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PROFESSIONAL LEARNING OPPORTUNITIES VERBALIZED BY FUTURE MATHEMATICS TEACHERS: DISCURSIVE INTERACTIONS WITH TEACHERS AND INDIVIDUAL DIFFERENCES

OPORTUNIDADES DE APRENDIZAGEM PROFISSIONAL VERBALIZADAS POR FUTUROS PROFESSORES DE MATEMÁTICA: INTERAÇÕES DISCURSIVAS COM DOCENTES ATUANTES E DIFERENÇAS INDIVIDUAIS

OPORTUNIDADES DE APRENDIZAJE PROFESIONAL VERBALIZADAS POR FUTUROS PROFESORES DE MATEMÁTICAS: INTERACCIONES DISCURSIVAS CON PROFESORES EN EJERCICIO Y DIFERENCIAS INDIVIDUALES

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ABSTRACT

A largely unexplored gap in teacher education concerns the understanding of professional learning opportunities (PLOs) offered to future mathematics teachers when they participate in border communities with secondary school teachers. Based on this problem, the research question was formulated: What PLOs were perceived by future mathematics teachers when they interacted with secondary school teachers in a formative process about mathematical reasoning and structured by the PLOT model? A qualitative research study was developed with the objective of identify, describe, analyze and contrast the PLOs verbalized by two future teachers, triggered from discursive interactions with secondary school teachers. The methodological approach involved semi-structured interviews, developed from audiovisual recordings of the meetings. The theoretical frameworks supported the construction of categories and indicators of analysis related to teacher knowledge. The research shows that the experience in a border community, combined with the PLOT model, constitutes a formative space for future teachers, by promoting situated and reflective PLOs that would hardly emerge in traditional formative contexts.

Keywords: teacher education; future mathematics teachers; professional learning opportunities; PLOT model; teacher knowledge.

RESUMO

Uma lacuna pouco explorada na formação de professores diz respeito à compreensão das oportunidades de aprendizagem profissional (OAP) oferecidas a futuros professores de matemática quando estes participam de comunidades fronteiriças com docentes da educação básica. A partir dessa problemática, formulou-se a questão de pesquisa: quais OAP foram percebidas por futuros professores de matemática ao interagirem com professores da educação básica, num processo formativo acerca do raciocínio matemático e estruturado pelo modelo PLOT? Desenvolveu-se uma pesquisa de natureza qualitativa com o objetivo de identificar, descrever, analisar e contrastar as OAP verbalizadas por dois futuros professores, decorrentes das interações discursivas com professoras da educação básica. O percurso metodológico envolveu entrevistas semiestruturadas, elaboradas a partir de gravações audiovisuais do processo formativo. Os referenciais teóricos subsidiaram a construção das categorias e indicadores de análise relacionados ao conhecimento profissional docente. A pesquisa evidencia que a experiência em uma comunidade

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fronteiriça, aliada ao modelo PLOT, configura um espaço formativo para futuros professores, por promover OAP situadas e refletidas que dificilmente emergiriam em contextos formativos tradicionais.

Palavras-chave: *formação de professores; futuros professores de matemática; oportunidades de aprendizagem profissional; modelo PLOT; conhecimento profissional docente.*

RESUMEN

Una brecha en gran parte inexplorada en la formación docente se refiere a la comprensión de las oportunidades de aprendizaje profesional (OAP) que se ofrecen a los futuros profesores de matemáticas cuando participan en comunidades fronterizas con profesores de secundaria. Con base en esta problemática, se formuló la pregunta de investigación: ¿Qué OAP percibieron los futuros profesores de matemáticas al interactuar con profesores de secundaria en un proceso formativo sobre razonamiento matemático estructurado por el modelo PLOT? Se desarrolló una investigación cualitativa con el objetivo de identificar, describir, analizar y contrastar las OAP verbalizadas por dos futuros profesores, resultado de interacciones discursivas con profesores de secundaria. El enfoque metodológico incluyó entrevistas semiestructuradas, elaboradas a partir de grabaciones audiovisuales de las reuniones. Los marcos teóricos sirvieron de base para la construcción de categorías e indicadores de análisis relacionados con el conocimiento docente. La investigación muestra que la experiencia en una comunidad fronteriza, combinada con el modelo PLOT, constituye un espacio formativo para los futuros profesores, al promover OAP situadas y reflexivas que difícilmente emergerían en contextos formativos tradicionales.

Palabras-clave*: formación de profesores; futuros profesores de matemáticas; oportunidades de aprendizaje profesional; modelo PLOT; conocimiento profesional del docente.*

1. INTRODUCTION

In discussions about mathematics teacher education, the notion of communities of practice has been highlighted, especially those configured as hybrid spaces between university and school. (Crecci; Fiorentini, 2018). Among these, the concept of a border community stands out, characterized by being an institutionally unregulated space, oriented towards collaboration between basic education teachers, teacher educators, and researchers (Crecci, 2016). These communities differ from traditional academic or school communities in that they are established in a border area between the university and basic education (Crecci, 2016).

The meetings held in this context tend to be marked by the sharing of narratives of teaching experiences, which are continually problematized and given new meaning through dialogue and interaction among the participants (Crecci; Fiorentini, 2018). Active participation in the collective processes of this type of community can promote significant transformations in how teachers understand and develop their pedagogical practice, thus becoming an important space for professional development (Crecci; Fiorentini, 2018).

