OBMEP in numbers: A quantitative analysis of the awards of schools in Piauí

Dalilla Ravene Marques da Costa[1], Adriano Faustino de Sousa[2], Daniel Cleberson da Conceição Rocha[3], Luiz Carlos Araujo da Silva[4], Eduardo de Moura dos Santos Silva[5], Mardonio Pereira do Vale[6], Raimundo Nonato de Sousa[7], Luiz Gustavo Farias de Oliveira[8], Guilherme Luiz de Oliveira Neto[9], Edson do Nascimento de Oliveira[10], Felipe de Sousa Santos[11] and Gilmar Antonio Ribeiro de Macedo[12]

ABSTRACT

The problem-solving methodology is one of the most studied trends in mathematics education in recent years. Based on this, this article aims to analyze the contributions of this methodology in the teaching of Mathematics through a bibliographic study on the performance indices of students and schools in Piauí in the Brazilian Public School Mathematics Olympiad (OBMEP). The bibliographic references were found through an advanced search on the Oasis Platform, which had three descriptors (Mathematics Olympiads, OBMEP and performance analysis) and generated a result with thirteen journals, which provided the methodological and bibliographic basis for the development of this study. It is justified by its relevant contribution to the understanding of the impact of the Olympiad on the learning and performance of the target students. Concerning this, this study will prove that the Olympiad studied stimulates interest and improvement in the teaching of Mathematics, the discovery of talents and continuing education, and also expands academic and professional opportunities.

Keywords: Mathematical Olympiads, OBMEP, Performance analysis.

[1] Degree in Mathematics IFPI – Floriano
E-mail : dalillaravene.m@gmail.com
[2] Master in Mathematics IFPI – Floriano
E-mail: caflo.2021114pmat01@aluno.ifpi.edu.br
[3] Master in Mathematics IFPI – Floriano
E-mail: caflo.2021114pmat04@aluno.ifpi.edu.br
[4] Master in Mathematics IFPI – Floriano
E-mail: caflo.2021114pmat15@aluno.ifpi.edu.br
[5] Master in Mathematics IFPI – Floriano
E-mail: caflo.2021114pmat08@aluno.ifpi.edu.br
[6] Specialist in Mathematics Teaching IFPI - Teresina
E-mail: catce.2022111eemd0003@aluno.ifpi.edu.br
[7] Master in Mathematics IFPI – Floriano
E-mail: caflo.2021114pmat17@aluno.ifpi.edu.br
[8] Degree in Mathematics IFPI – Floriano
E-mail : Gustavo.boq@gmail.com
[9] Doctor in Process Engineering, professor at IFPI - Floriano
E-mail: guilherme@ifpi.edu.br
[10] Master in Mathematics IFMA
E-mail: edson.oliveira@ifma.edu.br
[11] Specialist in higher education teaching IFPI – Angical
E-mail: filipeti2022@gmail.com
[12] Master in Mathematics IFPI – Floriano
E-mail: caflo.2021114pmat04@aluno.ifpi.edu.br

INTRODUCTION

Mathematics is a science of fundamental importance for the process of human, scientific, technological and social development. In view of this, it is necessary to highlight its relevance for various social groups, since the development of Mathematics happens at the same time as the development of science and human history. It makes sense, therefore, that mathematics education researchers talk so much about trends in teaching this science. (SKOVSMOSE, 2001).

Among the most used trends, problem solving, which promotes meaningful learning and develops essential skills for life in society, through the development of complex problem-solving skills and decision-making based on quantitative information, is one of the approaches that have been gaining prominence as a trend in mathematics teaching.

Juan Ignacio Pozo is a Doctor of Psychology with extensive educational experience. In his books, The Solution to Problems - Learn to Solve Problems, Solve Problems to Learn, Pozo organized his ideas and those of several other authors as ideas and guidelines for introducing problem-solving methods into the school curriculum. According to the author:

> "Problem-solving is based on the presentation of open and suggestive situations that require students to have an active attitude or an effort to seek their own answers, their own knowledge. Problem-based teaching presupposes promoting in students the mastery of procedures, as well as the use of available knowledge, to respond to variable and different situations." (Pozo, 1998)

The author further states that it is not enough to provide students with effective skills and strategies, they also need to develop the habit and attitude of seeing learning as a problem to which the answer must be found.

According to Polya (1945), problem-solving emphasizes the development of strategies to solve real, situational problems rather than the rote memorization of formulas and algorithms. This approach has been identified as a way to make the teaching of mathematics more relevant and interesting for students, as it allows for the practical application of the concepts learned. (VAN DE WALLE, 2013).

Additionally, research shows that problem-solving has a positive impact on students' math performance. Research by Jonassen and Strobel (2006) shows that students who learn mathematics through problem-solving score better on standardized tests and on critical thinking and problem-solving skills.

