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Tutorial Education Program and OBMEP at school: influences on the initial teachin education of future mathematics teachers[1]

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ABSTRACT

In this article we analyze relevant aspects about the initial formation of students from a public university who participate in the Tutorial Education Program (PET), in an extension project entitled "PET Mathematics in OBMEP at school", which involves actions developed by PET students with the Brazilian Mathematics Olympiad for Public Schools (OBMEP). This is a qualitative research and the data were collected through questionnaires developed with the project participants and were analyzed according to content analysis. With the data analysis, we could identify that the experiences of prospective mathematics teachers in school, made possible by the joint project between PET and OBMEP, can be an opportunity to build mathematical knowledge for teaching and knowledge of practice, generated by the third teaching education space.

KEYWORDS: Mathematics teacher initial education. Third teaching education space. Knowledge of practice. Mathematical knowledge for teaching. Tutorial Education Program.

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Programa de Educação Tutorial e OBMEP na escola: influências na formação inicial de futuros professores de matemática

RESUMO

Neste artigo analisamos aspectos relevantes sobre a formação inicial de alunos do curso de Matemática de uma Universidade Pública que participaram do Programa de Educação Tutorial (PET), no projeto de extensão intitulado "PET Matemática na OBMEP na escola", que envolve ações desenvolvidas pelos participantes junto à Olimpíada Brasileira de Matemática das Escolas Públicas (OBMEP). Trata-se de uma pesquisa qualitativa e os dados foram coletados por meio de questionários respondidos pelos com os participantes do projeto e analisados segundo a Análise de Conteúdo. Com a análise dos dados, pudemos identificar que as vivências dos futuros professores de Matemática na escola, possibilitadas pelo projeto conjunto entre o PET e a OBMEP, podem ser caracterizadas como uma oportunidade de construção do conhecimento matemático para o ensino e do conhecimento da prática, gerada pelo terceiro espaço de formação.

PALAVRAS-CHAVE: Formação Inicial de Professores de Matemática. Terceiro Espaço de Formação. Conhecimento da Prática. Conhecimento Matemático para o Ensino. Programa de Educação Tutorial.

Programa de educación tutorial y OBMEP en la escuela: influencias en la formación inicial de los futuros profesores de matemáticas

RESUMEN

En este artículo analizamos aspectos relevantes sobre la formación inicial de los estudiantes de la asignatura de Matemáticas de una universidad pública que participaron del Programa de Educación Tutorial (PET), en el proyecto de extensión titulado "PET Matemáticas en OBMEP en la escuela", que involucra acciones desarrolladas por los participantes de la Olimpiada Brasileña de Matemáticas en Escuelas Públicas (OBMEP). Se trata de una investigación cualitativa en los datos fueron recolectados a través de cuestionarios desarrollados con los participantes del proyecto y analizados de acuerdo al Análisis de Contenido. A través del análisis de datos, pudimos identificar que las experiencias de los futuros profesores de Matemáticas en la escuela,

posibilitadas por el proyecto conjunto entre PET y OBMEP, se pueden caracterizar como una oportunidad para construir conocimientos matemáticos para la enseñanza y conocimientos prácticos, generados por el tercer espacio de formación.

PALABRAS CLAVE: Formación inicial de profesores de matemáticas. Tercer Espacio de Formación. Conocimiento de la práctica. Conocimientos matemáticos para la docencia. Programa de educación tutorial.

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The Research Context: PET and OBMEP

Research in Mathematics Education and Education focused on teacher training emphasizes the importance of an education that favors experience and reflection on pedagogical practice. Thus,

> […] both official documents and academic documents from several associations in the educational area propose that training for the teaching profession should have as its axis an effective relationship between educational theories and practices (GATTI, 2013, p. 95).

In this text, to experience and reflect on the future teaching practice, we present the work developed by prospective mathematics teachers participating in the *Programa de Educação Tutorial*[5] (PET) of a public university in the state of Minas Gerais, Brazil, together with high school students from the same city, who participated in the *Olimpíada Brasileira de Matemática das Escolas Públicas*[6] (OBMEP).