The formative process of which this study[3] is part of can be understood as a border community. The formative process entitled “How to develop mathematical reasoning processes in the classroom” was promoted in partnership with the Pro-Rectorate for Extension and Culture of Federal University of ABC (UFABC) and held on the Santo André campus. The meetings took place weekly, on Wednesdays, from 2 pm to 6 pm, from April 3rd to July 10th, 2024, totalizing 72 hours.

3 This work is an excerpt from the first author’s master’s research, supervised by the second author (Silveira, 2026).

The training process aimed to promote the (re)construction of teachers' mathematical knowledge through the use of Professional Learning Tasks (PLTs), focusing on mathematical reasoning processes in mathematics teaching. In parallel, the study sought to investigate the professional learning opportunities (PLOs) provided to these teachers throughout the formative process. Each weekly meeting, lasting four hours, was structured into three interconnected moments: (i) individual work, (ii) working in small groups and (iii) plenary session with all participants. The activities carried out were hands-on, facilitated by the PLT, and the discursive interactions were led by the teacher educators.

Throughout the process, participants were organized into groups for the development of the PLTs. The teacher educator Marcia Aguiar, second author of this article, structured the groups so that each group included at least one teacher currently working in basic education and one future teacher, thus promoting the exchange of experiences between different stages of teacher professional development.

Based on this arrangement and a review of the literature, the research gap in which this work[4] is situated was identified. In particular, were not found studies that investigated the perceived PLOs by future teachers, triggered from interactions with teachers, when participating in formative processes on mathematical reasoning and structured on the PLOT model.

In face of this scenario, the research question was formulated: What PLOs were perceived by future mathematics teachers when interacting with secondary school teachers in a formative process about mathematical reasoning structured by the PLOT model? Given this context, this study aimed to identify, describe, analyze and contrast the PLOs verbalized by two future teachers, triggered from discursive interactions with secondary school teachers.

2. THEORETICAL FRAMEWORK

2.1 ABOUT THE PLOT MODEL

The Professional Learning Opportunities for Teachers Model known as PLOT model, constitutes a theoretical and methodological framework focused on the organization and design of formative processes for mathematics teachers (Ribeiro; Ponte, 2020). This model emerges as a response to the need to understand and structure formative contexts that promote meaningful PLOs for teachers (Ribeiro; Ponte, 2020).

Within the PLOT model, PLOs are understood as collective moments in which teachers engage in work and discussion of mathematical and didactic situations, with the purpose of expanding and deepening their professional knowledge (Ribeiro; Ponte, 2019). As defined by Ribeiro & Ponte (2019, p. 50), PLOs refers to "collective moments in which teachers work and discuss mathematical and didactical situations in order to expand their professional knowledge for teaching." This definition is adopted in this research for data analysis.

The model organizes professional teacher learning based on three interdependent domains, as illustrated in Figure 1:

(i) Role and Actions of the Teacher Educator (RATE): the teacher educator acts as a mediator and facilitator between mathematical and didactic knowledge in formative processes geared towards the professional practice of teachers (Silva; Ribeiro; Aguiar, 2023);

(ii) Professional Learning Tasks for Teachers (PLTT): developed from records of school practice, such as lesson notes, student work, and classroom videos, these resources aim to foster mathematical

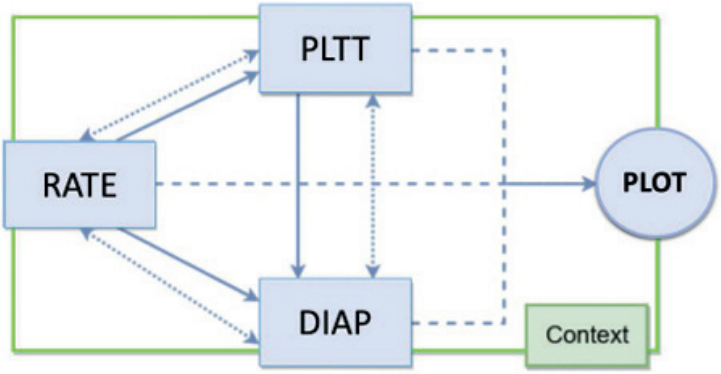
4 The study developed in this article was approved by the Research Ethics Committee (CEP) with the CAAE: 73768123.8.0000.5594.

and didactic discussions among teachers, allowing them to reflect on, share, and build knowledge about mathematics education (Pereira; Ribeiro, 2025);

(iii) Discursive Interactions Among Participants (DIAP): with the purpose of promote mathematical and didactic discussions among teachers, fostering the emergence of PLOs (Silva; Ribeiro; Aguiar, 2023).

These domains do not operate in isolation, but rather work together in an integrated way to create formative environments that foster the emergence of PLOs.

Figure 1 - Articulation of the PLOT model's domains.



Source: Adapted from Ribeiro & Ponte (2020, p. 4)

The PLOT model proposal is based on the idea that professional learning occurs through experiencing authentic teaching situations, structured from the PLT, mediated by the teacher educator's actions and enhanced by the discursive interactions established between the participants. From this perspective, teacher education is understood as a process of transformation of teachers' knowledge, beliefs, and practices, triggered by practical experience combined with collective and situated reflection (Trevisan; Ribeiro; Ponte, 2020).

When mobilized in an integrated way, the three domains of the model are fundamental for the creation of PLOs throughout the formative process. Thus, the PLOT model offers parameters that guide both the organization and development of formative programmes, contributing to the effectiveness of the PLOs and to the understanding of the teachers' learning processes that emerge from them (Ribeiro; Ponte, 2020).