It is worth mentioning that it is necessary to arouse the interest of students before they are asked to get involved with Mathematics. In this sense, D'Ambrósio (1993, p.7) states that "(...) Mathematics is the only school subject taught in roughly the same way and with the same content for all children in the world." To enjoy learning Mathematics, learning must be meaningful and students

must take an active role and ownership of their own knowledge. A school event should be an experience where people can compare, explain, build hypotheses and debate.

Therefore, problem solving is one of the methods to promote the progress of the dynamic teaching of Mathematics. In the process of finding solutions to mathematical problems, ideas need to be organized in terms of representations of mathematical objects and the relationships between them. The objectives of mathematical problem solving include providing the student with the construction or reconstruction of concepts, as well as providing the student with the opportunity to develop different types of reasoning and strategies in solving the proposed problems, such as expanding their knowledge to make sense of mathematical concepts and properties. (JOSELITO ELIAS, 2017)

In this context, the Mathematical Olympiad has been standing out as a trend in the teaching of the discipline through problem-solving approaches. These competitions promote the development of skills that are important for academic and professional success, such as the ability to think logically, solve complex problems, and be creative. In addition, math olympiads are able to motivate and challenge students to explore mathematical concepts more deeply and autonomously.

Several studies point to the importance of mathematical olympiads in developing mathematical skills and improving student performance. For example, a study conducted by Ribeiro e Silva (2018) showed that students who participate in math olympiads perform better on math tests, compared to those who do not. In addition, participation in Mathematics Olympiads has also been associated with greater student interest in the subject, according to a study by Muniz and Araujo (2018).

However, it is important to emphasize that participation in mathematical Olympiads should not be seen as an end in itself, but rather as a way to stimulate problem-solving and conceptual understanding. As such, it is essential for schools and teachers to adopt teaching approaches that encourage problem-solving and critical thinking, as a way to prepare students for success in the Olympics and for life.

The Mathematical Olympiad to be studied in this article is the Brazilian Public School Mathematics Olympiad (OBMEP), which is a national program that aims to encourage the study of mathematics and identify talents in this area among public school students in Brazil. The OBMEP is held annually and consists of two phases: the first is held in schools and the second is held in application centers designated by the organization of the Olympiad.

Students who excel in the two phases of OBMEP can receive awards in recognition of their performance. Among the awards offered are gold, silver and bronze medals, as well as honorable mentions. The criteria for the award vary according to the student's grade level and their ranking in the competition.

According to data released by the OBMEP organization, throughout its editions, the Olympiad has awarded more than 51 thousand students with gold, silver and bronze medals, in addition to granting more than 439 thousand honorable mentions. The awards are an incentive for students to dedicate themselves to the study of mathematics and also for schools to encourage their students to participate in the competition.

The OBMEP award is an important recognition for students, as it can open doors to future academic and professional opportunities. In addition, the Olympiad also offers other opportunities for students, such as the Junior Scientific Initiation Program (PIC), which aims to stimulate students' interest in mathematics and science.

Based on the data presented, this article aims to develop, through a bibliographic study, a systematic review through the analysis of performance data of the municipalities of Piauí in the Brazilian Public School Mathematics Olympiad (OBMEP) and highlight those with the best results in the last ten editions of the referred Olympiad. Data analysis will be done through graphs that compare the state's performance in the last ten editions of the Olympics.

This systematic review aims to analyze existing research on the relationship between participation in OBMEP and student and school performance rates. Research published in national and international scientific journals on participation in OBMEP and its impact on school performance will be included in the review. In addition to manual searches of relevant journals, the Oasis, Scopus, and Web of Science databases will be used.

This systematic review is justified in its relevance to understanding the impact of OBMEP on student learning and performance in Brazilian public schools. It is hoped that the findings of this review will contribute to the discussion of the importance of OBMEP as a public policy to encourage mathematics education and may support political decisions for investment in the program.

METHODOLOGY

A literature search is a research methodology that involves searching, selecting, and critically analyzing existing literature on a particular research topic or problem. In this type of research, the researcher uses bibliographic sources to obtain relevant and current information on the topic in question. This methodology is fundamental in several stages of the scientific research process, from the literature review, theoretical basis, the identification of gaps, the foundation of knowledge to the contextualization of the study.

According to Severino (2007, p. 122), "bibliographic research is that which is carried out from the available record, resulting from previous research, in printed documents, such as books, articles, theses, etc." Based on this, this research is characterized as a qualitative and bibliographic approach of the systematic type.

A systematic literature search is a method of literature review that seeks to identify, solve, analyze and synthesize in a systematic and transparent way the available evidence on a given topic or research problem. This type of research follows a rigorous and transparent protocol, with pre-defined criteria for study selection, methodological quality assessment, and synthesis of results, and aims to gather and critically evaluate existing evidence, identify knowledge gaps, and support decision-making.

The present research began with an advanced search on the Oasis Platform. The search had the following descriptors: Mathematical Olympiads, OBMEP and Performance Analysis. When applying the first descriptor, 459 journals were initially found, but when the others were added, the results were reduced to 128 and 15, respectively.

