followed by the conceptual aspect, which emphasizes mental calculation" (Araújo *et al*., 2024, p. 13). This finding highlights the importance of balancing the operational elements of games with the need to also develop abstract cognitive skills.

Furthermore, the literature points out in general that digital games can work as catalysts for students' interest and engagement in the study of Mathematics. Thus, "In general, the literature points out that digital games can act as catalysts for students' interest and engagement about Mathematics" (Araújo *et al*., 2024, p. 16). In this way, the implementation of such resources contributes to creating a teaching environment that encourages the active participation of students, favoring the development of essential skills for the discipline.

Additionally, to exemplify the practical applicability of games in the teaching of Mathematics, it is observed that platforms such as *Kahoot* and *GoConqr* can be used for the elaboration of *quizzes*, which enable greater interaction of students with the contents covered. This can be observed in the statement of the authors Romio and Paiva (2017, p.90) who expressed, "An example of this, games such as *Kahoot* and *GoConqr* can be used to prepare *quizzes* and enable greater interest in the discipline". Thus, the use of these resources proves to be an effective strategy to bring students closer to mathematics playfully and dynamically.

Finally, it is emphasized that the approach of educational games allows a different way of dealing with the mistakes made during the learning process. In other words, the response to a mistake during interaction with a game differs from the way this situation is treated in traditional classes, offering immediate and adaptive feedback that can contribute to the correction and improvement of students' performance (Romio; Paiva, 2017). Consequently, the integration of this characteristic with playful resources enhances the learning environment, promoting a more effective and engaging educational experience.

CASE STUDY: THE IMPLEMENTATION OF *MATBLOX* AT THE OLAVO BILAC STATE SCHOOL

Learning mathematics presents significant challenges at various school levels, which imposes the need for innovative strategies to overcome such obstacles (Brandão *et al*., 2018). Given this, the adoption of alternative methods, which involve technology and

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playfulness, proves to be a pertinent response to reconfigure the teaching and learning processes.

In addition, the implementation of educational games in the school environment is configured as a strategy capable of effectively integrating curricular content with activities that arouse the interest of students. In this context, at the Olavo Bilac State School, in Águas Lindas de Goiás, students from the 7th grade of Elementary School, under the guidance of the teacher, developed the game *Matblox*. This project started from the teacher's evaluative proposal and suggestion, entitled 'Exploring Mathematics in Roblox', thus demonstrating an adaptation of the initial project, which originally contemplated the creation of materials related to recyclable materials.

In addition, the choice to direct the project to the development of a virtual game focusing on the specific knowledge of integers shows the students' ability to apply mathematical concepts practically. In this way, the application of digital games in the teaching of Mathematics demonstrates a high potential to stimulate student engagement and promote a more accentuated interest in the contents of the discipline (Araújo *et al*., 2024).

In addition, the analysis of the educational games developed shows that the procedural aspect, particularly in solving equations, is the most prominent, followed by the conceptual aspect, which emphasizes mental calculation. Thus, when examining the games, it was observed that the practical approach, focused on solving equations, predominates, while the emphasis on the development of mental calculation is in a secondary position (Araújo *et al*., 2024). Consequently, this approach allows students to exercise both practical application and theoretical understanding of mathematical concepts.

Additionally, the implementation of *Matblox* demonstrated that digital games can work as catalysts for students' interest and engagement in the discipline of Mathematics (Araújo *et al*., 2024). Therefore, the virtual environment, which reproduces the graphic setting of the school itself on the *Roblox platform*, provides a scenario where mathematical challenges are presented innovatively and interactively.

In addition, *Matblox*'s setting, which faithfully reproduces the school environment, allows students to move virtually through classrooms and common areas, solving mathematical challenges aligned with the content of the school year. Through this approach, students can advance to new stages as they complete the proposed challenges, which reinforces the practical application of the concepts learned. In addition, this

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methodology differs significantly from traditional methods, especially in the way errors are treated, providing immediate and adaptive feedback that is not observed in conventional classes (Romio; Paiva, 2017).

Finally, the case of the Olavo Bilac State School illustrates in an exemplary way how the integration of educational games can transform pedagogical practice. As evidenced, the combination of theoretical references with the real practice of *Matblox* demonstrates that the use of digital resources, combined with an innovative evaluative proposal, promotes not only the understanding of mathematical contents, but also the engagement and creativity of students. Thus, the experience lived in this institution serves as a reference for the adoption of similar methodologies in other educational contexts, reinforcing the importance of strategies that dialogue with the contemporary demands of teaching.