PET is a program linked to the Brazilian Ministry of Education (Ministério da Educação - MEC), developed by groups of undergraduates enrolled in higher education institutions, henceforth *Petianos*, in which they build up actions related to research, teaching, and extension under a responsible professor's tutorship. The program's objective is to "ensure

[5] Tutorial Education Program.
[6] Brazilian Mathematics Olympiad for Public Schools.

scholarship holder students opportunities to have experiences different from conventional curricular structures, aiming at their global formation and favoring their education" (BRASIL, 2006, p. 4).

OBMEP is a national program with diversified actions that aim to improve the quality of mathematics teaching in basic education schools in the country. The *OBMEP na escola*[7] program is a subproject of OBMEP that seeks to arouse the interest of basic education students in mathematics and contribute to the training of its collaborators.

The *Diretrizes Curriculares Nacionais*[8] aimed at teacher initial and continuing education, Resolution CNE/CP (Conselho Nacional de Educação/Conselho Pleno) N. 2/2019, states the importance of connecting theory and practice based on didactic and scientific knowledge for the development of undergraduates, contemplating teaching, research, and extension (BRASIL, 2019). Thus, we consider that the PET is one of the actions the Brazilian government develops towards training guidelines, encouraging initiation to teaching, strengthening the training of higher education teachers, and contributing to improving the quality of public education in the country.

Therefore, in this article, we aim to analyze relevant aspects of the initial education of students enrolled in the Mathematics course of a public university, participating in the PET, in the extension project entitled *PET Matemática na OBMEP na escola*[9]. The project involves actions developed by PET scholarship holders at the *Olimpíada Brasileira de Matemática das Escolas Públicas*[10] (OBMEP), through a partnership between the tutor professor of *PET Matemática* at the university mentioned and a professor from the federal institute responsible for the *OBMEP na escola* program, where the work took place.

[7] OBMEP at school.
[8] National Curriculum Guidelines
[9] PET Mathematics in OBMEP at school.
[10] Brazilian Mathematics Olympiad for Public Schools.

This partnership led to the participation of the *PET Matemática* group in the *OBMEP na escola* program, helping in the activities proposed by OBMEP with basic education students. For this, we designed and developed actions and teaching strategies to contribute to the mathematics learning processes of basic education students who participate in the program.

Through the work developed, we seek to discuss relevant aspects of the initial education of those prospective mathematics teachers who participate in the PET, in the project *PET Matemática na OBMEP na escola*. Below, we present the theoretical-methodological frameworks that guided our study, highlighting the actions developed by the *Petianos* and, subsequently, our data analysis.

Theoretical framework

This research, based on the experiences lived by the *Petianos* when they elaborated actions with the students of basic education, supported by concepts and contents favored by the OBMEP, is grounded on the ideas of Zeichner (2010), who points out the need to create "hybrid spaces" in teachers' education at the university, seeking an interrelation between academic knowledge and professional knowledge. In addition, the work developed with the *Petianos* is based on the concept of "knowledge of practice" by Cochran-Smith and Lytle (1999) and concepts related to mathematical knowledge for teaching widely discussed by Ball, Thames, and Phelps (2008) and Ribeiro (2012).

Thinking about teacher education that privileges experiences at school, we consider that work developed in the field, coordinated and supervised by teacher educators, according to Zeichner (2010), helps prospective teachers to act successfully in their teaching practices. Indeed, Reali and Mizukami (2010) emphasize how vital it is to create possibilities for prospective teachers during their initial training, to carry out teaching

and learning experiences in teaching in different contexts, to allow the expansion of visions, stimulate the feeling that they are able to teach, and promote self-criticism.

Skovsmose (2004) highlights the importance of the participation of undergraduates in collaborative projects and emphasizes the need to consider their background, which is related to their customs, origin, and "cultural baggage." This author also says that we must consider the licentiate's foreground, i.e., the social, economic, political, and cultural opportunities that society and school, in particular, provide. Their foreground expresses hopes, aspirations, and expectations.