For the development of this study, only journals published in Portuguese of the types article, dissertation and course completion work published between the years 2013 and 2023 will be taken into account. In enforcing these requirements, thirteen journals remained. The journals were read and, by means of inclusion and exclusion criteria, one journal evaded the proposed theme, another presented a different objective, and two titles were not found through the access link provided in the Oasis Platform.

Figure 1 – Flowchart of the selection of journals
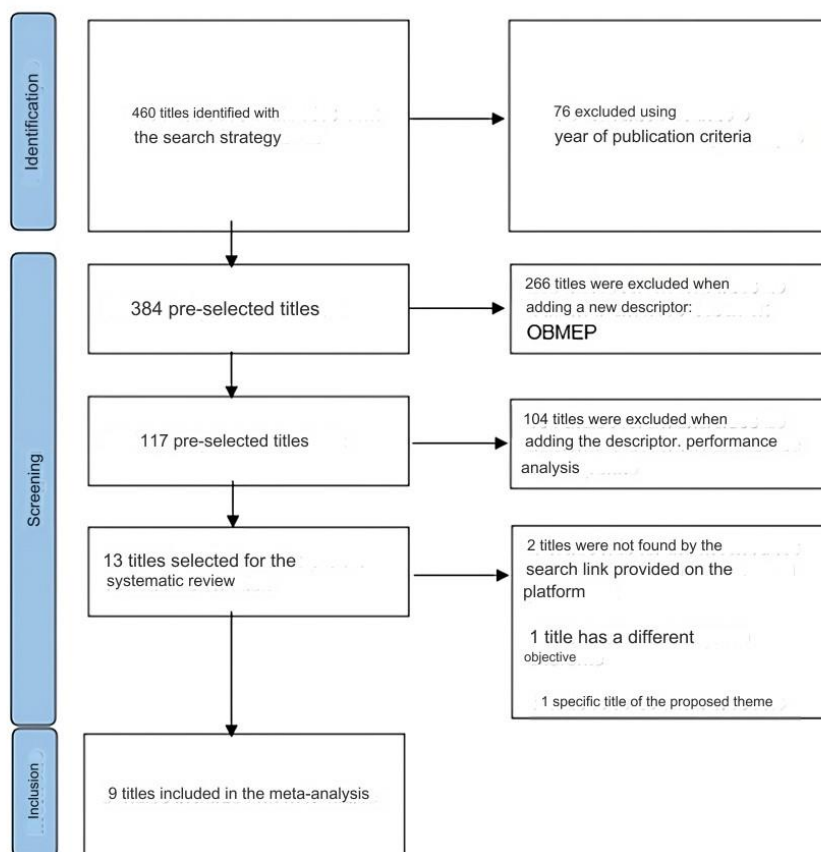
Source: The authors.

The flowchart above details the steps of identification, screening, and inclusion of the journals generated through the advanced search. After analyzing the journals generated in the search, nine titles were selected to reference the present study.

In addition to the periodicals, this study will investigate data regarding the awards in the last 10 editions of the Brazilian Public School Mathematics Olympiad (OBMEP) in Piauí and the distribution of these in the federal, state and municipal education networks.

Such data were collected on the official website of OBMEP, then redistributed and organized in Excel spreadsheets and, from there, graphs were generated to facilitate the analysis and organization of the samples obtained.

ANALYSIS AND DISCUSSION OF RESULTS
PARTICIPATION OF PIAUÍ

The participation of Piauí in the editions of OBMEP (Brazilian Public School Mathematics Olympiad) has been remarkable over the years. OBMEP is a national mathematics competition held annually, whose objective is to stimulate the study of mathematics among students from public schools in Brazil, seeking to identify talents and promote the development of logical reasoning and mathematical thinking.

The state of Piauí has stood out both in the number of participating students and in the awards won. Year after year, there is a significant number of enrollees, demonstrating the interest and engagement of students from Piauí in the curricular component of Mathematics.

The performance of students from Piauí in OBMEP has been satisfactory, since throughout the editions of the Olympiad, the state has won a significant number of medals in the most diverse categories (gold, silver and bronze). These are a recognition of the excellent performance of the students and also of the efforts of the schools and teachers in preparing the students for the competition.

In addition to the medals, OBMEP also awards students with honorable mentions, which are a way of recognizing the performance of the students who stand out the most in the competition. Piauí obtained a significant number of honorable mentions, which reinforces the quality of Mathematics teaching in the state.

The participation of Piauí in OBMEP has contributed to arouse interest in mathematics and encourage research and studies in related areas. The Olympiad also contributes to the motivation for students to enter studies in mathematics and to pursue a career in the area, stimulating the creation of projects and programs aimed at teaching this science in the state and awakening talents in the area.

In summary, the participation of Piauí in the editions of OBMEP has been marked by a significant number of registered students, a good performance in the tests and in the achievement of

medals and honorable mentions. Such participation contributes to the stimulation of the study of mathematics, the strengthening of the teaching of the discipline and the formation of new talents in the state.

