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THE USE OF TECHNOLOGY IN MATHEMATICS TEACHING: Perspectives for implementation within the final years of elementary education

THE USE OF TECHNOLOGIES IN MATHEMATICS TEACHING: Perspectives for Implementation in the Final Years of Elementary Education

Adriana Rodrigues de Aquino Araújo - World Ecumenical University - USA
Diego Antonio Matos Machado - World Ecumenical University - USA
Ana Carolina Aguiar da Silveira- Del Sol- PY
Milane Rebouças Monteiro - Christian Business School - USA
Francisco Thiago da Silva Soares - Christian Business School - USA

SUMMARY

The general objective of this paper is to discuss the use of technologies in teaching Mathematics, highlighting its main perspectives for its implementation in the final years of elementary school. The choice of this topic is justified by the growing presence of technologies in society and the need to understand how they can be effectively applied in teaching this subject, contributing to making the learning process more dynamic, engaging, and meaningful for students. The methodology adopted was bibliographic research, based on the analysis of various authors who discuss the role of digital technologies in the school context. Articles, books, and official documents that address the integration of technological resources into Mathematics teaching, as well as the challenges and possibilities that accompany this process, were selected. The paper is structured around three specific objectives: to explain the use of technologies in teaching-learning processes; to discuss how technologies can act as allies in Mathematics teaching; and to identify the main challenges encountered in the use of these technologies within the school context. The approach adopted seeks to provide a broad and critical perspective on the topic, considering both the pedagogical potential of technologies and the limitations and obstacles that need to be overcome. Thus, this study contributes to broadening the debate on innovative practices and to reflection on policies and strategies capable of strengthening the conscious and effective use of technologies in mathematics education.

Keywords: Technologies; Mathematics; Teaching-learning; Pedagogical innovation.

ABSTRACT

This study has as its general objective to discuss the use of technologies in the teaching of Mathematics, highlighting its main perspectives for the implementation process in the final years of elementary school. The choice of this topic is justified by the growing presence of technologies in society and by the need to understand how they can be effectively applied in teaching this subject, contributing to making the learning process more dynamic, attractive, and meaningful for students. As a methodology, bibliographic research was adopted, based on the analysis of different authors who discuss the role of digital technologies in the school context. Articles, books, and official documents were selected that address the integration of technological resources into the teaching of Mathematics, as well as the challenges and possibilities that accompany this process. The work is structured around three specific objectives: to explain the use of technologies in teaching-learning processes; to discuss how technologies can act as allies in the teaching of Mathematics; and to point out the main challenges found in the use of these technologies within the school context. The adopted approach seeks to provide a broad

and critical view of the topic, considering both the pedagogical potential of technologies and the limitations and obstacles that must be overcome. Thus, this study contributes to broadening the debate on innovative practices and reflecting on policies and strategies capable of strengthening the conscious and effective use of technologies in mathematics education.

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SUMMARY

The present work has as a general objective to discuss the use of technologies in the teaching of the Mathematics assignment, highlighting its main perspectives for the implementation process in the last years of primary education. The selection of the topic is justified by the growing presence of technologies in society and by the need to understand how they can be applied effectively in the teaching of this discipline, contributing to making the learning process more dynamic, attractive and meaningful for students. As a methodology, bibliographic research was adopted, based on the analysis of different authors who discuss the role of digital technologies in the school context. Articles, books and official documents are selected that address the integration of technological resources into the teaching of Mathematics, as well as the challenges and possibilities that accompany this process. The work is structured around three specific objectives: explaining the use of technologies in teaching-learning processes; discuss how technologies can act as allies in Mathematics teaching; and highlight the main challenges found in the use of these technologies within the school context. The approach adopted seeks to provide a broad and critical view of the topic, considering both the pedagogical potential of technologies and the limitations and obstacles that must be overcome. Therefore, this study contributes to expanding the debate on innovative practices and reflection on policies and strategies capable of strengthening the conscious and effective use of technologies in mathematics education.

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1 INTRODUCTION

The advancement of digital technologies, especially in recent decades, has caused profound changes in the way societies interact, produce knowledge and build solutions to complex problems, causing changes each increasingly complex.

In the educational field, these transformations are directly reflected in teaching methodologies, learning strategies and tools used in everyday school life. In this context, mathematics, a subject that requires logical reasoning, abstraction and problem-solving ability, can benefit greatly from incorporation of technological resources, making it more attractive and accessible to students.

