RCMOS - Multidisciplinary Scientific Journal of Knowledge.
ISSN: 2675-9128. São Paulo-SP.

Year V, v.1 2025 | submission: 2025-10-03 | accepted: 2025-10-05 | publication: 2025-10-07

Challenges and possibilities in teaching mathematics: analysis of the Parintinsense Mathematics Olympiad Mathematics in elementary school

Challenges and possibilities in mathematics education: analysis of the parintins mathematics olympiad in elementary education

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SUMMARY

This study aimed to analyze the main difficulties faced by 8th and 9th grade students during the second phase of the Parintins Mathematics Olympiad (OPM), held in 2024 in state schools in the municipality of Parintins, Amazonas. The research was conducted using a qualitative, exploratory, and descriptive approach. The instruments used included document analysis of the tests administered, student questionnaires, and interviews with mathematics teachers. The results showed that the students' main difficulties were related to the interpretation of statements, insufficient mastery of fundamental content, and the lack of problem-solving strategies, highlighting,

thus, the importance of reading and interpreting mathematics for success in solving questions and, consequently, for learning Mathematics.
Keywords: Mathematics Teaching, Learning Difficulties, Olympiads.

ABSTRACT

This study aimed to analyze the main difficulties faced by 8th and 9th-grade students in the final years of elementary education during the second phase of the Parintins Mathematics Olympiad (OPM), held in 2024 in state schools in the municipality of Parintins, Amazonas. The research was conducted using a qualitative approach, with an exploratory and descriptive nature. The instruments used included document analysis of the applied tests, questionnaires with students, and interviews with Mathematics teachers. The results highlighted that the main difficulties of the students were related to statement interpretation, insufficient mastery of fundamental content, and the lack of problem-solving strategies. These findings underscore the importance of mathematical reading and interpretation for success in solving problems and, consequently, for learning Mathematics.
Keywords: Mathematics Education, Learning Difficulties, Olympiads.

1. INTRODUCTION

This work presents an excerpt from the results of a survey on the difficulties faced by 8th and 9th grade elementary school students when solving the test applied during the second phase of the XVII Parintinense Mathematics Olympiad (OPM), held in 2024, in municipality of Parintins, Amazonas. In the educational context, mathematical competitions, such as the OPM and the Brazilian Mathematics Olympiad for Public Schools (OBMEP), play a role important in stimulating students' interest in challenges, promoting mathematical reasoning. However, it is common for students to encounter difficulties when participating in these competitions, especially at level 2, which involves 8th and 9th grade students, where greater mastery of the

mathematical concepts.

This study investigated students' difficulties in understanding mathematical concepts applied in the second phase of the XVII OPM test, since, at this stage, students are invited to answer three essay questions, which generates important data to assess the level of knowledge necessary to resolve the issues. For the development of the project, it was a questionnaire was applied regarding students' perception of the difficulty of the test. Based on the answers, it was necessary to investigate and map these difficulties. Thus, the research seeks to answer the following question: what is the students' perception of difficulty when answering the second phase test? of the XVII OPM, level 2, in 2024? The objective was to understand the difficulties of students in the OPM, level 2, in a state school in Parintins, identifying the main difficulties in solving of mathematical problems and analyzing the factors that contributed to these difficulties.

The research adopted a qualitative, exploratory and descriptive methodological approach. For the to carry out this study, questionnaires administered to students, interviews with Mathematics teachers and document analysis, such as the OPM regulations and the applied test to 8th and 9th grade students, in order to map the difficulties and understand the factors that influence student performance.

We know that Mathematics plays a fundamental role in the intellectual formation of students, being considered a key discipline for the development of logical reasoning, critical and creative. To stimulate student interest and promote excellence in teaching in this area, several mathematical competitions emerged in Brazil, such as OBMEP, created in 2005, and OPM, at the local level.

OPM is a Mathematics competition aimed at students from 6th to 9th grade. Elementary and High School. Started in 2004, it promotes the participation of students from the municipal and state, both in the urban and rural areas of Parintins. The OPM has the collaboration of professors, Mathematics students, and other partners. The competition is divided into three levels and executed in two phases. 6th and 7th grade students participate in level 1, from the 8th and 9th grades of level 2, and high school students of level 3. In the first phase, all students participate students from public and private schools in the municipality, while in the second phase they are classified 5% of students per level and school.