Those training models contribute to configuring distinct spaces in the process of initial teacher education. We observe the predominance of a "first space," the model of cultural/cognitive contents. Here, theory learning centered on subject matters occupies a large part of a degree course. Thus, the first space surpasses the "second space," the pedagogical-didactic model, usually allocated at the end of the course, and dedicated to the relevant knowledge to the teaching action contained in the curriculum under practicum or teaching practices. Having learned a set of theories, the prospective teachers must go to schools to practice and/or apply what was built in the academy.

Zeichner (2010) proposes the constitution of a "third space," which is the development of hybrid spaces-times that bring together practical and academic knowledge in less hierarchical ways to create new learning opportunities for teachers in training. The author defends the "third space" as a period when a more egalitarian status between the university and the school should be encouraged. This approach differs from the conventional partnerships between both institutions, especially for the practices, when the undergraduates carry out specific, fragmented, targeted, predefined activities, disregarding the complex school context and what happens in the relationship between teaching and learning in that place. This practice has been established as a

model from the outside in, considering that knowledge is most likely retained by the academy rather than by basic education teachers, who are supposed to accumulate knowledge from experience, which is not valued in this traditional equation.

For Zeichner (2010), this "third space" is an alternative to enhance the undergraduates' practice before they start it, legitimizing the school, so to speak, as a co-training institution, since much teaching knowledge can be built in the very exercise of the function.

Thinking about the highlighted aspects, the development of the study carried out with the PET group was also based on the concept of "knowledge of practice" by Cochran-Smith and Lytle (1999). We understand this concept as the knowledge that considers both the practice developed by the teacher in class and the theory produced by the researchers. In the relationship between theory and practice from this perspective, there is a need to create opportunities for teachers and prospective teachers to question and explore ideologies, practices, and interpretations, seeking to learn to challenge assumptions, assume leadership roles, identify problems, and provide solutions, among other objectives.

Furthermore, Cochran-Smith and Lytle (1999) argue that some teacher education programs seek to connect undergraduates' learning to that of experienced teachers and teacher educators. In fact, we point out that the project *PET Matemática na OBMEP na escola* is a possibility of training aligned with the concept of "knowledge of practice" since knowledge is produced when all members of the *PET Matemática* group, undergraduates and teachers, come together to learn, involving issues such as negotiation, decision-making, group work, and division of labor.

We also consider the importance of addressing aspects related to the knowledge of mathematics teachers, widely discussed by Ball, Thames, and Phelps (2008) and Ribeiro (2012) when dealing with mathematical knowledge for teaching (MKT). In the context of our study, we believe that mathematical knowledge for teaching, developed by Ball

and collaborators and widely discussed by Ribeiro (2012, p. 541), "is not limited to what teachers need to know to teach, it also involves what teachers themselves need to know and be able to do to carry out such teaching." Therefore, we identified that "teachers must be able to explain the meaning of concepts and procedures (for example, subtraction algorithm and subtraction concept) to students and choose examples and situations that are suitable for such development" (p. 541).

Therefore, when we deal with mathematical knowledge for teaching, we are talking about content-specific knowledge and pedagogical content knowledge, considering that "the first refers essentially to the mathematical content for teaching" and "the second refers to how this content can be taught, contemplating the curriculum, the students, and the very relationships between them and the mathematical content" (PAZUCH; RIBEIRO, 2017, p. 474). Furthermore, according to Ball, Thames, and Phelps (2008), the introduction of the term "pedagogical content knowledge" (SHULMAN, 1986) suggests the need for content knowledge that is unique to teaching. Continuing his studies, when introducing the notion of pedagogical content knowledge, Shulman (1986) discusses the link between content knowledge and teaching practice. Ball, Thames, and Phelps (2008) contest that, although the term pedagogical content knowledge is largely publicized, its potential has been little explored, as many assume that its nature and content are obvious. However, what is meant by pedagogical content knowledge is still poorly specified, without a definition and without empirical foundations, which eventually limits its usefulness (RIBEIRO, 2012, p. 539).

We believe that (1) teachers need to know the subject (content) they teach for one simple reason: teachers who do not know a subject well will likely not have the necessary knowledge to help students learn it – however, knowing well a subject is not enough to teach it; (2) teacher education courses should not only focus on the mathematical learning

gains of their students, as it seems more important that they prepare teachers to know and be able to use the mathematics that is necessary for the teaching work (RIBEIRO, 2012, p. 542-543).