The final years of elementary school, from 6th to 9th grade, represent a crucial moment in students' academic careers. It is during this phase that mathematical content becomes more complex and demands more capacity for abstraction, organization, and practical application. The introduction of technologies in this scenario, it not only helps to make classes more dynamic, but can also help in overcoming historical learning difficulties, favoring an understanding more concrete and contextualized understanding of mathematical concepts.

The social relevance of the topic is manifested in the need to prepare students for an increasingly digital and interconnected world. In a scenario in which mathematical and technological skills become essential for different professions, integrating these two fields from basic education is a way of ensuring that young people are better prepared to face future challenges.

Furthermore, the use of technologies in mathematics can also contribute to reduce educational inequalities, unfortunately still very present in the context of public education, as it offers new opportunities for access to knowledge and different forms of learning.

In the academic field, the debate on the integration of technologies in teaching mathematics stands out for encouraging research on pedagogical practices innovative. Studies in this area allow us to understand how digital tools, such as educational software, simulators, digital games and learning platforms, can be used to promote the construction of knowledge, enhance engagement of students and support teaching work. Thus, this research is part of a broader movement to seek active methodologies and resources that bring the mathematical content of the student's reality.

The general objective of this work is to discuss the use of technologies in teaching mathematics discipline, pointing out its main perspectives for the process of implementation within the final years of elementary school. As specific objectives seeks to explain the use of technologies within teaching processes learning; discuss how technologies can be used as allies of process of teaching mathematics; and point out the main challenges found for the use of these technologies in the educational context focused on mathematics subject.

The choice of this theme is justified by the fact that, despite the wide availability of technologies, there are still significant gaps in the process of implementing these

tools in math classes. Many teachers face challenges such as the lack of
of adequate infrastructure, the lack of continuing education and resistance to change
methodological. In this sense, understanding the perspectives and obstacles related
the use of technologies in this discipline can contribute to developing more effective strategies
effective integration and pedagogical use.

Another point that reinforces the relevance of the discussion is the observation that technologies, when misused or employed in a way that is disconnected from the objectives pedagogical, may not generate a positive impact on learning. Therefore, it is essential investigate how they can be incorporated into teaching planning, respecting the students' learning pace, encouraging active participation and promoting effective understanding of the content.

Regarding methodology, this work is characterized as research literature review, based on the analysis of scientific productions that address the use of technologies in teaching mathematics, especially in the final years of education fundamental. Choosing this method allows us to gather, compare and synthesize different theoretical perspectives, enabling a comprehensive view of the topic and highlighting both the advances and limitations existing in the area.

The organization present in this work strictly follows its objectives, where each one of the subtopics that are presented later in this work, respond in focal way to the specific objective outlined in this introduction. Thus, the first subtopic is what explains the use of technologies within the teaching process learning presenting an extremely expanded view of this process within the educational context of all subjects that make up basic education.

Next, we discuss how technologies can be used within the educational context as great allies in the teaching process of the subject of mathematics within the final years of elementary school, ending with the main challenges that teachers encounter when implementing technologies within of teaching mathematics.

2.1 Importance of using technologies within the educational context

The rapid digital transformation experienced in recent decades has impacted profoundly the educational landscape, requiring schools, teachers and students to

adapt to new ways of teaching and learning. Digital technologies are no longer mere supports to become active components of the pedagogical process.

When used well, they can promote more interactive education, personalized and meaningful for all students, who are digital natives, and has in technologies a much more symbiotic interaction than other generations, and this makes bringing school content closer to the realities experienced by students.

In essence, educational technology enhances the construction of knowledge by offering multimodal resources such as videos, simulations, applications and environments virtual, which cater to multiple learning styles. Furthermore, it allows the student acts as a protagonist, navigating through different sources, collecting data, experimenting and reflecting on their own procedures, promoting autonomy and critical thinking.

The use of technological tools also favors the democratization of access to information. This is especially evident when educational institutions adopt virtual learning environments (VLEs), which allow students to access content, carry out activities and interact with teachers and colleagues from anywhere and at any time moment. This factor broadens inclusion and helps overcome geographical and temporal barriers, enabling new study opportunities for different audiences.

Technologies also help teachers identify gaps in learning. Digital platforms and adaptive systems offer detailed data on student performance, allowing for more precise pedagogical interventions and personalized. Thus, the conscious use of these resources can contribute to making the fairer and more efficient education, meeting the individual needs of each student.