The education networks that participate in OBMEP include municipal public schools, that is, schools linked to municipal governments; state public schools, those linked to the state departments of education; federal public schools, those linked to the Union, such as Federal Institutes (IF's) and Technical Colleges (CT's), for example; and also, private schools, which participate in the competition with criteria and number of vacancies different from the others mentioned above.

The following graph shows the distribution of awards in each school system. It is noticeable that the distribution of these awards is mainly concentrated in the state education network, since it houses a large part of the high school students in the state of Piauí. The federal school system appears as the other school system that stands out in the awards, however, in terms of the number of awards, it always appears below the state network.

Figure 2 - List of Award-Winning Schools
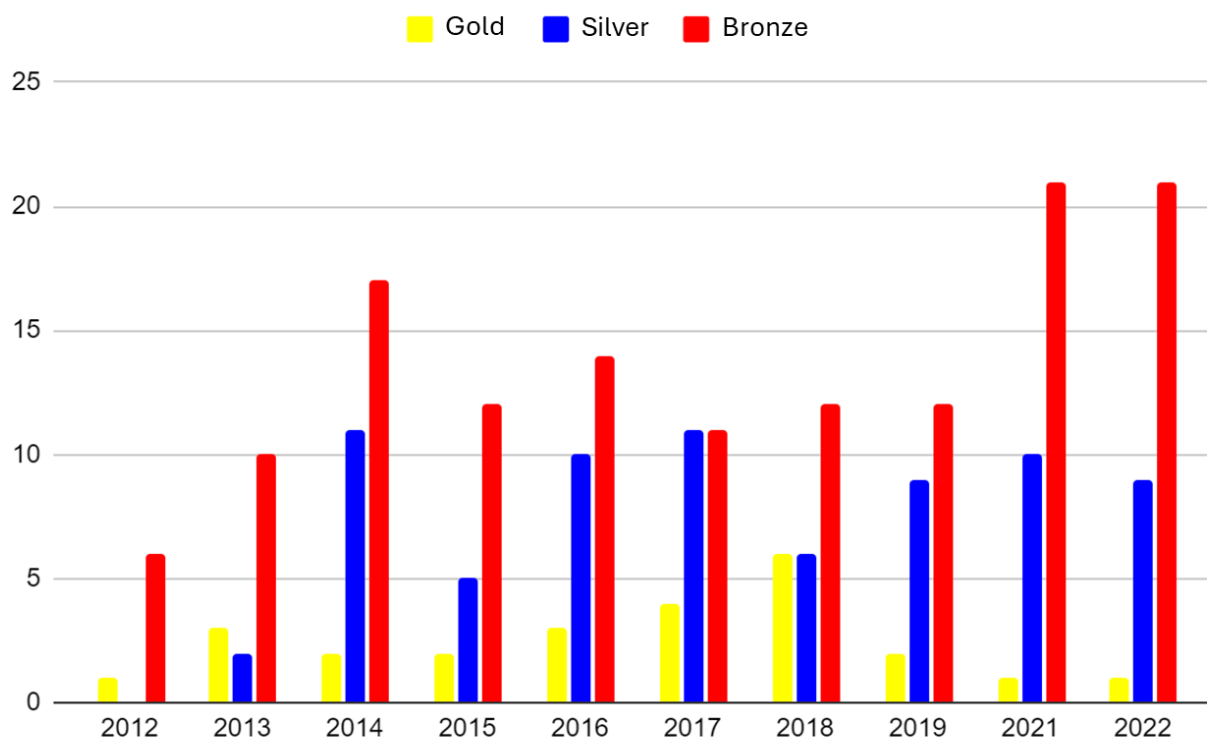
Source: The authors.

DISTRIBUTION OF PRIZES

This analysis will be divided into two stages. The first consists of analyzing the distributions of gold, silver and bronze medals, while the second will focus on the distribution of honorable mentions of the OBMEP editions studied.

Gold, silver, and bronze medals

The following is a breakdown of the data obtained through research on the official website of the Public School Mathematics Olympiad (OBMEP). Sufficient data and information were collected for the transposition of these into a graph, where the average number of awards in each category and their distribution in the federal, state and municipal education networks will be exposed. The 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2021 and 2022 editions will be considered, since the exponential growth of the COVID-19 Pandemic prevented the holding of the Olympics in 2020.

The figure above shows the distribution of awards in the last 10 editions of OBMEP. The highlight is red, which represents the number of bronze medals distributed in each edition studied. It is noticeable that such awards are more frequent than the other categories, with the exception only in the 2017 edition, whose number equaled the silver medals.

Analyzing the silver medals now, it can be seen that their distribution was carried out in practically all editions, except for the 2012 edition, the first edition considered in this study. From the 2013 to the 2014 edition, the great growth in the number of winners in the category is noticeable. From then on, in the following editions, there was a slight variation in relation to the quantities distributed. In the 2018 edition, the number of awards in this category equaled the gold ones.

