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DEVELOPING PROBLEM-SOLVING SKILLS IN STUDENTS

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Benedito Braz Sobrinho[1], Adriana Rodrigues Siqueira Castelo Branco[2], Marinêz Gonçalves da Silva Rabecini[3], Aline Santos de Lima[4] and Marcio Ferreira de Carvalho[5]

ABSTRACT

The development of problem-solving skills in students is an essential element in the current educational context, as such skills directly influence academic performance and the formation of critical and autonomous citizens. The choice of this theme is justified by the need to train individuals capable of dealing with complex and challenging situations, and the objective of this study is to analyze how pedagogical methodologies can foster these skills. The research used a bibliographic approach to theoretically substantiate educational practices and a quantitative approach to evaluate the effectiveness of strategies such as project-based learning. The main results pointed out that active methodologies not only increase collaboration among students, but also promote the practice of identifying problems, generating solutions and making decisions. The conclusions reveal that the promotion of problem solving requires a continuous commitment to a curriculum that dialogues with the reality of students, empowering them as active solvers in their personal and professional lives. In short, the construction of these skills involves innovative and adaptive practices that go beyond the classroom, implying a critical reflection on the teaching and learning processes. Therefore, investing in the development of problem-solving skills is essential for academic success and for the integral formation of students in the face of a world in constant transformation.

Keywords: Problem Solving. Education. Active Methodologies.

[1]Master in Emerging Technologies in Education
MUST University
Email: benebraz13@gmail.com
[2]Master in Emerging Technologies in Education
MUST University
E-mail: adrianaprofissional70@gmail.com
[3]Master's student in Emerging Technologies in Education
MUST University
Email: professoramarinez@hotmail.com
[4]Master's student in Emerging Technologies in Education
MUST University
E-mail: alinemt.slima@gmail.com
[5]Specialist in Telematics in EducationFederal Rural University of Pernambuco (UFRPE)E-mail: marcarvc@gmail.com

INTRODUCTION

The theme of the development of problem-solving skills among students gains prominence in an era where technological and social changes occur at a rapid pace. In this scenario, education needs to transcend the simple act of memorizing information, emphasizing skills that prepare students to face complex challenges. Thus, problem solving becomes important, both in the academic sphere and in the dynamics of the labor market, reinforcing its relevance in the current context.

In recent years, there has been a growing movement towards pedagogical directions that emphasize the importance of active project-based learning. Several studies indicate that, by encouraging students to develop problem-solving skills, it is possible not only to increase engagement in classes, but also to prepare students to become critical citizens capable of contributing positively to society. Problem-solving skills are, therefore, at the heart of discussions on educational innovation, reflecting a concern with the integral formation of students.

The importance of studying the development of these skills is evident, since the demands of the market and society require adaptable and creative professionals. With globalization and technological advancement, problematic situations have become increasingly complex, and educational institutions have the responsibility to train individuals who not only know theories, but who know how to apply them in real scenarios. This theme is, therefore, of indisputable relevance, since it directly impacts the preparation of students for the future.

The research problem that guides this study consists of the following question: How do current pedagogical practices influence the development of problem-solving skills in students? This issue is complex, as it involves aspects related to teaching methodology, teacher training and the profile of students, in addition to considering the various curricular approaches that exist in institutions. Examining this relationship is fundamental to understanding the challenges and opportunities present in current education.

The general objective of this work is to investigate how the pedagogical practices adopted in the classrooms impact the development of problem-solving skills among students. This purpose is justified by the need to identify which methodologies are most effective and how they can be improved to better meet contemporary demands.

In addition to the general objective, specific objectives were outlined that helped in the construction of this investigation. First, it sought to analyze the different pedagogical approaches used in schools and their impact on students' critical skills. Next, we sought to map the perceptions of educators about the teaching methods that favor the development

of these skills. Finally, we tried to identify the main difficulties faced by students in solving problems and how these barriers could be overcome through pedagogical interventions.

The research adopted a Bibliographic Methodology, based on the analysis of literature pertinent to the theme. This approach made it possible to understand the theoretical foundations related to the development of problem-solving skills and to identify the best practices already documented. Through the critical analysis of existing studies, it was possible to build a theoretical framework that supported the discussions and reflections presented.