The next section will present the theoretical foundations related to professional teacher knowledge, with a specific focus on teachers who teach mathematics, as adopted in the analysis of this research.

2.2 TEACHER KNOWLEDGE AND ITS DOMAINS ACCORDING TO PONTE (1999)

Teacher knowledge is formed from an articulated set of domains that manifest themselves in an integrated way in daily pedagogical practice. Understanding a teacher's professional knowledge implies recognizing the complexity of teaching and the variety of knowledge mobilized by teachers in the exercise of their profession.

According to Ponte (1999), a teacher's professional knowledge is neither static nor fragmented, but action-oriented and continuously reconstructed within the context of practice. This knowledge is organized into interdependent domains that support both classroom performance and professional development throughout one's career. From this perspective, Ponte (1999) identifies four core domains of teacher knowledge:

(i) Content Knowledge, which involves understanding mathematical concepts, their interrelationships, structures, and forms of reasoning;

(ii) Curriculum Knowledge, related to official curriculum guidelines, as well as the vertical and horizontal connections between content throughout schooling;

(iii) Student Knowledge, which encompasses understanding learning processes, interests, difficulties, classroom management, prior conceptions, and the social and cultural contexts that influence learning;

(iv) Instructional Process Knowledge, which relates to the preparation, conduct and evaluation in teaching practices, including the selection of tasks and pedagogical mediation strategies.

In this study, the Student Knowledge and the Instructional Process Knowledge domains are privileged, because they are particularly mobilized in the discursive interactions between future teachers and teachers within the context of the analyzed process.

3. METHODOLOGY

This research adopts a qualitative approach of an interpretative nature. Therefore, this research does not seek statistical generalizations, but rather a deeper understanding of particular phenomena. As described by Crotty (1998), "meaning and significance are constructed by human beings as they interact with each other and with their world" (Crotty, 1998, p. 43).

3.1 PARTICIPANTS OF THE FORMATIVE PROCESS AND PARTICIPANTS OF THE RESEARCH

The formative process involved six teachers, three women and three men. It should be noted, for characterization purposes, that all names used throughout this work are fictitious, with the exception of the names of the authors of this research. The first author participated and the second author was a teacher educator of this formative process.

The participants presented diverse profiles, both in terms of professional trajectory and educational stage: three of them are teachers with different levels of experience in basic education, and the other three are in the initial educational process to become teachers, as shown in Table 1.

Table 1 - Participants of the formative process and participants of the research.

Type of Teacher	Participants in the Formative Process	Number of Participants
Future Teachers	*Grazi* Marcos *Teo*	3
Teachers	Dani Rick Val	3
Total	3	6

Source: authors' construction.

Grazi and Teo are the two participants who also participated in the research. To understand the reasons behind this choice, we first need to understand a little more about the formative process.

3.2 THE FORMATIVE PROCESS

Structured over 72 hours, from April 3, 2024 to July 10, 2024, the formative process included in-person meetings at UFABC, a meeting at a public school located in the municipality of São Vicente, and a meeting at a private school located in the municipality of São Paulo, in addition to moments of independent work for the teachers.

The teachers involved had the opportunity to participate in theoretical studies, conducted in workshops, with practical activities mediated by PLTs, in addition to discursive interactions led by 3 teacher educators. The process' 72 hours were divided into 15 weekly meetings of 4 hours each, totaling 60 hours, and the remaining 12 hours consisted of individual readings of articles recommended by the teacher educators.

The in-person meetings were divided into four stages:

1st Stage) Welcoming and gathering preliminary information from participants. Presentation of the programme proposal. Realization of the first PLTs;

2nd Stage) Workshops given by the teacher educators for the participants;

3rd Stage) PDR cycle (Planning, Development and Reflection), the participants experienced a set of practical and collaborative experiences focused on creation (Planning), application (Development) and analysis (Reflection) of math classes that valorize mathematical reasoning (Trevisan; Ribeiro; Ponte, 2020);

The participants were organized into two distinct groups:

Green Group: Grazi, Teo, Val and Rick;

Blue Group: Marcos and Dani[5];

The composition of these groups were carefully planned by Marcia so that in each group future teachers would work in collaboration with teachers. This configuration allowed for an in-depth analysis of the phenomenon investigated in this research, that is, the PLOs emerged by the interaction between teachers at different stages of their careers.

4th Stage) Systematization of participants' learning[6].

5 The Blue Group has only two members, as Chico, a future teacher, had to drop out of the programme for professional reasons shortly after the blue group's first meeting.

6 More details about the formative process can be found in the first author's master's thesis (Silveira, 2026).

3.3 SELECTION OF RESEARCH PARTICIPANTS

To meet the objective of this research, future teachers Grazi and Teo were selected as participants. The selection of these two participants was guided by intentional criteria aligned with the study's objective. Firstly, it should be noted that both participated continuously, actively and engaged throughout all stages of the process, from the initial welcome to the systematization, demonstrating effective involvement with the proposals developed.

Furthermore, Grazi and Teo integrated the PDR cycle in direct collaboration with teachers. This experience is especially relevant because it constitutes a privileged space for observing the interactions and the PLOs that emerge from the joint practice between teachers with different levels of experience.