Regarding the gold awards, the graph shows that this occurred in all editions studied, but in a much smaller amount than the other categories. In the 2013 edition, the gold awards exceeded the number of bronze awards, and in 2018 the two categories had the same number of students awarded.

Honorable mentions

The surveys on the official website of OBMEP also provide data regarding the distribution of honorable mentions in each of the editions considered in this study. These data were organized in tables and transposed into the following graph.

Figure 3 - Distribution of Honorable Mentions (2012 – 2022)
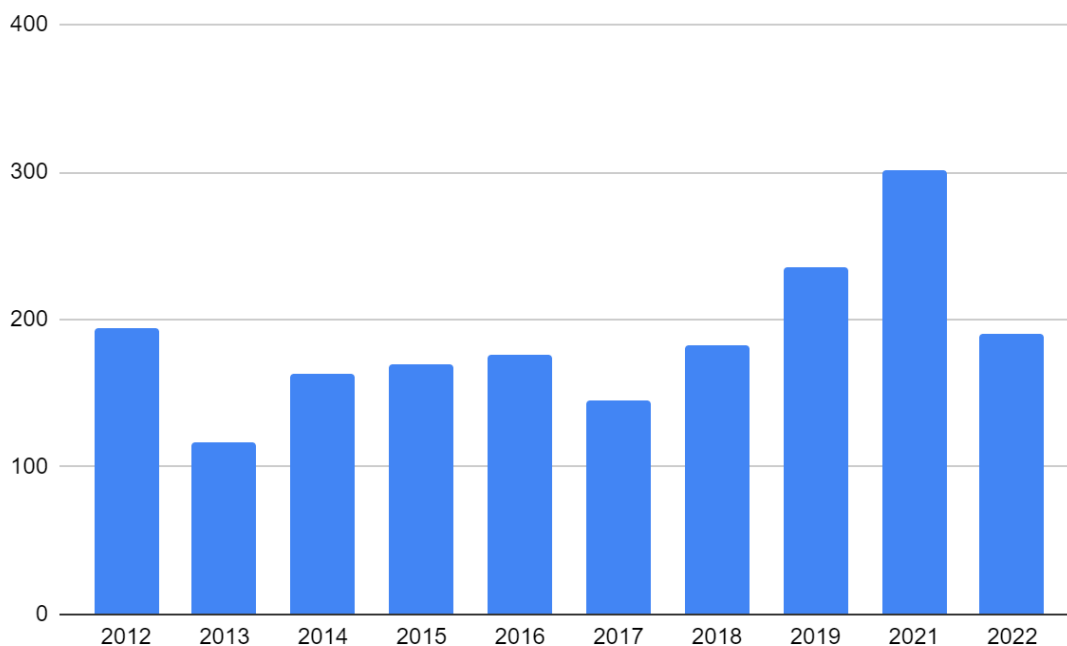
Source: The authors.

The state of Piauí, since the edition of OBMEP held in 2012, has obtained an excellent number of students awarded with honorable mentions. The number of students awarded in each edition is more than 100 and in most editions it shows growth in relation to the number of awards of the previous year, except in the 2013, 2017 and 2022 editions.

The highest number of awards recorded in this study is found in the 2021 edition of the Olympiad, with approximately 300 honorable mentions distributed among the participating students. The lowest record, in turn, was found in 2013, which had just over 100 awards in the category.

In the years 2017 to 2021, the state network stood out even more. Numerically, the number of awards continued to grow and higher than that of the federal school system.

PARTICIPATING SCHOOLS

In order to further deepen the data collected in this research, the following graph details the number of schools participating in each edition of the OBMEP considered in the present study.