Based on these discussions, we understand that the prospective mathematics teachers' experiences at school made possible by the joint project between PET and OBMEP can be an opportunity to build mathematical knowledge for teaching and knowledge of practice, generated by the third space of training. The following section presents the research methodological assumptions and data analysis.

The Work Developed and the Methodological Assumptions

The project developed by the PET group with OBMEP took place in three editions, the first in 2017, the second in 2018, and the third in 2019. The work had a team formed by eighteen participants, as follows: a university professor and tutor at PET, a collaborating professor who also taught at the university, a collaborating professor, who also taught at the federal institute, and fifteen students from the Mathematics course linked to PET, which we call *Petianos*. The target audience was students from the 1st to the 3rd grade of secondary and technological education who participated in the mathematics olympiad from 2017 through 2019.

There were fourteen meetings each year, organized in seven cycles of two meetings each, whose general objective was to help high school students who participated in the activities proposed by OBMEP. For this, actions and teaching strategies were designed and developed focused on the contents covered in the activities to contribute to those students' mathematics learning process.

The division of the cycles occurred due to the separation of the topics covered in the mathematics Olympiad, and we used the materials available by OBMEP (video classes, handouts, lists of exercises) as support for the work developed in the classroom. These materials,

usually consisting of math exercises and problems to be solved on the topic addressed in each cycle, were made available in advance to the *Petianos*, so that they could plan actions and strategies in advance for each meeting.

Chart 1 presents the seven cycles developed in the project and the respective contents covered in each:

CHART 1: Cycles and contents

CYCLE	CONTENT
1. Algebra and Functions	– Factoring algebraic expressions; – Notable algebraic identities; – Linear equations and inequalities; – Systems of two linear equations in two variables; – Coordinates in the plane; – Function concept and its graph; – Proportionality and percentage; – Affine function and its graph.
2. Counting	– Additive and multiplicative principles; – Event probabilities of equiprobable sample spaces.
3. Geometry I	– Angle; – Triangles; – Quadrilaterals; – Circle.
4. Arithmetic I	– Parity; – Decimal system; – Divisibility criteria; – Euclidean division; – Greatest common divisor (GCD); – Least common multiple (LCM).
5. Arithmetic II[11]	– Prime numbers and prime factoring; – Calculation of GDC and LCM through prime factorization; – Geometric and arithmetic progressions.
6. Geometry II[12]	– Similarity of triangles; – Thales' and Pythagoras' theorems; – Calculation of volume, areas, and perimeters.
7. Algebra and Functions	– Quadratic equations and inequalities; – Quadratic functions.

Source: Prepared by the authors.

[11]It is a continuation of the previous cycle.
[12]In this cycle, some concepts worked on in the third cycle were also deepened.

The meetings, of four hours each, took place on Fridays, alternating every other week. For these meetings, the team was organized so that there were always at least five *Petianos* and a professor responsible for the program at each meeting. Before each meeting, the *Petianos* prepared by studying the material to be worked on, and if they had doubts, they were resolved by one of the responsible teachers.

During the meetings, high school students were organized into groups of four students so that each *Petiano* could help a group, with the teacher's support, who guided them as the needs arose, following the planning of the OBMEP. This dynamic helped to direct the activities.

After this presentation, we bring an analysis of the understandings that were produced by the *Petianos* when participating in the work developed with the OBMEP. For this, we analyzed individual manifestations we collected through questionnaires that were applied at the end of each edition of the project in those years, aiming to notice relevant aspects of the initial formation of *Petianos* when participating in the *PET e OBMEP na escola*.

The analysis was based on content analysis, described by Bardin (1997) as a set of systematic and objective procedures for describing the content of messages, indicators that allow the inference of knowledge related to the conditions of production and reception of those messages, in search of an analysis of communications. Therefore, we went through the different phases of content analysis: pre-analysis, exploration of the material, treatment of results, inference, and interpretation.