3.4 INSTRUMENT, METHOD AND MOMENT OF DATA COLLECTION FOR THE RESEARCH

All meetings were recorded using two cameras: one camera pointed at the whiteboard and another positioned to capture the overall dynamics of the classroom. During group work sessions, audio recordings of the discussions were made using a portable recorder and subsequently stored. In addition to the audiovisual recordings, all written materials produced at PLTs were collected and digitized for analysis purposes. These materials are not part of the data collection for this research, however, they were used to develop the semi-structured interviews, which were the data collection instrument for this research.

During the interview, the questions directed to the future teachers were distinct, since, throughout the analysis of the records (audio, video, and notes), differences were identified in the speech, interactions, and positions of each participant during the formative process. Furthermore, Teo was present during the development phase of the lesson planned by his group, while Grazi did not participate in that stage. These diverse experiences resulted in unique perspectives and perceptions, thus justifying the development of specific interview scripts for each individual. The interviews were conducted and transcribed in full by the first author after the formative process and on separate days[7], in order to avoid any interference in the responses, in case one participant had access to the other's speech.

In order to organize the interview, the questions were classified into three different scopes, namely:

(i) Open questions, that seek to answer the research question;
(ii) Planning, questions regarding the planning phase during the PDR cycle;
(iii) Reflection, questions regarding the reflection phase during the PDR cycle;

Next, we will show how we will analyze the collected data.

3.5 CATEGORIES OF ANALYSIS

The Content Analysis of Bardin (1977) was used to create categories aimed at organizing the data and as an analytical tool to systematize and interpret the collected material. The research presents two categories of analysis: Instructional Process Knowledge and Student Knowledge. They were

7 The interview with Grazi was conducted on April 12, 2025, and the one with Teo on March 13, 2025. Transcripts of the interviews can be found in the first author's dissertation (Silveira, 2026).

proposed with the intention of engaging with the research objective, the theoretical framework of analysis of Ponte (1999), the materials produced during the formative process, and the research's data collection instrument.

3.6 ANALYSIS METHODOLOGY

In this section we will show the step-by-step process followed to present and analyze the data. Eight steps were carried out:

1. The two interviews were transcribed verbatim and in their entirety;
2. The transcripts of each question, along with their respective semi-structured interview question table, were grouped into a separate Google document;
3. Only the responses that were related to the research objective were selected;
4. The verbalized PLO was highlighted in green, and what/who provided it was highlighted in blue. Evidence of the absence of PLO was highlighted in yellow;
5. Classified the respondent's answer in at least one Analysis Indicator, see Table 2 - Analysis Indicators by Category;
6. Identified and described the verbalized PLO(s);
7. Synthesized the PLOs in Table 11 - Contrasting the PLOs of future teachers, with the question number in parentheses, so that it would be possible to contrast Teo and Grazi's results in each analysis indicator;
8. Immediately after this presentation of the data, analysis was made, supported by Ponte (1999), compared and concluded the results of Teo and Grazi in the two categories;

Table 2 - Analysis Indicators by Category.

Category: Instructional Process Knowledge
The construction of instructional knowledge as a collective process promoted by DIAP
Learning teaching practices through narratives
Anticipation of students' difficulties
Category: Student Knowledge
Recognition of student diversity
Reflections on classroom management
Building a critical and attentive teaching stance towards the student

Source: authors' construction.

In the next section, we will present the data and their respective analyses according to this adopted methodology.

4. PRESENTATION AND ANALYSIS OF DATA

4.1 CATEGORY: INSTRUCTIONAL PROCESS KNOWLEDGE

This section highlights and analyzes excerpts from the speeches of future teachers Grazi and Teo throughout the data collection process, observing indicators related to Instructional Process Knowledge based on the perspective of Ponte (1999).

The category Instructional Process Knowledge, within the scope of Teacher Knowledge, refers to the future teacher's ability to understand and operationalize the elements that constitute effective teaching: lesson planning, the development and selection of meaningful didactic tasks, anticipating possible student solutions, and acting in the face of their difficulties, aspects closely linked to reflective and exploratory practice, as pointed out by Ponte (1999).

4.1.1 The construction of instructional knowledge as a collective process promoted by DIAP

Next, we will begin the presentation and description of the data related to the analysis indicator The construction of instructional knowledge as a collective process promoted by DIAP.

Table 3 - 2nd question from the semi-structured interview with Grazi.

[8]Open questions		
Interviewer's question	**[9]Comments**	**Question Objective**
What PLO were promoted to you by the interaction with teachers regarding the theme of the formative process? How did this interaction influence your view on mathematics teaching?	The PLO that were promoted by the formed groups will be investigated. We will examine, through the questions raised during the formative process, whether she has a different view on didactics and teaching practices in mathematics now.	Identify the PLO provided by DIAP.

Source: authors' construction.

We present the transcript of Grazi's response to the second question of the interview, in which the participant comments on her perception of her interaction with basic education teachers during the process.

> **Researcher**: And what learning opportunities were fostered by the [10]interaction with your fellow teachers regarding the theme of the formative process?
> **Grazi**: I think I had the opportunity to [11]understand a little bit about the classroom without being in it. [...] And I think what helped me in relation to their experience is having this universe that I didn't have at that moment, and being able to see and visualize it in a different way, which for me was all zero, although I had already done an internship and it was different. In short, I think that was it, from them to place me within the practical context when I didn't have that context.

