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Active Methodologies in Mathematics Teaching: A Path to Meaningful Learning

Active methodologies in Mathematics education: A path to meaningful learning

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SUMMARY
Mathematics teaching faces challenges related to the abstraction of concepts and a lack of connection with everyday life. Approaches such as Ausubel's theory of meaningful learning and active methodologies have stood out for promoting greater student engagement and empowerment. These practices, enhanced by digital technologies, facilitate the understanding of abstract concepts and make learning more contextualized and dynamic.
This article reviews studies published between 2019 and 2024, analyzing the impact of these approaches on mathematics teaching. The results indicate that active methodologies, such as flipped classrooms and problem-based learning, promote greater engagement, autonomy, and critical thinking skills, despite challenges related to infrastructure and teacher training. The conclusion is that these practices represent a promising path toward more meaningful mathematics teaching aligned with the challenges of the 21st century.

Keywords: Mathematics; meaningful learning; active methodologies.

ABSTRACT
Mathematics education faces challenges related to the abstraction of concepts and the lack of connection to real-life contexts. Approaches such as Ausubel's meaningful learning theory and active methodologies have proven effective in fostering greater engagement and student protagonism. These practices, enhanced by digital technologies, facilitate the understanding of abstract concepts and make learning more contextualized and dynamic. This article reviews studies published between 2019 and 2024, analyzing the impact of these approaches on mathematics education. The results indicate that active methodologies, such as Flipped Classroom and Problem-Based Learning, promote higher engagement, autonomy, and critical thinking skills, despite challenges related to infrastructure and teacher training. It is concluded that these practices represent a promising path toward more meaningful mathematics education, aligned with the challenges of the 21st century.

Keywords: Mathematics; meaningful learning; active methodologies.

1 INTRODUCTION

Mathematics teaching faces historical challenges, particularly with regard to abstraction of concepts and the difficulty many students have in applying them in everyday life (D'Ambrósio, 2005). To overcome these difficulties, pedagogical practices have been adopted innovative, such as active methodologies and the theory of meaningful learning, which seek

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promote greater engagement, protagonism and contextualization of content (Ausubel *et* al., 1978; Bergmann and Sams, 2012).

The theory of meaningful learning, developed by the American psychologist David Ausubel, emphasizes the integration of new knowledge into students' previous schemes, facilitating both retention and practical application. Active methodologies, such as the Classroom, Flipped Classroom and Problem-Based Learning put students at the center of the educational process, encouraging collaborative and interactive practices that stimulate greater autonomy and engagement in learning (Valente, 2017; Ribeiro and Pereira, 2023).

Recent research indicates that these approaches not only promote understanding of mathematical concepts, but also contribute to the development of skills critical, creative and social, fundamental to the challenges of the 21st century (Damian and Kaiber, 2023; Nascimento, 2024). This article aims to investigate the impact of methodologies active in teaching Mathematics, highlighting how these practices can make learning more meaningful and engaging.

2 **THEORETICAL FRAMEWORK**

2.1 **Teaching Mathematics**

According to D'Ambrósio (2005), the teaching of Mathematics is debated in academic circles, especially due to the difficulties faced by many students in understanding and apply the content in a practical and contextualized way. For the author, it is essential that the teaching this discipline goes beyond the simple transmission of operational techniques, establishing connections with the sociocultural realities of students. In this way, the development of logical and critical thinking by integrating Mathematics into everyday life students.

Currently, the use of digital technologies, such as simulation software and applications, has stood out as an efficient tool to facilitate the understanding of concepts abstract. These technologies provide more interactive and dynamics, expanding the possibilities of student engagement and understanding (Valente, 2018), which can become allies in the teaching of Mathematics.

2.2 **Meaningful learning**

The theory of meaningful learning, developed by David Ausubel, argues that learning occurs when new knowledge is integrated into schemas previously existing conceptual structures, forming an organized and hierarchical cognitive structure (Ausubel *et* al., 1978). In teaching Mathematics, this perspective is fundamental to overcome the idea that concepts are overly abstract, making them more accessible and practical by linking them to everyday situations, such as interest or percentage calculations (Damian and Kaiber, 2023).

Motivation is a central element in this process, and the use of strategies as resources technological and practical activities can make the content more attractive and relevant. Technologies such as interactive simulations help connect Mathematics to people's daily lives. students, facilitating understanding and awakening interest (Valente, 2018). The teacher, in this context, it plays an indispensable mediating role, organizing the content in a way logic and relating them to the students' prior knowledge.