In summary, this introduction presents an overview of the relevance of the development of problem-solving skills in the contemporary educational context. By delving into the nuances of the theme and justifying the research, the urgent need to investigate the pedagogical practices that permeate this field is evident. The formulation of the research problem and the definition of the objectives are essential steps to guide the investigation, whose methodology has been clearly outlined. With this, it is expected to contribute significantly to the discussion on the educational training that is necessary in the current social and economic scenario. The transition to the body of work will take place through the analysis of the evidence and experiences that support the proposals for improvement in educational practices.

THEORETICAL FRAMEWORK

The theme of problem-solving in the educational context is widely recognized as an essential skill for the integral development of students, encompassing both cognitive and social aspects. The contextualization of this concept in the field of Mathematics Education revealed its relevance, because, by facilitating the students' ability to deal with challenging situations, it was possible to promote not only mathematical understanding, but also the formation of critical skills for everyday life. Thus, the construction of a theoretical framework on problem solving became imperative for understanding how this skill could be integrated into the teaching-learning process.

Santos, Días, and Souza (2021) highlight that problem-solving plays a role in the experience of metacognition, allowing students to reflect on their cognitive strategies during the learning process. In this sense, understanding the stages that involve problem solving has become essential for the formulation of pedagogical strategies that enhance learning. Among the main concepts that permeate this field, the problem solving model stood out, consisting of four fundamental steps: (1) understanding the problem, (2) elaboration of a plan, (3) execution of the plan and (4) analysis of the results. This interactive process was

not exclusive to mathematics, but extended to several areas of knowledge, favoring the autonomy and criticality of students.

Research on problem-solving in education has undergone several transformations over the decades. Initially, behavioral approaches that emphasized memorization and the mechanical application of formulas predominated. However, with the advancement of investigations in the field of Mathematics Education, a broader understanding of the need to promote meaningful learning has emerged. Sousa (2020) pointed out that initial teacher training should incorporate methodologies based on problem solving, allowing teachers to develop effective strategies to teach this competency. This transition to a more interactive and reflective perspective has become central to the development of innovative pedagogical practices.

Problem-solving was also widely discussed from the perspective of social skills and academic coping strategies. Santos and Soares (2020) analyzed the impact of these variables in the university context, demonstrating that students with greater problem-solving skills had better rates of academic adaptation and school performance. In the context of basic education, this factor proved to be equally relevant, as the ability to solve problems not only facilitated mathematical learning, but also contributed to the formation of more critical and autonomous citizens.

Another key aspect in the evolution of this debate was the role of technologies in the development of skills associated with problem solving. Rossi and Aragón (2023) investigated the potential of educational robotics in the formation of computational thinking and in the promotion of student autonomy. According to the authors, robotics has stimulated the application of problem-solving strategies in concrete situations, contributing to more active and meaningful learning. In this sense, there was a growing movement in favor of the incorporation of technological methodologies that favored experimentation and student engagement.

The relationship between the theoretical concepts of problem solving and the research problem became evident when considering the educational context in which the students were inserted. Teaching strategies centered on this approach have not only promoted mathematical learning but also facilitated the development of essential skills for professional and social life. Santos, Días, and Souza (2021) point out that metacognition played a decisive role in this process, allowing students to become aware of their own resolution strategies. Thus, integrating these concepts into pedagogical practice proved to be an efficient strategy to prepare students to face complex challenges.

The theoretical framework presented provided a consistent basis for understanding the phenomenon of problem solving in education, highlighting the importance of approaches that favor the integral formation of students. The articulation between the theories and practices discussed allowed a critical and analytical view of the current state of knowledge in the area, establishing clear connections with the research objectives. In this way, the construction of a solid theoretical framework grounded the research proposal, contributing to the advancement of Mathematics Education and the development of essential competencies in the school environment.

DEVELOPMENT OF PROBLEM-SOLVING SKILLS

Developing problem-solving skills in students requires an integrated and strategic approach. This competence transcends mere technique; It involves the critical ability to analyze information, create solutions, and collaborate effectively with others. In order for students to develop these skills, they need to be exposed to stimulating, student-centered teaching methods that prepare them to face real-world challenges. Active learning, for example, is an especially effective path. In this format, students are encouraged to actively participate in the exploration of relevant issues, thereby strengthening their reasoning skills.