8 Scope of the question.
9 Comments related to the question to assist the interviewer. This can be any type of evidence, such as a timestamp of a dialogue.
10 Highlighted in blue: who/what facilitated the verbalized PLO.
11 Highlighted in green is the PLO verbalized by the interviewee.

[12]The verbalized PLO was the exchange of experiences with Val and Dani during the formative process, which allowed her to understand aspects of teaching practice even without being in the classroom. This interaction allowed her to situate herself within the practical context of teaching, broaden her perspective beyond her internship experience, understand different ways of conducting mathematics teaching considering the characteristics of each class, and gain exposure to teaching resources and practices. According to Ponte (1999), teacher knowledge is constituted as action-oriented knowledge, developed from the articulation between practice and reflection, including experiences that allow the future teacher to understand and analyze the functioning of teaching, albeit indirectly.

Table 4 - 14th question from the interview with Grazi and 13th question with Teo.

Planning		
Interviewer's question	**Comments**	**Question Objective**
How did interacting with teachers help you overcome your lack of classroom experience during the planning phase of the PDR cycle?	In the formative process, when asked about the limitations experienced during the PDR cycle, Grazi replied: "The lack of classroom experience was also a limiting factor in developing the task and making better plans according to the class and content they had, especially on anticipation and developing a task appropriate to the class level."	To demonstrate how the DIAP with teachers helped overcome limitations due to lack of experience.

Source: authors' construction.

Let's see Grazi's response.

> **Researcher**: In what way the interaction with teachers helped you overcome your lack of classroom experience during the planning phase of the PDR cycle?
> **Grazi**: I think it's an opportunity, you know, to ask the question you have, clarifying the points that you are unable to resolve due to your lack of experience. And I think that's it, you know, of direction, I think, in that sense, of directing, questioning, and asking, to organize your ideas, to improve how you perform the task at that moment, in that sense, you know, of performing the planning, the PDR cycle, and so on.

Now, let's see Teo's answer to the same question:

> **Researcher**: And in what way interacting with teachers helped you overcome limitations you have due to your lack of classroom experience during the planning phase of the PDR cycle? Remember, the PDR cycle is the planning, development, and reflection cycle. So, more specifically at the planning stage, how does the interaction with teachers allowed you to overcome your limitations due to a lack of classroom experience?
> **Teo**: [13]I'm trying to remember a situation where this was relevant, but I can't.

Grazi explicitly acknowledges that interaction with experienced teachers is a PLO. She highlights clarification of doubts, guidance, organization of ideas, and improved planning as direct ben-

12 Identification and description of the verbalized PLO(s).
13 Highlighted in yellow are indications of the absence of PLO.

efits resulting from this interaction. For her, contact with experienced teachers serves as an active formative support, capable of compensating for her lack of experience. This experience reveals an approximation to the formative logic described by Ponte (1999), in which professional development occurs from situations that articulate practice and reflection, allowing the future teacher to understand and anticipate teaching action.

On the other hand, Teo does not recognize interaction with teachers as significant, which suggests not necessarily the absence of experience, but the absence of its problematization as a formative space. From this perspective, his speech indicates a lower mobilization of reflective processes on practice, a central aspect in the development of teacher knowledge according to Ponte (1999).

4.1.2 Learning teaching practices through narratives

Next, we will begin the presentation and description of the data related to the analysis indicator Learning teaching practices through narratives.

Table 5 - 19th question of the interview with Grazi.

Reflection		
Interviewer's question	**Comments**	**Question Objective**
Explain further: what do they think? How do they deal with students, or rather, what actions do they take that would be different from yours and why? Now, how would you try to do it? What is the role of exploratory practice in classroom management?	During the small group work session on July 3, 2024, at minute 16:30, Grazi said: "I don't have professional experience, so for me it was very valuable to observe how they behave, the way they think, which is very different from my world, even how to deal with the student, how to think about the questions and answer the PLT, it was very valuable in my learning."	How exploratory practice helps in classroom management (it could give students a leading role).

Source: authors' construction.

In this part of the interview, Grazi recounts how her contact with Dani and Val impacted her.

> **Researcher**: You said the following: "I don't have professional experience, so for me it was very valuable to observe how they behave, Val and Dani, the way they think, which is very different from my world, even how to deal with the student, how to think about the questions and answers of the PLT, for me it was very valuable in my learning."
> **Researcher**: Explain further: what do they think? How do they interact with students? Or better yet, what actions do they take that would be different from yours? Why? Now, how would you try to do it? What is the role of exploratory practice in classroom management?
> **Grazi**: Because when you're approached with a question and you don't even know how to explain or answer it, it's easier when someone gives you some guidance, right? That's the idea behind it. Dani and Val shared their classroom experience and I was able to get some guidance. It stems from their lived experiences, and that's why it helped me, because I didn't have those experiences.

The PLO was provided by teachers Val and Dani, who, by sharing their experiences and ways of thinking in the classroom, enabled the interviewee to broaden her understanding of teaching beyond her "assumptions" and the references from her internship. According to Ponte (1999), knowledge of the instructional process involves the preparation, conduct, and evaluation of teaching practice, requiring the teacher to be able to make decisions in the face of unforeseen situations. In this sense, by appropriating the teachers' experiences, Grazi begins to build criteria for acting in the classroom, albeit indirectly, approaching the demands of teaching practice.

Table 6 - 21st question from the interview with Grazi.