Figure 4 – Total Participating Schools (2012 - 2022)
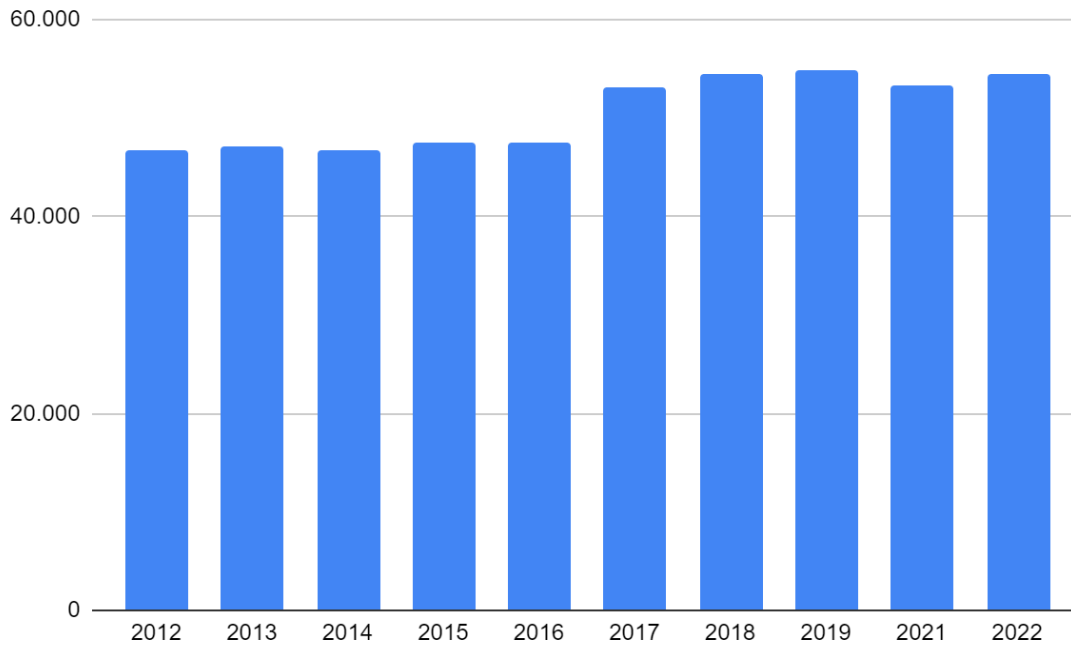
The figure above shows in detail the number of schools registered in the editions of the Brazilian Public School Mathematics Olympiad (OBMEP). It is noticeable that there was little variation in the number of participating schools between 2012 and 2016, the same happening between 2017 and 2019. In 2021, after the Covid-19 Pandemic, there was a significant decrease, but this decrease was repaired in the following edition.

The number of participating schools in Brazil is close to the range of 40,000 to 60,000 and varies between the editions studied. None of the variations are outside the range mentioned above. If this pattern continues in subsequent editions, it is likely that the number of participating schools will get closer and closer to 60,000.

When proceeding with such analyses, it is also necessary to verify the number of students participating in OBMEP. The following graph depicts the growth or decline of these during one of the 10 editions of the Olympiad seen in the present study.

Figure 5: Total number of students participating (2012 - 2022)
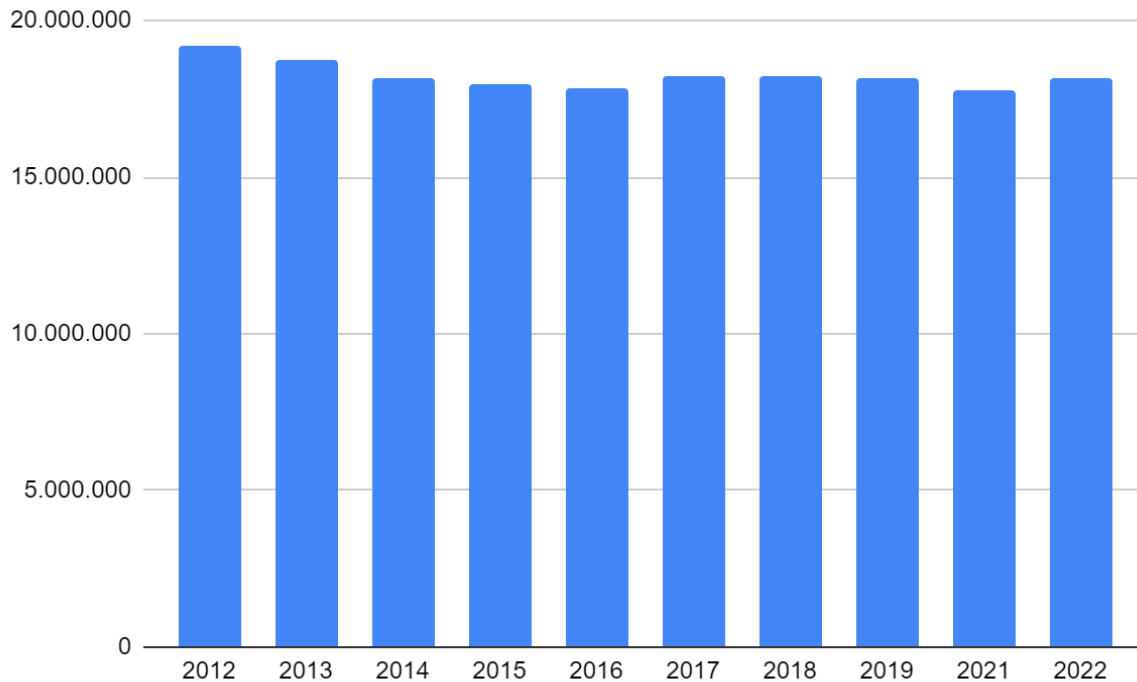
Source: The authors.

It can be seen through the analysis of the graph above that the quantities presented vary little between one edition and another. There are also some intervals in which this variation remained almost constant, with little growth or decrease. The edition that obtained the largest number of students was the one in 2012, which reached very close to 20,000,000.