The OPM was designed to stimulate the interest of students from Parintins-AM and the region in Mathematics, promoting logical reasoning, creativity and problem-solving skills complex. The competition is divided into phases and levels appropriate to different age groups and grades schoolchildren, allowing an assessment that goes beyond the simple memorization of formulas and concepts. As Polya (1995) points out, problem-solving is essential for the development of logical, critical, and creative reasoning of students. Both OBMEP and OPM share the

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aim to challenge students to apply the knowledge acquired in the classroom to situations new ones, which require analysis, interpretation and development of strategies for the solution. According to Bloom (1956), the development of higher cognitive skills, such as application, analysis and synthesis, is fundamental for effective learning, and that is what these Olympics seek to encourage.

Carneiro (2004, p. 5) states that there is a misconception that, in order to participate in a Mathematics Olympiad, it is necessary to study content that goes beyond basic education:

> *"Mistakenly, many people think that studying to participate in a Math Olympiad means advancing in the usual school subject matter [...]. It is nothing like that. The problems do not require a greater dose of knowledge, but rather the awakening of reasoning and a lot of creativity."* (CARNEIRO, 2004, p. 5).

Therefore, the focus of preparation for the Olympics should be on depth and creativity. of reasoning, and not simply in the anticipation of more advanced content. Carneiro (2004) highlights that adequate preparation involves constant problem-solving, using books specialized, websites and practices that stimulate creative thinking and analytical skills of students. Dante (2007, p. 11-12) states that problem-solving makes it possible to "develop in the student initiative, exploratory spirit, creativity, independence and the ability to develop logical reasoning", promoting the intelligent use of available resources to solve everyday issues. Time spent thinking about a problem is always time well spent. Even if it seems like you're not making any progress, this clipping shows the results. from the questionnaires administered to students and the interviews conducted with teachers.

2 THEORETICAL FRAMEWORK

2.1 TROUBLESHOOTING

Problem-solving is an essential skill in teaching mathematics. Polya (1995) structured this process into four main stages: understanding the problem, elaborating of a plan, execution of the plan and verification of the results. For the author, "the ability to solve problems goes beyond the simple knowledge of formulas and involves the development of strategies cognitive and metacognitive" (Polya, 1995).

One of the biggest challenges faced by students is in correctly interpreting the statements. Polya (1995) highlights that "many students have difficulty correctly interpreting the problem statements", which may compromise the identification of relevant information and the formulation of appropriate strategies for the solution.

Carneiro (2004, p. 5) states that preparation for mathematical olympiads does not require mastery of advanced content, but rather "the awakening of reasoning and a lot of creativity", suggesting that the focus should be on developing logical reasoning skills and

creativity, rather than in-depth technical knowledge.

In this context, effective preparation for mathematical competitions involves deepening of basic education content, with an emphasis on logical reasoning and creativity. Badoró (2015) proposes methodologies to guide teachers and students, such as the use of supplementary materials, books, websites, and practices that encourage the resolution of challenging problems. Puldeco (2017) reinforces that solving mathematical problems is an activity in which the student is challenged to mobilize your knowledge, seeking, with the support of colleagues and the teacher, strategies that lead you to troubleshooting.

Furthermore, problem solving establishes a link between intuitive mathematics, that arises from everyday experiences, and formal mathematics, based on concepts, theorems and propositions. Polya (1995) highlights that “the problem-solving method is one of the main strategies to make mathematics more understandable”, also highlighting the pleasurable and challenging this practice for students.

Finally, the ability to solve mathematical problems is considered a competency crucial not only in the school environment, but also for the formation of individuals capable of thinking critically and analyze situations in a logical and structured way.