RESULTS AND DISCUSSIONS

Initially, the main conclusions of the study are highlighted, which show that the implementation of educational games in the teaching of Mathematics provides an effective integration between curricular content and interactive playful activities. In particular, the data indicate that the use of digital games contributed to a significant increase in the interest of students, facilitating the understanding of mathematical concepts. Thus, the study confirms that the use of technological resources combined with playfulness can create a more dynamic learning environment that is conducive to experimentation, as demonstrated by the theoretical frameworks (Brandão *et al*., 2018; Araújo *et al*., 2024).

In addition, the analysis of the applied games revealed that the procedural aspect, notably in the solution of equations, was the most predominant, while the development of mental calculation was less intense. This result reinforces the need to balance the practical and conceptual elements in the teaching of Mathematics, to promote not only the execution of procedures, but also the understanding of the theoretical foundations (Araújo *et al*., 2024). In other words, the study suggests that, although games encourage problem-solving, there must be a careful articulation between practice and theory so that students can effectively consolidate mathematical concepts.

The significance of these findings lies in the demonstration that innovative strategies, such as the use of digital games, are feasible to transform traditional pedagogical practice. By integrating these tools into the school routine, it is observed that

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students are more willing to get involved with the contents, which contributes to overcoming the challenges inherent to the teaching of Mathematics. Thus, the results point to a positive change in the learning process, evidencing the importance of incorporating methodologies that dialogue with the contemporary demands of the educational environment.

In addition, these findings are consistent with what has been pointed out by other studies in the area, which emphasize that digital games act as catalysts for students' interest and engagement in Mathematics (Araújo *et al*., 2024). Therefore, the present study not only corroborates the existing literature, but also reinforces the need to expand the use of interactive technologies in teaching practices, enabling a more complete approach adapted to the students' reality.

However, it is important to highlight the limitations of the findings, which refer mainly to the variability of school contexts and the difficulty of generalizing the results to different educational realities. Indirectly, bibliographic studies indicate that methodological constraints, such as the limited sample size and the specificity of the context in which the games are applied, may compromise the scope of the results. This limitation reinforces the need for caution in interpreting the findings and points to the importance of replicating the research in diversified environments.

In addition, the unexpected or inconclusive results, such as the predominance of the procedural aspect to the detriment of the development of mental calculation, can be attributed to the complexity of the learning processes and the variations in the methods of application of educational games. This divergence suggests that external factors, not controlled in the present study, such as individual differences among students and variations in the practical implementation of activities, influenced the results. Thus, the literature points out that these issues can be explained by the need for a fine-tuning of the pedagogical strategies adopted, seeking a more balanced integration between practice and theory (Romio; Paiva, 2017).

Finally, the study suggests that future research should adopt expanded methodological approaches, involving more heterogeneous samples and varied contexts, to examine in more depth the impact of educational games on the teaching of Mathematics. Extensive investigations are also recommended, to analyze the long-term effects of these interventions and identify which contextual factors enhance or restrict the impact of interactive technologies on the learning process. In this way, the continuity of

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studies in this area can provide more robust subsidies for the consolidation of innovative and adaptive pedagogical practices, contributing to the evolution of the teaching of Mathematics in different educational realities.

CONCLUSION

The study allowed us to answer the questions raised in the introduction and the methodology, demonstrating that the application of educational games in the teaching of Mathematics provided an innovative approach to face the traditional challenges of the discipline. It was observed that the use of digital resources, when integrated with pedagogical practices, enabled a more dynamic, interactive learning environment conducive to experimentation. In this way, the initial questions about how to transform the teaching of Mathematics and increase the interest of students were duly answered through the implementation of the proposed strategies.

In addition, the objectives of the research were successfully achieved. The purposes of integrating curricular content with playful activities and promoting student engagement were confirmed by the results obtained, which showed that the use of digital games contributed to the assimilation of mathematical concepts and the overcoming of difficulties at various levels of learning. It was found that the procedural approach, combined with elements that stimulated the development of mental calculation, provided an improvement in the understanding of the contents, as the theoretical references indicated. In this way, the objectives of innovating pedagogical practices and streamlining the teaching process were fulfilled, corroborating the effectiveness of the methods applied.

Finally, the study left important notes for future research. It was recommended that subsequent investigations adopt broader methodological approaches, with the inclusion of heterogeneous samples and the performance of longitudinal studies, to analyze the long-term effects of the integration of educational games in the teaching of Mathematics. In addition, it was suggested that future research should explore in more detail the contextual factors that can enhance or restrict the observed results, contributing to the continuous improvement of pedagogical strategies. In summary, the findings of this study provided relevant subsidies for the consolidation of innovative practices in education and paved the way for more in-depth investigations that can expand knowledge about the impact of digital games on the learning process.

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