Reflection		
Interviewer's question	**Comments**	**Question Objective**
What specific types of learning opportunities were you able to have? What were those experiences like?	In the formative process, when asked how the interactions with the teachers were meaningful to her, Grazi says the following: "It was possible to learn from the experiences of others with greater knowledge and experience."	Identify the PLO offered by the teachers' experience.

Source: authors' construction.

Below is a transcript of Grazi's response to the 21st question of the interview.

> **Researcher**: Regarding: "It was possible to learn from the experiences of others with greater knowledge and experience." But what specific types of learning opportunities were you able to have? With these more experienced teachers. And what were those experiences?
> **Grazi**: [...] It was those conversations where they share their experiences in the classroom, offering a glimpse into their classroom activities, how they interact with students, and how they apply concepts.

The interviewee again highlights PLO based on the narratives of teachers Val and Dani, observing how they interacted with students and applied mathematical concepts in real-world contexts. We present the continuation of the second question from the interview, in which the participant comments on her perception of her interaction with them. This experience can be understood, according to Ponte (1999), within the scope of the development of professional knowledge, especially because it involves contact with concrete teaching situations that allow the future teacher to understand the dynamics of the classroom and how the teacher acts in response to student responses.

We present the continuation of the second question from the interview, in which the participant comments on her perception of her interaction with basic education teachers during her training.

> **Researcher**: And how did this interaction influence your view on teaching mathematics?
> **Grazi**: I think seeing what worked and what didn't work for them with each student, and even seeing the classes, each class has its own characteristics, you know, and how you can guide the learning of mathematics, up to the reasoning processes you can promote, what works, what doesn't work, what they brought from their experiences. [...] And even, I think in one of the classes we discovered that there were some

> cabinets full of games, even Val got interested, because she said they worked, that they were interesting (...). Dani also mentioned the tasks she assigned, the exercises she promoted in the classroom, the difficulties each teacher faced, including with students who were more challenging to manage, and even some things they had difficulty getting students to learn in mathematics, besides it was a subject that was uninteresting to most students.

The analysis of the three questions from the interview with Grazi reveals that the learning of teaching practices, especially in a context of little professional experience, occurred through the narratives of teachers Val and Dani. Grazi repeatedly emphasizes that her lack of classroom experience led her to see these interactions as a "guide," that is, as fundamental references for understanding how to behave, how to deal with students, and how to structure pedagogical responses and decisions. Contact with their narratives allowed her to access dimensions of teaching practice that are not evident solely in theories or lesson plans: strategies that work and those that don't work with certain students, ways of guiding mathematical reasoning, understanding the particularities of each class, use of teaching materials, management of students with greater difficulties or disinterest, and necessary adaptations to make learning more effective.

The narratives of teachers also played an important role in making visible the pedagogical reasoning that guides their actions, helping Grazi to understand not only the "how" but also the "why" of each teaching decision. This set of experiences contributed to transforming her view on mathematics education, expanding her repertoire and showing that teaching involves situated decisions, adjusted to the characteristics of the students and the dynamics of the classroom. Thus, interaction with experienced teachers not only filled gaps resulting from their inexperience, but also fostered the construction of a more complex, reflective, and contextualized understanding of teaching practice. In terms of Ponte (1999), this process highlights the construction of knowledge of the instructional process, particularly with regard to conducting the class and making decisions in real teaching contexts, even if mediated by reports.

4.1.3 Anticipation of students' difficulties

Next, we will begin the presentation and description of the data related to the analysis indicator Anticipation of students' difficulties.

Table 7 - 12th question from the interview with Grazi.

Planning		
Interviewer's question	**Comments**	**Question Objective**
How were you able to overcome these difficulties?	Let's investigate whether the teachers helped her with this task and overcome any difficulties she may have had in this area. Did contact with teachers help her overcome these difficulties? In what way?	Identify the PLO resulting from the DIAP at the time of anticipation.

Source: authors' construction.

Below is the transcript of Grazi's response to the 12th question of the interview.

> **Researcher**: And how did you manage to overcome the difficulty of having made a poor anticipation?
> **Grazi**: I don't think it was resolved. I think it was only later that I realized it was actually a problem, because I didn't see it at the time. Sometimes it seems to me that everything is fine, and then talking to people that you can see there were things missing here that I really couldn't see before. And I think that was it.
> **Researcher**: So, you hadn't realized you'd made a poor anticipation, and it was only after talking to your colleagues that you were able to see it?
> **Grazi**: That is it.

She acknowledges that her initial anticipation was limited, but only realized this gap through interaction and conversation with colleagues, demonstrating how dialogue with other professionals can reveal aspects not perceived individually. In Ponte (1999), knowledge of the instructional process involves preparing teaching practice, including anticipating strategies, student responses, and potential difficulties. Thus, by becoming aware of these limitations, Grazi begins to mobilize elements of this knowledge, improving her planning and her capacity for pedagogical intervention.

4.2 STUDENT KNOWLEDGE

When addressing the question presented in Table 8, we noticed a difference in the two respondents' responses. Teo clearly stated that he had not experienced any PLO in this category through the interactions, as we will see below.

Table 8 - 22nd question from the interview with Teo and 18th question with Grazi.

Reflection		
Interviewer's question	**Comments**	**Question Objective**
What did you learn from Val about students? Do you have a different perspective on students now? How did this learning process occur? When did it happen?	Val talks a lot and at different times about her students. We're going to investigate if this was a PLO for them. During the formative process, Grazi was asked: "In the small group sessions, you worked with future teachers, teachers, and teacher educators. What did you learn from these exchanges of experience? Please comment." She replied: "Grazi: I learned how to deal with students, how to act in the classroom."	Identify the Teacher's Knowledge in the Student Knowledge domain provided by DIAP with Val.