2.2 STUDENTS' DIFFICULTIES IN OLYMPICS

Participation in mathematical olympiads requires more than technical knowledge: it requires critical thinking, the ability to ask pertinent questions and select information relevant to problem-solving. In this sense, it is highlighted that “it is necessary to think critically, inquire, problematize — in terms of formulating questions related to problems and the separation of those that will or will not be useful in the search for the answer.” Furthermore, “in many cases, it is necessary to relate the problem to another that has already been resolved, perhaps a little simpler and clearer”.

According to Vygotsky (1978), the development of learning skills occurs mainly through social interaction and pedagogical support, within the so-called Zone of Proximal Development. According to the author, “learning development occurs through social interaction and pedagogical support (Zone of Proximal Development)”, which reinforces the importance of a collaborative learning environment and ongoing support.

The absence of practices aimed at solving higher-level problems can reduce both student confidence and competence. Many schools often “don’t offer specific practices that involve advanced-level mathematical problems”, which directly impacts the performance of participants, limiting their opportunities for

development.

Socioeconomic factors, the lack of adequate teaching materials and limited support from school and family pose significant obstacles. This scenario is particularly evident in the state schools of Parintins, where “the study environment and limited school support” affect negatively impacting students' development, hindering access to resources and quality education. quality.

Motivation is another crucial aspect. Many students arrive at the Olympics carrying “negative attitudes towards mathematics”, unmotivated by previous experiences of failure or the belief that they are “not good at math.” In this context, it is important to recognize that every novelty brings with it both the admiration of some and the rejection of others. Although rejection initial is natural, it is perfectly manageable and, with time and proper guidance, tends to transform into acceptance and interest in the topic.

Therefore, understanding and acting on these factors is essential to promote better results in competitions. Furthermore, this contributes to the formation of more confident students, critical and prepared to face academic and professional challenges, whether in the field of mathematics or in other areas of knowledge.

2. MATERIAL AND METHOD

This research used a qualitative approach with methodological triangulation, as propose Creswell and Plano Clark (2021), this triangulation being fundamental to validate the results. The researcher's interpretation aimed to understand in depth the difficulties faced by 8th and 9th grade elementary school students in solving questions of the second phase of the XVII Parintins Mathematics Olympiad (OPM), allowing an analysis comprehensive analysis of the difficulties faced by students and teachers' perceptions of the teaching process and preparation for this competition.

By crossing the information from the questionnaires administered to the students, interviews with the teachers and the researcher's critical analysis, it was possible to identify convergences and divergences in perceptions about teaching, learning, and test performance. Triangulation methodological approach allowed for a broader and more validated understanding of the data.

The application of structured questionnaires with open questions to students made it possible to data collection that helped establish a profile of the difficulties encountered in the tests of OPM. Semi-structured interviews with teachers sought to understand the practices pedagogical and the challenges faced in the process of preparing students, according to the assumptions of Minayo (2014), who defends qualitative analysis as fundamental to exploring the

perceptions and meanings attributed by subjects to their reality.

The research subjects were 30 8th and 9th grade elementary school students and 3 teachers of Mathematics of three public state schools located in the municipality of Parintins-AM. The selection of students was made based on participation in the tests of the second phase of the XVII OPM of 2024. The inclusion criterion for teachers was the fact that they were directly involved in the process of preparing students for the competition. According to Flick (2018), the choice of subjects must ensure the richness of the information collected, aiming to meet the specific objectives of the research.

The questionnaires administered to the students contained questions about the perception of difficulties faced in the test, assessment of the relationship between the content covered and the test questions, and the adequacy of the instructions provided. For teachers, the questions addressed the performance of students, the content that caused the most difficulties, and the pedagogical strategies used to deal with these challenges.

The qualitative analysis of the interview data was conducted based on the principles of content analysis, as proposed by Bardin (2016), and followed the categorization of responses of teachers in relation to the methodologies used and the pedagogical challenges faced. This approach allowed us to explore in detail the teachers' perceptions of the difficulties faced by students, in addition to identifying the pedagogical practices adopted to overcome them.

The research also included a documentary analysis of official documents, such as the Project Pedagogical Framework for the Bachelor's Degree in Mathematics (PPP/2013) and the Common National Base Curricular (BNCC). The analysis sought to verify how Problem Solving is addressed in these documents and how it should be developed in the training of Mathematics teachers. This stage followed the guidelines of Moreira (2020), who highlights the importance of understanding the role of normative documents in guiding pedagogical practices.