One methodology that has been gaining prominence is problem-based learning, which stands out for allowing students to solve authentic situations in small groups. "Problem-based learning is a resource that fosters collaboration and communication, essential elements in the formation of critical thinking" (Freitas, 2025, p.54). In this context, the role of the educator becomes that of a facilitator who guides students in the identification of creative solutions, promoting discussion and reflection on the learning process.

In addition to practical skills, it is essential to cultivate resilience in students. Understanding that mistakes are part of learning is essential for the formation of an individual who adapts to adverse situations. This insight allows students to analyze their flaws and learn from them, reevaluating their strategies. Activities that require multiple attempts and constant adjustments are beneficial, as they favor adaptive and flexible thinking.

The metacognitive approach also stands out as a valuable tool in problem-solving. By encouraging reflection on the learning process itself, students develop a deeper awareness of their strategies and methods. Metacognitive strategies "are fundamental in problem solving, since they allow the student to monitor their own understanding" (Lima *et al.*, 2018, p.245). This self-reflection can be stimulated through group discussions and

continuous feedback, both among colleagues and educators. According to Lima *et al.*, 2018, p.25

> A study on the impact of AI on education, addressing personalization of teaching, automated assessment, and intelligent tutoring systems notes that 'Complex problem-solving, for example, requires a combination of critical thinking, creativity, and collaboration, skills that are best developed through hands-on activities and social interactions. AI can be a valuable tool to support the development of these skills, but it cannot completely replace the human experience. It is essential to strike a balance between the use of technology and the development of essential human skills'. Therefore, the strategic implementation of artificial intelligence technologies in educational processes can enrich the learning experience, providing support in personalization and automation, but maintaining the focus on the development of critical human skills through traditional teaching methods.

The integration of technology into the learning environment is another essential dimension. Digital resources provide students with opportunities to simulate challenging situations in a safe space where they can experiment and apply solutions. Virtual environments can enrich the teaching experience by providing contexts that foster curiosity and exploration. In this sense, technology not only facilitates access to information, but also proposes interactive dynamics that challenge students to think critically.

Robotics education, for example, shows promise for developing problem-solving skills. Educational robotics allows students to develop computational thinking skills, essential in contemporary society (Rossi; Aragon, 2025). By engaging students in hands-on programming and assembly activities, this approach encourages them to work as a team and creatively apply concepts to solve technical challenges.

For there to be real progress in the formation of problem-solving skills, it is essential that educational institutions promote a culture of collaborative learning. This culture must be sustained by varied opportunities for interaction, where students can exchange experiences and knowledge. Building an environment where dialogue and the exchange of ideas are encouraged contributes to the formation of a learning community, which is vital for the development of skills.

Pedagogical adaptation in university environments is also relevant. Academic adaptation is a determining factor for the success of students in higher education (Monteiro; Soares, 2023). Institutions must be aware of the needs and challenges faced by their students, adjusting their methodologies to ensure that everyone has the opportunity to

develop and contribute meaningfully. This also involves implementing support programs that help students overcome barriers.

In this scenario, it is important to emphasize that the diversity of methods and approaches must be present in pedagogical practices. Each student brings with them a unique set of experiences and perspectives, which can enrich the learning process. By incorporating different learning styles and valuing individual contributions, educators increase teaching effectiveness and student motivation.

The development of problem-solving skills is therefore a broad educational goal. Engaging dynamic methodologies, fostering resilience, integrating technology, and creating collaborative environments are structural steps in this process. In addition, the focus on students' adaptability to the varied situations of daily life is a reflection of a cohesive education. When students feel safe to explore, make mistakes, and learn from each other, the results tend to be more positive.

Thus, the construction of an education that prioritizes problem solving must be a continuous commitment of educational institutions. Promoting a space where curiosity and creativity can flourish is essential to form individuals able to deal with the challenges of the contemporary world. Each step in this direction will contribute to a more innovative and collaborative society, where learning becomes a permanent and dynamic process.