Furthermore, contact with technologies encourages the development of 21st century skills such as critical thinking, creativity, collaboration and digital literacy. By interacting with digital tools, students become familiar with contemporary languages and learn to solve complex problems in contexts diversified, which is essential for professional and personal life in today's society (Valente, 2018).

Pedagogical innovation gains strength when technologies are integrated into curriculum in a planned and coherent manner. They should not be used only as complement, but as elements that can transform the logic of teaching, favoring more student-centered practices and active learning methodologies. This requires teachers to adopt a reflective and intentional stance towards their practice.

In this sense, Papert (1993, p.109) states that “Children learn better when they can act upon the world and immediately see the effects of their actions; computer thus offers a controlled and full of experimentation space concrete meanings.”

This potential for experimentation is particularly effective for understanding mathematical and scientific concepts, as it allows students to visualize phenomena and test hypotheses interactively and safely, using technological resources such as learning support.

In a recent study, Silva (2020, p. 47–48) highlights that “The introduction of digital simulations in teaching abstract mathematical concepts promotes not only the visual and intuitive understanding of the contents, but also greater autonomy in process of knowledge construction.” This type of approach transforms the perception of mathematics from something rigid and distant to a fertile field of discoveries and practical applications.

The use of technologies also contributes to redefining the role of the teacher, that goes from being a mere transmitter of content to a mediator, guide and facilitator of learning. This change, however, requires continuous investment in training teaching, focusing on mastering digital tools, planning activities interactive and technological mediation (Kenski, 2012).

However, it is essential to recognize that technology, alone, does not guarantee quality in teaching. The positive impact depends directly on intentionality pedagogical and teacher preparation to use it strategically. As state Moran *et al.* (2021, p. 132), “technologies are used as tools strategic, not mere gadgets; it is the pedagogical intentionality that makes the difference.”

It is also necessary to consider the structural challenges that limit the effectiveness of technology in schools, such as the lack of adequate infrastructure, the low quality of internet, inequality of access and the absence of consistent training policies teaching. These factors, if not treated as a priority, can reinforce inequalities existing educational institutions.

Despite the challenges, there is a growing movement towards incorporating educational technologies at different levels of education. The COVID-19 pandemic accelerated this process, showing both the potential and the limits of these tools, especially in contexts marked by digital inequality (Souza, 2021).

Hybrid education, combining face-to-face and remote modalities mediated by technology, has consolidated itself as a viable alternative to guarantee the continuity of education. This modality brought greater flexibility and multiple forms of interaction, requiring reflection on pedagogical models, the teaching role and the creative use of resources available.

In this scenario, the use of technologies in the educational context reveals itself fundamental not only to modernize school practices, but to transform the learning experience. It involves rethinking the curriculum, school organization, and skills that we want to develop in students so that they are prepared to the challenges of the 21st century.

Invest in public policies aimed at digital infrastructure, training continued training of teachers and production of digital educational resources is a measure strategic. Educational technology, when incorporated in a planned and aligned manner to clear pedagogical objectives, it becomes a powerful ally for a more inclusive, meaningful and transformative.

2.2 Use of technologies as allies in the teaching process of the subject of mathematics

After understanding the importance of working with technologies within of the educational context, to bring the teaching processes developed closer to the reality and the demands of students, we will focus at this moment on the use of these possibilities within the teaching of mathematics in the final years of elementary school.

We start from the understanding that teaching Mathematics has always been challenging for teachers and students, mainly due to the need to understand concepts abstract concepts and apply them in practical contexts. With the advancement of digital technologies, new tools and methodologies became part of the school environment, providing resources capable of making learning more meaningful and dynamic.

The use of technologies in teaching Mathematics is not limited to just insertion of computers in the classroom, but involves the incorporation of software, applications, digital platforms and interactive resources that facilitate the visualization of concepts and problem solving.

Digital technologies allow teachers to explore new ways of presentation of mathematical content, expanding the possibilities for interaction and

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experimentation. Applications and programs like GeoGebra, for example, make it possible the construction and manipulation of geometric figures, graphs and functions in real time, helping the student understand complex concepts. In this sense, the use These resources do not replace the role of the teacher, but offer support for teaching clearer and more attractive.