3. RESULTS AND DISCUSSION

Analysis of the perceptions of students from Schools A, B, C and D about the Olympiad test Parintinense de Matemática reveals a diversity of experiences, but with common points that help to understand the main challenges faced. Regarding the general perception of difficulty of the test, many students considered it complex, especially because it required more than only mechanical calculations, requiring logical reasoning and interpretation. A student at School A reported: *"The test was complex, requiring not only to know how to do math, but also a lot of reasoning",* while another highlighted that *"there were some very difficult ones and some easy ones".* Students at School B mentioned confusion in the questions and lack of preparation as factors that increased the difficulty. Students from Schools C and D also pointed out calculations as a major obstacle, in addition

of the interpretation of statements. As Pavanello (2007) highlights, regardless of the level of schooling, in Mathematics classes, the student, in addition to dealing with the problems involving language and the act of communication, must also be confronted with a formal language – the mathematical language. However, in some cases, students still do not fully master the mother tongue, which makes it difficult to understand the proposed problems. According to Pavanello, (2007),

> In math classes, it's important to consider the asymmetry between the subjects of the educational act—the teacher and their students. This asymmetry doesn't just concern mathematical knowledge, but also native language proficiency. Therefore, it's crucial that teachers listen to their students, allowing them to express their doubts and questions.

Regarding the relationship between the questions and the content studied, many students stated that the topics covered were present in the classes, but presented in a more in-depth way or demanding. A student from School A highlighted: *"They are the same subjects, only more complex, where you need to go beyond your knowledge of mathematics."* Other students indicated that not all the test content was studied in advance, as exemplified by a student from School B: *"The content that I studied was not on the test."*

According to Costa e Silva (2013) the existence of mathematical problems is directly related to the content requested in their statements and to resolve them it is necessary auxiliary mechanisms according to the embedded mathematical content. According to the Regulations for this competition, at each level the curricular components were addressed, in the area of Mathematics and its Technologies, distributed across five thematic axes: Numbers and Operations, Algebra, Geometry, Quantities and Measurements, and Statistics and Probability

Regarding specific difficulties during resolution, the most cited were complex calculations, the interpretation of statements, and nervousness. A student from School B stated: *"My calculation gave one thing and the answer had another, but that's because my calculation was wrong. same".* Students from School D also mentioned that the time to answer the questions was short contributed to the difficulty: *"All the questions had to be answered off the top of my head, and time what they gave was very little."*

Opinions were divided regarding the test instructions and information. Some students considered them to be adequate, as stated by a student at School C: *"The information given to student were good and at the student's learning level."* On the other hand, some stated that communication was flawed and the content of the test exceeded what had been worked on in class, as reported a student from School D: *"They told us at the last minute that there would be a test and we didn't have studied".*

The students' responses reflect a scenario already discussed by authors such as Dante (2018), who

claim that teaching Mathematics needs to go beyond memorization and involve problem solving contextualized and challenging problems. According to Lopes (2007), it is common for students have difficulties in mathematics because they do not understand the logic of the reasoning required, which is confirmed in the statements analyzed. Furthermore, the National Common Curricular Base (BNCC, 2018) highlights the importance of developing logical thinking, problem-solving problems and mathematical communication — points that many students have demonstrated are still developing.

Analysis of responses from teachers at Schools A, B and C reveals common challenges faced by students when solving questions in the Parintins Mathematics Olympiad (OPM). Among the main difficulties are the interpretation of statements, concentration and logical reasoning, in addition to obstacles in specific content such as algebra, arithmetic, geometry and problem-solving that requires strategic thinking and spatial visualization.

According to the teacher at School A, the students demonstrated difficulties in interpreting the statements and maintain focus on the logical reasoning necessary to solve the questions. teacher at School B points out that the low proficiency in the programmatic contents, especially in algebra, significantly compromises student performance. The teacher at School C reinforces this observation by stating that algebra questions, such as notable products and factorization of polynomials, represented the greatest challenges for the students.