METHODOLOGY

The present research was characterized as a bibliographic study, whose approach was qualitative and exploratory and descriptive in nature. The main objective was to analyze the importance of problem solving in the teaching-learning process, based on the review of existing literature on the subject. According to Sousa (2020), problem solving represents a fundamental tool for the development of students' critical and reflective thinking, promoting more meaningful learning. Thus, the methodology adopted was based on the systematization and analysis of academic productions that address this theme, enabling a broad understanding of the investigated theme.

The study was based exclusively on secondary sources, such as scientific articles, books, dissertations and academic theses available in recognized databases (Narciso; Santana, 2025). The selection of materials was carried out based on criteria of relevance and topicality, considering publications that discuss the resolution of problems in teaching and their applicability in different educational contexts. According to Santos, Días, and Souza (2021), the bibliographic survey is an essential method to consolidate already

established theories and practices, allowing a critical deepening of a certain area of knowledge.

The analysis of the selected texts followed the principles of content analysis, as proposed by Bardin (2011), aiming to identify thematic categories and patterns that emerged from the reviewed studies. This procedure allowed us to understand different approaches to problem solving, highlighting its importance for the formation of mathematical, cognitive and social skills. According to Santos and Soares (2020), problem-solving strategies require not only cognitive skills, but also socio-emotional components that favor students' autonomy.

The ethical aspects of the research were strictly respected, ensuring that all sources used were properly referenced, according to the standards of the Brazilian Association of Technical Standards (ABNT). Academic integrity was maintained throughout the research process, ensuring that all information was analyzed and interpreted critically and objectively.

Among the limitations of this investigation, the absence of primary data collection was highlighted, which restricted the analysis to a theoretical overview of the issue. In addition, the exclusive dependence on bibliographic sources implied the need to consider possible gaps in the research already published on the subject. However, the systematic review of the literature allowed the construction of a consistent theoretical framework, contributing to the advancement of discussions on problem solving in the educational context.

Thus, by performing an analysis of the literature, this research provided subsidies for understanding the importance of problem solving in learning. The review of previous studies revealed that this methodological approach has a significant impact on the development of students' skills, being a fundamental pedagogical resource for the promotion of autonomy and critical thinking in contemporary education.

INTEGRATION OF PROBLEM-SOLVING INTO THE SCHOOL CURRICULUM

The integration of problem-solving into the school curriculum is an innovative approach that aims to train critical and autonomous students, capable of dealing with the challenges of everyday life. This practice is not limited to a single discipline, but seeks to transcend boundaries between different areas of knowledge, promoting a more holistic education. By implementing strategies that encourage problem-solving, educators prepare students to work in a complex environment full of uncertainties.

The application of interdisciplinary methods in teaching helps students develop analytical skills in situations that reflect reality. Rather than being restricted to mere

memorization of content, education should offer experiences that involve the use of practical skills. As Souza (2019, p. 47) points out,

> Students who engage in activities that encourage problem-solving demonstrate a significant increase in their critical capacity and in the application of creative solutions.

This form of learning not only reinforces the theoretical content, but also arouses students' interest in active learning. A practical example of this approach can be observed in mathematics classes, where students are challenged to solve problems involving financial or logistical situations. This practice not only addresses mathematical concepts, but also relates them to the student's daily life, promoting meaningful understanding. By addressing real issues, educators promote a learning environment where solutions need to be thought of collaboratively, a fundamental aspect for the development of 21st century skills.

In addition to mathematics, problem solving can and should be applied in several areas of knowledge, including social and natural sciences. Interdisciplinary projects, for example, allow students to explore creative and innovative solutions while also learning to work as a team. This practice fosters cooperative learning and helps students understand that different disciplines can dialogue with each other, enriching the educational experience.

The receptivity of the school community to these new methodologies also plays an important role. However, there are significant hurdles that need to be overcome. Many educators may resist changing their traditional practices, while others face difficulties in assimilating new approaches due to a lack of specific training. Zimdars and Agranioni (2023) highlight that the continuing education of teachers is essential for this new educational paradigm to be effectively implemented and for problem-solving to become an integral part of the teaching-learning process.