The Brazilian Public School Mathematics Olympiad (OBMEP) is a mathematics competition aimed at elementary and high school students in Brazil. Participation in the Olympiad is open to both public and private schools, although most of the participants are students from the public school system.

The participation of private schools in the Olympiad was effective in 2017. The following graph compares the number of private and public schools participating in OBMEP. The 2017, 2018, 2019, 2021 and 2022 editions will be taken into account.

Figure 6: Comparison between the number of public and private schools (2017 - 2022)
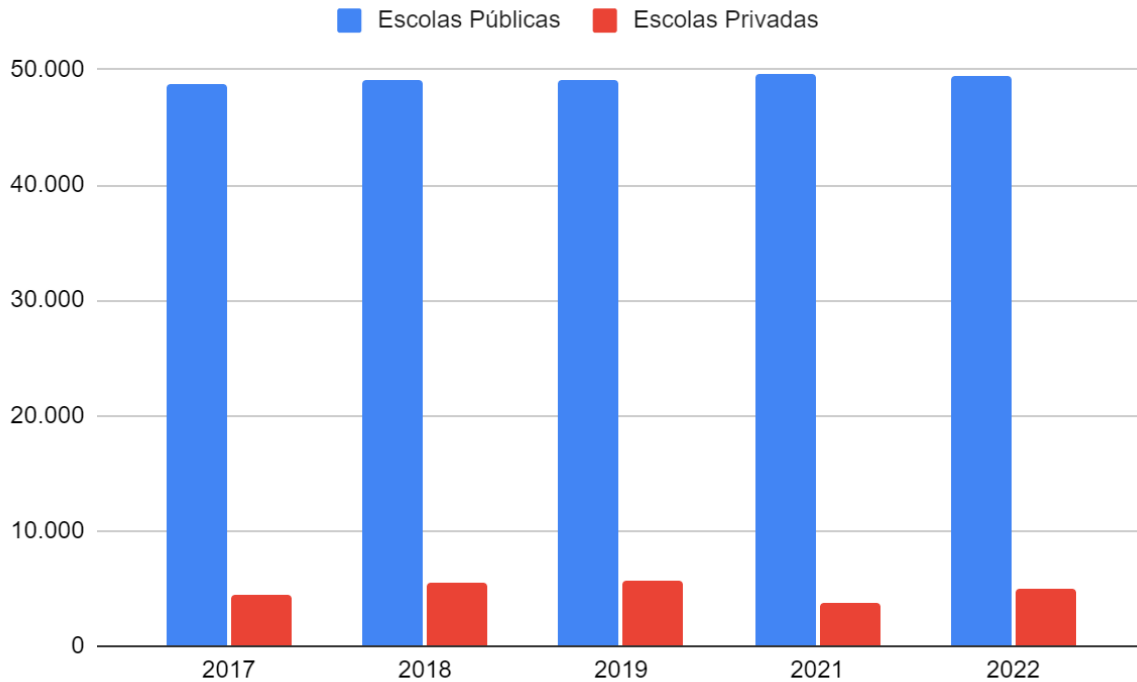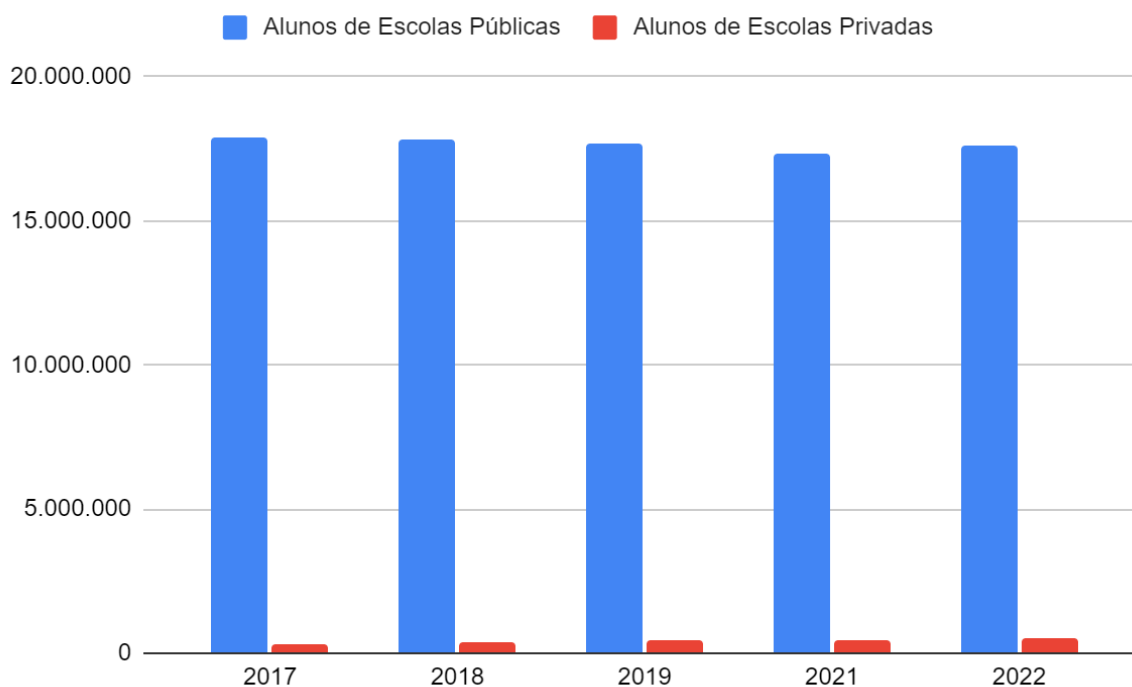
Source: The authors.