In the initial phase, the pre-analysis, we organized the data to constitute the documents to be submitted to the analytical procedures, the research corpus. After that, we did the "floating reading," searching for the first contacts with the documents, and created impressions and guidelines. Then, we encoded the data, which corresponds to a transformation that, through clipping, aggregation, and enumeration, allows the representation of the expression, the content.

In the "exploring the material" phase, the corpus was studied in depth, and the results were analyzed to be meaningful and valid. For this, we defined that the register unit adopted in this research is the theme. The register unit aims at the categorization and frequency counting (BARDIN, 1997). We can cite different types of register units, such as word, documents, theme, and character. We chose the theme because it is a statement about a sentence, a subject, in which we can find a vast set of singular formulations. To find the themes, we organized the ideas from the answers to the questionnaires and separated similar and discrepant elements. From the themes and the analysis of recurrences, we found the categories of analysis that emerged from the content of the *Petianos*' answers. Thus, this article discusses the category "Influences on the *Petianos*' initial teacher education."

Influences on the *Petianos*' Initial Teacher Education

When a new project starts, it brings expectations, aspirations, and sometimes even insecurity and anxiety in the face of the challenge. The participants stressed those feelings when considering the project proposal, to work with high school students who stood out in the Brazilian mathematics olympiad with activities proposed by the *OBMEP na escola* program. The prospective teachers were concerned about teaching students who feel comfortable with mathematics, besides working with mathematical content at a more advanced level than they were used to, as we can see in *Petiano* Tarley's speech: "It is a very good project that delves into mathematics with interested and very intelligent students. I need to study hard for each meeting". Indeed, they had to prepare well and study the mathematical content to be worked on at each meeting to enable all involved to develop logical-mathematical reasoning. In this regard, Flavia also comments:

> The project presents slightly less conventional mathematics to the students, getting closer to the contents of the OBMEP tests with a greater degree of difficulty and, of course, the activities worked on help in the development of logical reasoning, both ours from the PET, and the high school students.

The highlighted lines align with Ribeiro's (2012) notes when discussing aspects related to the knowledge that teachers need to mobilize for students to learn mathematics. For him, mathematical knowledge for teaching "is not limited to what teachers need to know for teaching, but also involves what teachers themselves need to know and be able to do to carry out such teaching" (RIBEIRO, 2012, p. 541).

Hence, when the prospective teachers were asked about their participation in the project and the influences on their teaching training, they highlighted the importance of these experiences as a way of facing situations that may be present in their future practice in class:

> It's a gratifying project for us because we deal with students interested in learning, so they question us, ask for help, and show us other ways to solve exercises. Thus, we have an idea of what it will be like when we are teachers, helping us to gain experience to deal with probable events in the classroom. [...] Contact with high school students helps us a lot to perceive how we should act in the class, see what the main difficulties are and how to communicate better with them (Petiano 1).

The scholarship holders' perception, provided by their participation in the project, is in line with the discussions by Ribeiro (2012) when dealing with training courses. The author notices that these should not only focus on gains in mathematics learning for prospective teachers since "it seems more important that they [the courses] prepare teachers to know and be able to use the mathematics that is necessary for the teaching work" (RIBEIRO, 2012, p. 543).

About the prospective teachers' construction of specific knowledge of mathematical content, we noticed that insecurity gave way to satisfaction, favoring the feeling of being capable, as we can observe:

> [...] the exercises are usually well elaborated and with a greater degree of difficulty than we solve in classrooms. They are difficult to interpret and solve, and thus make us, prospective teachers, more familiar with this type of exercise, which usually involves logical reasoning and text interpretation, among other skills. Each one that I solve, I feel great joy (Petiano 2).

Those feelings of satisfaction and of being capable are part of what Skovsmose and Penteado (2007) claim that we can find when we step out of the comfort zone toward the risk zone, where it is necessary to develop a constant search stance.