Source: authors' construction.

Teo doesn't think it's possible to acquire this type of knowledge through interaction with other teachers.

> **Researcher**: What did you learn from Val about students? Do you have a different perspective on students now?
> **Teo**: In what sense?
> **Researcher**: During the audio recordings I listened to in the groups you were working with, Val talks a lot about her students. About their habits, problems, and difficulties. I wanted to know if you... about the classroom management problems she faces and how she deals with them. I wanted to know if, through these discussions and comments she made during the group discussions you were participating in, you were able to learn anything about students from her?
> **Teo**: Look, I'm going to say that I don't think so. I only managed to learn about students by experiencing teaching firsthand. I think it's very difficult to understand it solely from another person's perspective.

Teo, continuing the interview, suggests that he learned much more when he was observing the class than when interacting with other teachers, but this is not addressed here because it is not the scope of this article. We find this information in the analyses of the first author's master's thesis (Silveira, 2026). Now, let's analyze Grazi's statements regarding this category in the 3 analysis indicators below[14].

4.2.1 Recognition of student diversity

Unlike Teo, Grazi, answering the same question in Table 8, expresses PLO by recognizing the diversity of the students, as we will see below.

> **Researcher**: What did you learn from Val about students?
> **Grazi**: [...] Regarding the students, you were more specific about, each one individually, each one has their own individual development, and explain how she managed the class as well (...)

14 We placed Teo before Grazi because Teo does not identify himself in any of the analysis indicators below.

> **Grazi**: And I think that was it, right? It's you trying to find a way to guide each student, right? So it's very enriching for you to see how they act in the classroom, right, from Val.

Grazi recounts her experience as a PLO gained from follow-up Val's work. Grazi indicates that this interaction provided opportunities for reflection on differentiated teaching strategies and ways to deal with classroom heterogeneity. In Ponte (1999), knowledge of the student involves understanding the learning processes, difficulties, and specificities of the students, including factors that influence their performance in the classroom. In this sense, by observing the teacher's practice, Grazi broadens her perception of the diversity present in the class and begins to build references to adjust her future pedagogical actions to this reality.

4.2.2 Reflections on classroom management

Table 9 - 22nd question of the interview with Grazi.

Reflection		
Interviewer's question	**Comments**	**Question Objective**
Which of these ideas were most impactful for you?	In the formative process, when asked about which aspects were most relevant to her professional development, she said the following: "The exchange of ideas provided a very enriching learning experience. Everyone makes a difference. And the ideas and knowledge they bring make a difference." Let her express these ideas more explicitly.	Identify the main PLOs resulting from DIAP.

Source: authors' construction.

Below is a transcript of Grazi's response to question 22, which reveals a PLO.

> **Researcher**: Which of these ideas were most impactful for you?
> **Grazi**: [...] It's about how you handle, you know, attention in the classroom, with the students [...]

The interviewee again highlights PLO related to classroom management. In Ponte (1999), it is highlighted that the teacher knowledge involves, among other domains, knowledge of the student and their learning processes, as well as the ability to make decisions in conducting the class.

4.2.3 Building a critical and attentive teaching stance towards the student

Table 10 - 20th question from the interview with Grazi.

Reflection		
Interviewer's question	**Comments**	**Question Objective**
What did you find interesting about teachers Val and Dani's classroom experience?	In the plenary session on July 3, 2024, at minute 26:25, she states that she found it interesting to see the experience of Val and Dani, who are already in the classroom. Let's investigate: What exactly did she find interesting? What caught her attention when she saw the experience of these teachers already practicing the teaching profession in basic education?	Identify Teacher Knowledge.

Source: authors' construction.

Next, we will see the transcript of Grazi's answer, corresponding to the 20th question.

> **Researcher**: What did you find interesting about the classroom experience of teachers Val and Dani?
> **Grazi**: The way you deal with a student also depends on who your student is, the context they are in, both culturally and socially.

Grazi reports a PLO related to understanding the influence of students' sociocultural context on the teaching process. This occurred through interaction with teachers Val and Dani, who have students from different sociocultural backgrounds. In Ponte (1999), student knowledge encompasses not only cognitive processes, but also social and cultural aspects that can interfere with school performance.

4.3 CONTRASTING THE PLOS OF FUTURE TEACHERS GRAZI AND TEO

The analysis of the interviews reveals distinct PLOs, even though anchored in the same formative context and the same analysis indicators; the future teachers engaged in PLOs with different emphases and paths. Below is a table comparing the PLOs verbalized by Grazi and Teo in each analysis category and their respective analysis indicators.

Table 11 - Contrasting the PLOs of future teachers.

Instructional Process Knowledge		
Analysis Indicator	**Grazi**	**Teo**
The construction of instructional knowledge as a collective process promoted by DIAP	DIAP made it possible to understand aspects of teaching practice without actually work in a classroom ([15]2)	Teo doesn't recall any instance where the DIAP with teachers provided him any PLO during the formative process (13)
Learning teaching practices through narratives	Understand strategies for teaching mathematics, teaching sequences, and choices made by teachers (2; 21)	
Anticipation of students' difficulties	Expand the capacity for critical evaluation of pedagogical strategies (12)	
Student Knowledge		
Recognition of student diversity	Ways to deal with students heterogeneity (18)	Teo couldn't grasp PLO in terms of Student Knowledge; according to him, it's very difficult to understand it from another person's perspective (22)
Reflections on classroom management	Guidance on how to deal with students (22; 21; 2)	
Building a critical and attentive teaching stance towards the student	A critical perspective on the context in which the student is situated (20)	

Source: authors' construction.