In all editions, it is common for the number of participating public schools to be significantly higher than the number of private schools. Numerically, the number of public schools is close to 60 000 and the number of private schools is less than 10 000.

In fact, it is also observed that the number of students participating in OBMEP is concentrated in public schools. The following chart numerically represents such data for better analysis.

Figure 7 – Comparison between the number of students from public and private schools (2017 - 2022)

Source: The authors.

The graph shows that the number of students from public schools participating in the Olympiad is significantly higher than that of the private network. While the number of students in the public school system reaches 20,000,000, those in the private school system are well below the 5,000,000 line.

FINAL THOUGHTS

Mathematics plays a fundamental role in people's daily lives. It is present in many aspects of daily life, in basic activities such as counting and calculating change, and also in more complex tasks such as financial planning, decision-making, understanding statistics, and problem-solving.

In this sense, enhancing the expansion of Mathematics teaching is crucial to promote a broader and deeper understanding of this discipline, enabling students to face challenges of the modern world.

According to Silva (2017), OBMEP has proven to be an extension tool that can enhance the teaching of mathematics in Brazil with the active participation of students, teachers, and employees. In this expansion through competition, reward actions can be seen as satisfactory, since "Personal development, success, well-being serve as a reason for the student to learn, which can be explored by OBMEP by stimulating through its awards." (Alves, 2010, p. 30).

The development of this study promoted the knowledge of the importance of problem solving as a trend in mathematics teaching and based on this, it elected the Brazilian Public School

Mathematics Olympiad (OBMEP) as an excellent instrument to offer improvements in teaching, especially in public schools.

OBMEP stimulates interest in mathematics, the discovery of mathematical talents, encouragement of the continuing education of teachers, promotion of the improvement of mathematics teaching and the expansion of academic and professional opportunities. In this sense, the Olympiad has proven to be a valuable initiative for the promotion of quality mathematics education in Brazil.

REFERENCES

1. Alves, W.J.S. (2010). O impacto da Olimpíada de Matemática em Alunos da Escola Pública. (Mestrado Profissional em Ensino de Matemática). Pontifícia Universidade Católica de São Paulo, São Paulo.

2. Brasil. Ministério da Educação. Instituto Nacional de Matemática Pura e Aplicada. (s.d.). Olimpíada Brasileira de Matemática das Escolas Públicas. Recuperado de https://www.obmep.org.br/

3. Brasil. Ministério da Educação. (s.d.). Olimpíada Brasileira de Matemática das Escolas Públicas. Recuperado de http://portal.mec.gov.br/component/tags/tag/20612-obmep

4. D'Ambrosio, U. (2011). Educação Matemática: da teoria à prática (22a ed.). Papirus Editora.

5. Jonassen, D. H., & Strobel, J. (2006). Model building for conceptual change. In D. H. Jonassen (Ed.), Learning to solve complex scientific problems (pp. 191-226). Lawrence Erlbaum Associates Publishers.

6. Kovsmose, O. (2001). Educação Matemática Crítica: a questão da democracia. Papirus.

7. Muniz, F. H. F., & Araujo, J. A. (2018). Mathematical Olympiad participation and student's interest in mathematics: Evidence from Brazil. International Journal of Mathematical Education in Science and Technology, 49(7), 965-977.

8. Pozo, J. I. (1998). A SOLUÇÃO DE PROBLEMAS – Aprender a resolver, resolver para aprender. Artmed.

9. Polya, G. (1945). How to solve it: A new aspect of mathematical method. Princeton University Press.

10. Ribeiro, A. R. P., & Silva, C. A. (2018). Participação em olimpíadas de matemática e desempenho escolar. Caderno de Pesquisa, 48(169), 129-146.

11. Severino, A. J. (2007). Metodologia do trabalho científico (23a ed.). Cortez.

12. Silva, N. V. da. (2017). Um estudo acerca do desempenho do estado do Piauí na OBMEP no período de 2005 a 2016. Universidade Federal do Piauí. Recuperado de https://sca.profmatsbm.org.br/sca_v2/get_tcc3.php?id=150233056

13. Van de Walle, J. A. (2013). Elementary and middle school mathematics: Teaching developmentally (8th ed.). Pearson.