By understanding the *Petianos'* expectations about the project and highlighting how they perceive the opportunity to work with basic education students in their initial training, we try to understand their foreground, which expresses expectations, hopes, and aspirations (SKOVSMOSE, 2004). Next, we can see the foreground flourishing in the *Petianos*' speeches:

> [...] I learned to be committed, to get prepare for the activity that was going to be developed, to be more confident to teach, and to have a teacher's attitude towards the students (Petiano 1).
> [...] I was afraid of not knowing how to solve some activity and one of the things I learned in the project was that if I dedicate myself, I can do it. I don't need to be afraid of teaching. It is so good to solve difficult exercises, which we think we would never be able to do (Petiano 3).
> [...] several times, I had to learn to find different ways of explaining the content, facilitate the students' understanding of the activities and interpret specific problems, and whenever this happened, I was very happy to do so (Petiano 4).

We also identified the background, which has to do with their customs, their origin (SKOVSMOSE, 2004). A *Petiana* highlighted:

> I really enjoyed participating in the project, mainly because, as I won a medal in the mathematics olympiad when I was in high school and had the opportunity to participate in a similar project as a student, and now it's the opposite, me as a teacher helping and teaching medalist students, it was very gratifying and a very important experience in my life (Petiana 5).

We can say that the project made it possible for the *Petianos* to have a deeper understanding of problems and exercises of different mathematical contents, generating the opportunity to produce knowledge and reflect on their practice as prospective teachers. Those aspects align with Zeichner's (2010) notes when discussing the need to create "hybrid spaces" in teacher education, spaces that privilege both academic and professional knowledge. For this reason, from the *Petianos'* speeches, we can say that the project *PET e OBMEP na escola* is an initiative to promote these "hybrid spaces", or "third space" of training, bringing an opposite position to "the disconnection between school and university and the valorization of academic knowledge as the only authoritative source of knowledge for learning about teaching" (ZEICHNER, 2010, p. 487).

In fact, Domingos emphasizes: "I'm sure that working with students who are already considered excellent in mathematics will help me when I become a teacher because I learned to solve very difficult problems together with them." We consider that this process results in the autonomy of the construction of knowledge, making the future teacher participate actively in the activities developed, generating an investigative and reflective posture.

We noticed that the *Petianos* had a critical attitude in relation to what they studied and what they found in practice. This situation refers to "knowledge of practice" (COCHRAN-SMITH; LYTLE, 1999), as the work enabled prospective teachers to explore and question interpretations and ideologies, and to create a critical attitude towards their beliefs, assumptions, and experiences.

In fact, the curricular guidelines for the teachers' initial and continuing education recommend that such works be essential for teacher training and highlight the importance of carrying out "formalized partnerships between schools, educational networks or systems, and local institutions for the planning, execution, and joint evaluation of the expected practical activities" (BRASIL, 2019, p. 4). Regarding the work analyzed in this article, we emphasize that it is a partnership between university and school, promoted by the *PET Matemática* group and developed with the high school students of the federal institute of the city.

As the entire project was developed in a group, we sought to identify the importance given and difficulties pointed out by the *Petianos* when executing the *OBMEP na escola*. Guedes et al. (2007) emphasize that the results of a project and the engagement of those involved depend on the adoption of positive stances and that, to manage possible conflicts, it is necessary to adopt established rules.

We evidenced that group work involves discussions about the division of tasks, ideas, and exchange of experiences. In this direction, Helamã commented on "the difficulty in organizing the time and activities for each individual in the group, and we found in some tools aids that allow dialogue, execution, and organization of group and distance tasks." Another point to be noted is that although some *Petianos* commented that they do not like to work in groups, they actively participated and showed they understand the importance of developing group work for their formation:

> I don't like group work, I don't get along [with the others] very well, but since I joined the PET, I did what was proposed to me in a serious and committed way. When the work is well divided and organized, it works better, and I know it is good for our formation (Petiano 6).

> I am not particularly familiar with works and activities that should be carried out in groups, however I know that they encourage me to develop my skills and they have certainly helped me in the sense of interacting with other colleagues and listening to other opinions (Petiano 7).