2.3 **Active methodologies**

Active methodologies position the student as the protagonist of the learning process. teaching-learning, fostering their autonomy, participation and engagement. Strategies such as the Flipped Classroom, Problem-Based Learning (PBL), and Rotation by Stations promote the construction of knowledge in a collaborative and practical way. In the Room In a Flipped Classroom, students access the content in advance at home, dedicating their time class to practical activities, discussions and problem-solving (Bergmann and Sams, 2012).

ABP, in turn, challenges students to solve complex problems in a collaborative, linking learning to real contexts (Barrows, 1986). Complementing these methodologies, the use of digital technologies enhances the process, offering interactive and personalized experiences that meet individual student needs (Ribeiro and Pereira, 2023).

3 **MATERIAL AND METHOD**

This article is a literature review, in which the database used for the The research search was the CAPES Periodicals Portal. First, the keywords were defined

key as "active methodologies" AND "meaningful learning" AND "mathematics" in the language Portuguese. The time frame chosen was the years 2019 to 2024, with a view to having as focus on the most recent articles to develop this review. Within these criteria, 14 articles were found, however, only 4 were peer-reviewed, bringing greater reliability in their results and therefore, was a criterion for inclusion in the present study. The last criterion for inclusion was based on the choice to include only experimental articles, which excluded one of them. This Therefore, the 3 articles that met all the defined criteria were used to compose the research.

4 RESULTS AND DISCUSSION

Table 1 presents the articles that met the research criteria for inclusion, it highlights the main information about the works analyzed.

Table 1 - Analysis of studies on the impact of Active Methodologies in Teaching Mathematics

Authors	**Aspects investigated**	**Results**	**Conclusions**
Damian and Kaiber (2023)	Investigated the use of Methodologies Active in teaching Mathematics, applied in two 9th grade classes year. LIFOs were prepared, with topics such as irrational numbers, percentage and interest, using digital resources and strategies such as flipped classroom and rotation by stations.	To the methodologies stimulated the engagement and the commitment of students, promoting learnings significant at the levels representational, propositional and conceptual. The activities practices, such as games and mind maps, helped to develop autonomy and critical thinking.	The study concluded that the Active Methodologies are effective to make learning more participatory and relevant. Despite challenges such as technical limitations, the approach contributed to overcoming difficulties and involved students from more dynamic and reflective way.
Ribeiro and Pear tree (2023)	The study analyzes how *mobile learning,* combined with methodologies active, can promote a meaningful learning in	The use of apps and tools digital made possible the dynamic visualization of	The approach promoted a comprehensive training and emancipatory, integrating theory and

	theme "Complex Numbers" in context of Professional Education and Technological. The research involved 17 3rd year students of Course Technician in Electrical engineering.	procedures mathematicians. To the methodologies active strengthened the student protagonism node process of learning.	practice in an environment collaborative, especially relevant for teaching Mathematics in context professional and technological.
I was born then (2024)	The article explores the application of classroom methodology inverted with the platform *Edpuzzle* in education of Mathematics, involving 35 students and 4 teachers.	THE methodology provided bigger engagement of the students, what actively participated of process of learning. The use of *Edpuzzle* allowed monitor understanding of the students and guide them face-to-face moments to clarify doubts.	The flipped classroom promoted learning significant and student protagonism, highlighting- as an effective strategy for integrate theory and practice in Mathematics.

Source: The author himself (2024).

Damian and Kaiber (2023), Ribeiro and Pereira (2023) and Nascimento (2024) agree that active methodologies promote meaningful learning, integrating theory and practice dynamic and contextualized way. All authors highlight student protagonism, with greater engagement and autonomy, but recognize technical challenges related to infrastructure and teacher training for the implementation of methodologies.

The results reinforce the effectiveness of these approaches in different contexts. Damian and Kaiber (2023) highlighted understanding at representational, propositional and conceptual, while Ribeiro and Pereira (2023) emphasized collaboration in environments technicians, integrating theory and practice. Nascimento (2024), in turn, highlighted the role of *Edpuzzle* in monitoring and personalizing learning, promoting greater autonomy and student engagement.

Despite the specificities of each study, active methodologies, combined with technologies digital, emerge as effective strategies for meaningful learning aligned with

contemporary demands. They also favor the development of critical skills and creative, in addition to stimulating collaboration between students, preparing them for the challenges of 21st century.

5 FINAL CONSIDERATIONS

The present study highlighted that active methodologies and learning theory significant represent promising advances in the teaching of Mathematics and, such approaches, especially when combined with digital technologies, they promote greater engagement, protagonism and contextualized learning, in addition to developing critical skills and creative.

Although challenging due to technological limitations and the need for training teaching, the methodologies analyzed demonstrated potential to transform practice pedagogical, making it more meaningful and aligned with contemporary demands. Thus, they are presented as important tools for facing the historical challenges of the discipline and prepare students for 21st century contexts.

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7