Regarding the identification of the level of difficulty of the questions, the methods varied between schools. School A used collective correction, simple statistical analysis and dialogue with students to understand the main difficulties. In contrast, School B did not carry out activities specific for this purpose, based only on exercises provided by the coordination of the XVII OPM and informal conversations. School C, on the other hand, had joint resolution of issues with the Mathematics teachers.

This reality highlights a lack of systematic diagnostic strategies and pedagogical intervention. According to Ponte et al. (2012), understanding students' difficulties in mathematics requires an approach that goes beyond mechanical repetition, involving practical investigative and reflective. The absence of these practices in some schools can make it even more difficult overcoming the identified obstacles. Table 1 below summarizes the difficulties perceived in joint analysis of student and teacher questionnaires. In addition, some suggestions for pedagogical practices with the potential to remedy these deficiencies.

Table 1: Analysis of student and teacher questionnaires

Challenges Identified	Suggested Pedagogical Practices	Authors/References
Difficulty in interpreting statements	Systematic training in problem solving problems and critical reading of statements	Polya (1995); Dante (2007, 2018)
Lack of resolution strategies and logical reasoning	Creative Mathematics and Problem Solving Workshops contextualized problems	Carneiro (2004); Badoró (2015)
Little fundamental content and practices (fractions, proportions,	Review of consolidated consolidation concepts essential algebra content)	Bloom (1956); Lopes (2007)
Anxiety and nervousness during exams	Test simulations and training under conditions	Dante (2018); Carneiro real (2004)
Lack of specific practice for competitions	Analysis of previous tests, resolution of challenging questions	Carneiro (2004); Badoró (2015)
Low motivation and engagement of students	Cooperative learning, clubs Mathematics and extracurricular activities	Vygotsky (1978)
Insufficient teacher training for innovative methodologies	Continuing teacher training in active methodologies and problem solving	Moreira (2020)
Inequality of opportunities and resources,	Investment in infrastructure, laboratories, educational software and individualized support	Vygotsky (1978); Papert (1980, 1996)
Lack of pedagogical diagnosis	Continuous formative and diagnostic assessment with constructive feedback	Malta (2025)

Source: Authors (2025).

Therefore, the reports point to the need to strengthen the teaching of Mathematics through of more active methodologies, continuous diagnosis of difficulties and teacher training focused on teaching of the most challenging content, especially those related to algebra and reasoning logical.

FINAL CONSIDERATIONS

The main objective of this research was to investigate the difficulties faced by students of Level 2, Phase II (8th and 9th grades), during the second phase of the Parintinsense Olympics Mathematics (OPM), held in 2024, in state schools in the municipality of Parintins. The analysis of data obtained from interviews with 30 students, distributed across four state schools with greater representation in the Olympics, allowed us to identify recurring factors that influenced negatively affect student performance.

The results showed that students faced difficulties especially in questions that required interpretation of statements, logical-mathematical reasoning and the application of basic operations in complex contexts. The items with the highest error rate were related to reading and understanding problems, to the lack of mastery of fundamental content (such as fractions, proportions and simple algebraic expressions) and the absence of problem-solving strategies.

In interviews with Mathematics teachers from participating schools, it was possible find that the majority recognizes the importance of the OPM as an initiative to stimulate

learning, but point out the lack of time for specific preparation, curricular overload and shortage of teaching materials aimed at the Olympics as obstacles to good performance of students. Still, they highlighted the motivating potential of the competition, especially for students with interest or skill in the area.

The research therefore highlighted the need for investment in continuing education for teachers, as well as the creation of school programs to encourage and prepare for the Olympics scientific, which include extracurricular activities, workshops and pedagogical monitoring systematic. Furthermore, it is urgent to rethink mathematics teaching methodologies, making them more interactive, contextualized and accessible.

It is concluded that, although the challenges are numerous, OPM represents an opportunity valuable way to identify talents, stimulate logical reasoning and value the teaching of Mathematics in public schools in Parintins. For future studies, it is recommended to expand the sample, analyze performance by gender or grade, as well as longitudinal monitoring of participants to assess the impacts of the Olympiad on their educational path.

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