However, the vast majority highlighted that they like group work due to the possibility of exchanging experiences, knowledge, and division of tasks:

> I particularly like group work. Interaction with others and knowing how to deal with different personalities to achieve a common goal are very important virtues, even for a teacher, who at school or university will have distinguished students and co-workers as well. I believe that the difficulty in developing group work may come from the lack of commitment of some, or the confrontation of ideas, but these are situations that can be circumvented if everyone is focused on the common goal (Petiana 5).

We consider that the positive and responsible attitude adopted by the group favored the development of the project, as well as the initial training of the *Petianos*, as it helped in the development of the capacity to work in groups, solve problems, reflect, make decisions, and in personal performance, among other aspects.

Zeichner (2010) emphasizes the importance of creating well-supervised projects that open up opportunities for prospective teachers' new experiences and knowledge for teaching. Indeed, we can see in the *Petianos*' speeches how, based on practice, they improved their insecurity about speaking in public: "I lost the fear of speaking in public, and I am learning to position myself more" (Petiano 7). As for Thais, "the project brought me closer to the classroom, where, even if only for a few hours, I am the teacher, I must be responsible for adapting what I am saying to those who are listening to me and little by little, I am feeling more confident." Those personal experiences with practice as teaching situations are considered central elements in the processes of teacher professional development.

The national curriculum guidelines for teachers' initial and continuing education requires that the prospective teachers develop

specific competencies, such as participating in pedagogical projects in schools, planning teaching actions in search of effective learning, and committing to their professional development, among others (BRASIL, 2019). In the following statements, we can see the importance of student participation in the project:

> [...] participating in the *OBMEP na escola* made me study mathematical content more and try to create strategies to teach students who already have a good understanding of mathematics. This influenced me to reflect on how I teach, and helped me in my teacher training (Petiano 2).
> As I had to study a lot, because they were difficult exercises, I lost the fear of making mistakes and I gained more confidence to teach (Petiano 1).

We noticed that the project satisfied what the guidelines indicate and enabled, through practice, self-knowledge and new knowledge about teaching, privileging the *Petianos*' insertion in a differentiated teaching and learning context, favoring initial training concerning the development of searches, strategies, and interpretations.

Final Remarks

When we take a look at the work developed, we realize that, when investing in teacher training courses, such as the PET, we find several effects on the teaching professionalization of the prospective teachers. In particular, we indicate group learning, which occurs through actions developed in teaching, research, and extension.

We believe that the investment of public resources in government programs such as the PET shows the government's concern for encouraging professional training at a higher level and highlights the importance of creating projects that encompass all undergraduates and not just a small group within the university (FEITOSA; DAYS, 2019).

It is worth mentioning that among the high school students of the federal institute participating in the project, fifteen received honorable mentions (three in the Top 100) and one received a bronze medal. Considering the 19 million students in Brazil that compete for the OBMEP, and that the federal institute only competes with some selected schools such as other federal institutes, application schools, and military schools, the working group sees these results as excellent.

The work presented here allows us to affirm the importance of programs such as the PET, which involve prospective teachers in their initial training with educational, methodological, and social issues, among others. We hope that the experience in projects of this nature reflects positively on the future teaching practice of the prospective teachers and, consequently, in class.

Based on the considerations presented in this article, we corroborate Gatti's (2013, p. 106) notes about pedagogical practice as the core of the teacher training process, emphasizing the importance of constituting a "hybrid axis that articulates a prospective teachers' education that favors the construction of meanings for educational practices; an axis that, necessarily, must connect university and school." For this reason, we stress the importance of developing projects such as the one discussed in this work, which privileged the experience of pedagogical practice at school by prospective mathematics teachers.

The text presented is a proposal for a teacher initial education action developed through a partnership between the university and the federal institute, and we hope that this work will directly contribute to the initial training of mathematics teachers and motivate new projects and investigations that promote the mathematics teacher training contextualized to their teaching practice.

Finally, we believe that the aspects discussed in this article open different possibilities for new discussions on the mathematics teachers' initial education in a third space that privileges the construction of

mathematical knowledge for teaching and knowledge of practice. Therefore, we hope to contribute to research in mathematics education that focuses on teacher education and inspire researchers and teacher educators to develop works and projects focused on prospective teachers' training in different university environments, thinking about their future teaching practice.

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