As highlighted by Moran, Masetto and Behrens (2021), technologies have the potential to transform the classroom into a more participatory and collaborative space, as long as they are used in a planned manner and integrated with pedagogical objectives. They state that:

> Technology alone doesn't change education, but it enables profound changes when combined with innovative methodologies, with teachers prepared and committed to student learning. In mathematics teaching, this means creating problem situations, simulating experiments, and exploring virtual learning environments, enhancing logical reasoning and problem-solving skills. (Moran; Masetto; Behrens, 2021, p. 89).

The teacher's role, in this scenario, is that of a mediator, guiding the students in the use of technologies to achieve more effective learning. The simple insertion of digital resources do not guarantee the success of pedagogical practice, planning is necessary to that the activities are meaningful and reflect the reality and needs of the students. This involves knowing the tools well, understanding how they work and knowing how to integrate them into the subject content.

In addition to promoting the understanding of concepts, technologies enable development of essential skills, such as autonomy, critical thinking and collaboration. When working with digital platforms and educational games, for example, the student begins to assume a more active role in the process of knowledge construction, exploring different paths to get to the answers and sharing their discoveries with colleagues.

> When incorporated into mathematics teaching, technologies enable students to experience the subject as a field of investigation and experimentation, where trial and error are integral to the process. By using resources such as dynamic geometry software, spreadsheets, and virtual learning environments, teachers create the conditions for students to explore different representations and gain a deeper understanding of mathematical relationships (Borba; Silva; Gadanidis, 2014, p. 112).

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One of the great benefits of using technologies is the possibility of personalization teaching, adapting activities to the pace and level of understanding of each student. Adaptive platforms, such as Khan Academy, allow students to advance according to their performance, reinforcing content when necessary and introducing new challenges as you demonstrate mastery.

Another important point is that technologies contribute to contextualizing the Mathematics, bringing it closer to students' daily lives. The use of simulators, spreadsheets and statistics applications, for example, allow the student to perceive the application of concepts in real situations, such as data analysis, planning financial and in solving practical problems.

Furthermore, the use of technological resources favors collaborative work, as that many digital tools allow simultaneous interaction between multiple users. Interdisciplinary projects involving Mathematics and other areas, such as Sciences or Geography, can be enhanced with the use of modeling software, maps digital and geographic information systems.

According to Kenski (2012), the integration of technologies into the teaching of Mathematics requires a change of attitude on the part of the teacher:

> The teacher must stop being the sole transmitter of content and assume the role of facilitator of the learning process. By mediating the use of technology, the teacher guides, stimulates, and encourages critical thinking, helping students construct meaning and develop their own strategies for solving mathematical problems. (Kenski, 2012, p. 57).

Thus, the use of technologies in teaching Mathematics must be understood as part of a broader process of pedagogical innovation. It is not just about modernize the classroom, but to transform the way knowledge is constructed, making it more meaningful, collaborative and connected to the students' reality.

In this context, the integration of technologies into the teaching of Mathematics is presented as a promising way to expand learning possibilities, awaken student interest and develop essential skills for the 21st century.

2.3 Main challenges encountered in the use of technologies in the context educational

The incorporation of digital technologies into teaching in the final years of schooling fundamental has proven to be a complex task, permeated by several challenges that impact the effectiveness of its use. Although technological advancement offers numerous possibilities for the pedagogical process, the reality of Brazilian schools — especially in the public network — presents obstacles that make it difficult to take advantage of full of these tools.

One of the main challenges is related to inadequate infrastructure. Many schools still face problems such as a lack of computers in sufficient quantity insufficient, low-quality internet or even no connectivity. According to Silva (2019, p.76):

> The precarious technological infrastructure in public schools limits students' access to digital tools, making it impossible to effectively implement pedagogical practices that integrate technology into daily school life. Unstable connectivity, outdated equipment, and a lack of technical support compromise not only use but also the motivation of teachers and students to innovate.

The author highlights a common reality in many schools maintained by the power public, where technological resources are scrapped or, in many cases, not even exist. This lack of adequate technological infrastructure prevents students from have access to teaching mediated by these tools in a systematic way, making teachers feel limited and unable to develop their activities fully, due to the insufficiency and low quality of resources available.

Furthermore, insufficient teacher training constitutes a significant obstacle. Many teachers enter the career without specific preparation for the use of educational technologies and, during their professional activities, they do not receive training continued adequate.