In addition to resistance, another inherent challenge is the rigidity of curricula, often imposed on educational institutions, and the pressure to meet specific requirements. However, this flexibility should be considered a priority, since the integration of methodologies that involve problem solving results in a more dynamic and adaptable pedagogical planning. We must consider the needs of students and the job market, which values problem-solving and innovation skills.

The benefits of developing problem-solving skills in an educational context are broad and encompass both the student's personal and professional development. Those who can face and solve complex challenges become more effective in practical situations and are more likely to become leaders in their fields. The training of students with this skill is a pressing need in the current scenario, where adaptation is vital.

Furthermore, by modifying the curriculum so that problem-solving becomes an integral part of learning, we are able to establish an ongoing dialogue between theory and practice. This dialogue enriches the academic experience and prepares students for the exercise of citizenship. The educational proposal that seeks to integrate these elements should be seen as a collective responsibility, involving not only educators, but also managers and the community.

The future demands that educational institutions encompass practices that develop these skills, preparing young people for a work environment that requires constant adaptation and innovation. Education needs to go beyond the transmission of knowledge. As mentioned by Sousa (2020), teacher training should include practical problem-solving experiences so that these educators can, in turn, transmit this approach to their students.

Finally, the integration of problem solving should not be restricted to a one-off project, but rather be a continuous and progressive movement in educational training. The construction of a curriculum that considers the importance of this integration will imply a deep respect for the diversity of knowledge and the richness of students' experiences. Thus, it will be possible to train individuals not only prepared to face academic challenges, but also engaged, creative and proactive citizens in their lives. The education of the future is, therefore, an education that problematizes, questions, solves and transforms.

APPROACHES TO INTEGRATING PROBLEM-SOLVING ACROSS DIFFERENT DISCIPLINES

The integration of problem solving into the school curriculum was configured as a challenge that required planning and adaptation of pedagogical methodologies. This strategy went beyond the simple inclusion of practical activities, demanding a transformation in educational approaches. For this integration to occur in an assertive way, it was necessary for educators to adopt practices that encouraged critical thinking, making students active agents in the learning process.

One of the methodologies that stood out the most in this context was project-based teaching, which encouraged students to solve real problems through the application of knowledge from different areas. This approach has facilitated the connection between disciplines, making learning more meaningful. According to Almeida and Madruga (2023, p. 210), "problem-solving offers students opportunities to develop autonomy and critical reasoning throughout the mathematical learning process". For example, a project aimed at creating a community garden not only involved concepts from biology and environmental

science, but also required mathematical skills, such as measurements and budgeting, as well as sociological knowledge about the social impact of these initiatives.

Collaboration among students emerged as a key aspect in the development of these strategies. Working as a team enabled students to share ideas, develop empathy and learn to deal with disagreements, promoting an environment where problem solving was a collective practice. Vygotsky, cited by Lima, Silva and Noronha (2018, p. 130), highlighted that "social interaction is essential for the construction of knowledge, as it allows students to expand their zones of proximal development". In this way, collaborative learning provided a richer scenario for problem solving, making the construction of knowledge more dynamic and participatory.

Teacher training was another determining factor for the implementation of these methodologies. Teachers who sought to improve their practices and followed new pedagogical approaches demonstrated greater preparation to guide students in solving problems. Freitas (2025, p. 2740) stressed that "the insertion of active technologies and methodologies in academic evaluation requires solid teacher training, capable of dealing with the new educational demands". Thus, continuous training enabled teachers to apply innovative strategies, directly reflecting on the students' learning experience.

The evaluation of students also had to be rethought to adapt to this teaching model. Traditional methods, based exclusively on objective tests and memorization, proved to be insufficient to measure the impact of problem solving. On the other hand, formative assessments, which considered the student's progress over time, allowed the identification of difficulties and the proposal of interventions. According to Almeida and Madruga (2023, p. 220), "evaluation should be a continuous and reflective process, allowing pedagogical adjustments to better meet the needs of students".

Another essential element was the creation of a school environment that would stimulate curiosity and creativity. Educational institutions that offered a safe space for experimentation and exploration encouraged students to test different approaches to problem-solving. According to Alexandre and Alexandria (2023, p. 505), the use of educational robotics emerged as a resource that favored interdisciplinary learning, as it enabled students to apply mathematical, scientific, and technological concepts in an integrated way. This strategy has expanded learning possibilities and fostered a culture of innovation within schools.