Based on this summary, we can now write our conclusions.

5. CONCLUSIONS

This study aimed to identify, describe, analyze, and contrast the verbalized PLOs expressed by two future teachers, resulting from discursive interactions with secondary school teachers, in a formative process structured by the PLOT model and developed in a border community. The research question was answered and the objective achieved through detailed analysis, in light of Ponte (1999), of the verbalized PLOs expressed by participants Grazi and Teo.

The results show that the participation of future mathematics teachers in a border community, structured by the PLOT model, can constitute a formative space by favoring the emergence of PLOs that are simultaneously situated, reflective, and socially constructed (Ribeiro; Ponte, 2019). Discursive interactions with basic education teachers proved particularly relevant in mobilizing knowledge that goes beyond decontextualized theoretical approaches, bringing future teachers closer to the complexities of pedagogical practice.

In Grazi's case, interactions with experienced teachers fostered the emergence of multiple PLOs related to both Instructional Process Knowledge and Student Knowledge. These PLOs manifested themselves primarily in the structuring of classes, in learning teaching strategies from reports, in anticipating student difficulties, and in building a more critical, reflective, and attentive teaching posture towards the sociocultural characteristics of the students. Analyzing this evidence in light of Ponte (1999),

15 The question(s) from the interview related to PLO presented in the table are highlighted in parentheses, and in the absence of PLO, the question in which the participant could have verbalized PLO is indicated.

it becomes possible to understand that the PLOs identified in this study are not limited to the punctual acquisition of knowledge, but are configured as moments of (re)construction of professional teaching knowledge in its different domains. Furthermore, the results corroborate the idea that professional teaching knowledge is action-oriented and develops in close relation to practice, as highlighted by Ponte (1999).

Teo, in turn, was unable to appropriate the discursive interactions within the same formative context[16]. This difference highlights that the emergence of PLO is neither automatic nor homogeneous, even when teachers participate in the same formative process, demonstrating the unique nature of the construction of teacher knowledge. Thus, the research contributes by highlighting that, for future teachers, interactions with secondary school teachers can take on different formative meanings. In conclusion, the insertion of future teachers into border communities, structured according to the PLOT model, expands the possibilities of PLOs by promoting experiences that would hardly emerge in traditional formative contexts.

6. FINAL CONSIDERATIONS

Beyond the conclusions presented in the previous section, we would like to reflect on the possible perspective of this work's contributions to the field of teacher education, the results are considered to offer valuable, though not conclusive, elements for rethinking formative practices in teaching license and undergraduate programmes. First, the research shows that working in border communities is a powerful alternative for future teachers programmes, as it promotes PLOs that goes beyond both the transmissive logic of undergraduate courses and the limited observation of traditional supervised internships. Furthermore, the research suggests that such diversity also benefits practicing teachers, although this analysis was not the subject of this study. Thus, possibilities remain open for future investigations into the effects of this bidirectional relationship.

Another important contribution lies in the possibility of rethinking the supervised internship itself. Based on the results obtained, it becomes evident that the internship could incorporate principles from border communities and the formative process in question, such as: collaboration, co-planning, anticipation of student difficulties, joint analysis of practices, and horizontal interaction so that future teachers experience more meaningful and less episodic PLOs.

Although the research does not aim to propose curricular changes, the results point to possible alterations in teaching license degree programmes. Among them, the importance of: (a) including extension activities that articulate theory and practice in a more organic way; (b) promoting collaborative experiences with basic education teachers from the first years of the undergraduate programme; (c) systematically incorporating spaces for the analysis of student practices and reasoning; (d) ensuring that undergraduate students have real opportunities to observe, interpret, and react to didactic situations in authentic environments.

At this point, it is worth highlighting that these results directly align with the National Curriculum Guidelines for Initial Teacher Formation, established by CNE/CP Resolution No. 2, of December 20, 2019, which stipulate that practice as a curricular component must be present throughout the entire course, being developed from the first year of the undergraduate programme (Brasil, 2019).

16 The absence of verbalization of PLO by Teo, within the context of discursive interactions, does not imply the non-existence of PLO throughout the formative process. Evidence of PLOs experienced by this participant emerges from other sources, forms, and moments of the training, especially related to the processes and natures of mathematical reasoning, which are analyzed in the dissertation (Silveira, 2026) that were not included here because they were not within the scope of the article's research question.

This research reinforces the understanding that practice should not be reduced to mere classroom observation, but needs to involve processes of active participation, such as: planning together with the teacher, collectively analyzing and evaluating the lesson, anticipating student difficulties, constructing shared pedagogical interventions, and reflecting on the effects of these actions. Thus, the aim is a formative process that integrates, from the beginning, real and collaborative situations with teachers.

In this context, it becomes possible to envision a set of extension activities that materialize the bidirectional logic (university/society/university) characteristic of extension actions. Among them, proposals stand out in which the undergraduate student takes materials, investigative sequences, or formative devices produced at the university to the school, and, in turn, the teacher returns to the university bringing data, reflections, or practices for joint analysis.

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