> The absence of systematic technological and pedagogical training programs prevents educators from developing the skills necessary to integrate digital resources into their planning and practices, reducing technology to a secondary and little-explored instrument in the teaching-learning process (Moraes; Campos, 2020, p. 42).

Another relevant difficulty is resistance to change, which can be found both among teachers and school administrators. The insertion of technologies involves rethinking consolidated practices and adopting active methodologies that require greater

involvement of educators and students. Many professionals still feel insecure or unmotivated in the face of this transformation, preferring to maintain methods traditional.

School management also faces challenges when trying to articulate inclusion technological with administrative and pedagogical demands. The lack of planning strategic, the lack of constant technical support and insufficient financial resources compromise the sustainability of technological projects in schools (Almeida, 2018).

Regarding the curriculum, it is observed that the use of technologies is often not is integrated in an articulated way with the contents and objectives of the discipline of Mathematics. This results in isolated activities, disconnected from the objectives pedagogical, which hinders students' meaningful learning.

Another factor that makes it difficult to use technologies in the final years of education fundamental is the socioeconomic inequality of students. Many of them do not have home access to computers, tablets or the internet, which limits the continuity of learning in virtual environments outside of school. This disparity accentuates the educational inequalities and requires public policies that expand digital access.

Furthermore, the excess of available resources can generate confusion and difficulty so that teachers can choose the most appropriate tools for their goals pedagogical. Overloading options without proper guidance can result in the use superficial or inefficient technologies.

Student motivation can also be negatively affected when technologies are used without consistent pedagogical planning. The use indiscriminate use of electronic devices for activities not related to learning or the lack of interactivity in digital proposals may alienate students from expected engagement.

In the context of evaluation, the absence of instruments that integrate the use of technologies makes it difficult to measure the pedagogical impact of these tools, limiting feedback and adjustment of teaching strategies, which leads to underutilization of these possibilities by teachers.

Furthermore, the role of the teacher as a mediator in the use of technologies is still little valued and understood in educational institutions. This can lead to underutilization of available technological resources, restricting their potential transformer.

In many cases, public policies do not consistently follow the needs of schools for the implementation of technology, whether in terms of investment, training or monitoring. The lack of continuity in projects and the bureaucratization of access to resources compromises the expected results (Souza, 2020).

The development of digital skills among students also depends of encouragement and adequate guidance. The absence of pedagogical strategies aimed for digital literacy limits the critical and productive appropriation of technologies, reducing them to merely instrumental tools.

Another difficulty is the uneven pace of adaptation of schools, teachers and students to new technologies, which can generate mismatches and frustrations in the learning process teaching-learning, as not everyone involved is always able to use these resources at the same speed.

> Technologies in education are not panaceas; their success depends on the articulation of infrastructure, training, planning, and school culture. Without the alignment of these elements, technologies can even increase inequalities and reinforce traditional practices, rather than promoting meaningful change. (Kenski, 2012, p. 101).

Therefore, the challenges for using technologies in teaching the final years of elementary education are multiple and complex. Overcoming them requires efforts articulated between governments, schools, teachers, students and families, with investments in infrastructure, continuing education, pedagogical planning and public policies inclusive.

By facing them, technology will be able to fulfill its role as an ally in the process of teaching, promoting more dynamic, inclusive learning aligned with the demands of the 21st century, thus helping in the development of learning in the discipline of mathematics, which historically creates great challenges for learning and participation of students in the final years of elementary school.

3 CONCLUSIONS

This work fulfilled the general objective of discussing the use of technologies in teaching the subject of Mathematics, highlighting the main perspectives for its implementation in the final years of elementary school. Through a literature review, it was possible to understand how technological resources can transform the

mathematical learning, promoting greater interactivity, autonomy and understanding of the contents.

This analysis highlighted the potential of technologies to modernize practices pedagogical and bring the discipline closer to the reality of students, who have a increasingly close daily relationship with these possibilities, as they are native digital, all this highlighted the importance of planned use and integrated with the objectives educational.

Regarding the specific objectives, the text explained in detail the use of technologies in teaching-learning processes, highlighting their role in knowledge construction and student engagement. He also discussed how technologies work as allies in teaching Mathematics, offering resources that expand the visualization and experimentation of mathematical concepts.

Finally, the main challenges for using these were highlighted. technologies in the educational context, such as insufficient infrastructure, training teaching and inequalities in access, allowing a critical and realistic view that supports the need for appropriate public policies and pedagogical strategies to overcome such obstacles.

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