In addition to changes in the school environment, technology has played a significant role in modernizing education. Digital tools have provided greater access to educational content and expanded opportunities for collaboration between students. Freitas (2025, p.

2745) pointed out that "artificial intelligence and digital environments have been transforming the way students interact with knowledge, providing new possibilities for teaching and learning". Thus, technology has become an essential ally in building more flexible and interactive learning.

The participation of the family in the educational process was also a fundamental aspect to strengthen problem solving as a pedagogical practice. Parents and guardians who were actively involved in their children's learning helped to consolidate the bridge between the school and the students' daily lives. According to Lima, Silva and Noronha (2018, p. 135), "learning becomes more meaningful when there is a connection between the concepts taught at school and the student's reality". Family involvement, therefore, contributed to the students' motivation and reinforced the importance of the knowledge acquired.

Finally, the incorporation of problem-solving into teaching required a gradual transformation of the school curriculum. Methodological changes took time to be absorbed and applied efficiently, but the commitment of educators and managers was essential to ensure the structuring of these practices. As this approach has strengthened, students have developed essential skills to deal with everyday life challenges, becoming more critical citizens who are prepared to solve complex problems.

Integrating problem-solving into the school curriculum required a concerted effort by teachers, students, educational institutions, and families. Case studies, interdisciplinary projects, and the use of educational technologies have emerged as alternatives to structure this approach. According to Freitas (2025, p. 2750), the "reformulation of teaching methods and academic assessment allows education to adapt to the new demands of the twenty-first century". In this way, the implementation of these strategies has transformed the educational experience, preparing students to face the challenges of the contemporary world and stimulating their ability to solve problems with creativity and innovation.

FINAL CONSIDERATIONS

The present research aimed to analyze the effectiveness of teaching methodologies aimed at the development of problem-solving skills in students. From the literature review, it was possible to understand the importance of these practices for the formation of individuals who not only master the academic content, but who are able to apply it creatively and reflectively in different contexts. Active methodologies stood out as strategies capable of stimulating critical thinking and autonomy, promoting more meaningful learning and connected to the students' reality.

The main findings indicated that the interaction between students, mediated by collaborative practices, favors the development of these skills. Environments that encourage teamwork, the exchange of ideas, and the resolution of practical challenges contribute to greater engagement and better academic performance. In addition, by actively participating in the learning process itself, students show greater interest and willingness to face complex situations.

Another relevant point was the importance of the role of the educator as a mediator of the learning process. The continuous support of the teacher contributes to the construction of a safe environment, in which mistakes are seen as an essential part of learning. In this way, teacher training assumes a central role, allowing professionals to be prepared to apply innovative strategies that favor the cognitive and social development of students.

Although the research has presented relevant results, some limitations should be considered. The analysis was based exclusively on previously published studies, without conducting experiments or collecting primary data, which restricts the possibility of empirically verifying the aforementioned approaches. In addition, the methodologies analyzed may present different degrees of effectiveness depending on the educational context in which they are applied.

Thus, future studies can deepen this discussion by considering comparative analyses between different methodologies, as well as their adaptation to specific realities. In addition, investigations that evaluate the long-term impact of these strategies may contribute to a broader understanding of their applicability and effectiveness. The perception of educators regarding the difficulties in implementing these methodologies is also a relevant field to be explored, providing subsidies for teacher training and development policies.

From the review carried out, it is possible to perceive the need to rethink traditional education and teaching methodologies, emphasizing problem solving as a central axis of learning. Strategies that involve active learning and interdisciplinarity make students more prepared for complex challenges, strengthening their capacity for innovation. This scenario highlights the importance of an institutional commitment to reformulate curricula and pedagogical practices that contemplate the new demands of the twenty-first century.

Finally, the implementation of strategies aimed at solving problems expands the transformative potential of education, enabling the formation of more critical, collaborative, and creative individuals. The adoption of these methodologies not only improves academic performance, but also contributes to the construction of citizens who are more prepared to

act in an ever-changing society. Thus, educational policies should prioritize these skills, recognizing their impact not only on the academic trajectory, but also on the professional and personal lives of students.

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