

In-service continuing education for Mathematics teachers: a practice focused on reflection

Felipe de Almeida Costa¹ State Secretariat of Education of São Paulo – SEE-SP

> **Gilberto Januario**² Montes Claros State University – Unimontes

ABSTRACT

The study presented in the article originated from educational practices carried out with a group of Mathematics teachers from a public school in São Paulo, Brazil, in which the intention is to promote the process of teacher reflection, considering the evaluations made by students about the teachers and their teaching practices and considering the educational demands of the teaching staff. The educational action is part of the teachers' continuing education, and is organized and developed by a group of educators consisting of the principal and the pedagogical coordinators. The study is guided by the question: *What is the school's power to establish itself as an agency for the continuing education of its Mathematics teaching staff?*. This study is incorporated into a larger research project that focuses on the school as a locus of continuing education guided by the teacher's and the reflective school's references. In the article, the discussion focuses on the process of planning educational meetings and their repercussions on teachers. The theoretical framework refers to the concepts of reflective teacher and reflective school. The educational action fits into the concept of research-education. Based on questions asked to the group of educators, the process of reflection in which the group is inserted is evident, which allows planning processes of reflection in Mathematics teachers. The purposes of the group refer to the teaching and learning processes and professional development reverberated by the reflection that the action can promote in Mathematics teachers.

Keywords: Teacher Education; Reflective Teacher; Research Training.

Formación continua en servicio para profesores de Matemáticas: una práctica centrada en la reflexión

RESUMEN

El estudio presentado en este artículo se originó a partir de prácticas de formación realizadas con un grupo de profesores de Matemáticas de una escuela pública de São Paulo, Brasil, con el objetivo de promover la reflexión docente, considerando las evaluaciones realizadas por los estudiantes sobre los profesores y sus prácticas docentes, así como las demandas formativas del profesorado. Esta acción formativa se enmarca en la formación continua del profesorado y es organizada y desarrollada por un grupo de formadores compuesto por el director y los coordinadores pedagógicos. El estudio se guía por la pregunta: ¿Cuál es el poder de la escuela para consolidarse como un organismo para la formación continua de su profesorado de Matemáticas?. Este estudio se integra en un proyecto de investigación más amplio que se centra en la escuela como espacio de formación continua, guiado por las referencias del docente y de la escuela reflexiva. En el artículo, la discusión se centra en el proceso de planificación de las sesiones de formación y sus repercusiones en el profesorado. El marco teórico se refiere a los conceptos de docente reflexivo y escuela reflexiva. La acción formativa se enmarca en

¹ Doctor in Mathematics and Science Education from Cruzeiro do Sul University. ORCID: <u>https://orcid.org/0000-0002-9055-9427</u>. Lattes: <u>http://lattes.cnpq.br/4722999165127277</u>. E-mail: <u>felipeacosta@prof.educacao.sp.gov.br</u>. ² Doctor in Mathematics Education from Pontifical Catholic University of São Paulo (PUC-SP). ORCID: ¹ University of São Paulo (PUC-SP). ORCID:

https://orcid.org/0000-0003-0024-2096. Lattes: http://lattes.cnpq.br/4492457524733108. E-mail: gilberto.januario@unimontes.br

el concepto de formación-investigación. A partir de las preguntas formuladas al grupo de formadores, se destaca el proceso de reflexión en el que se encuentra inmerso el grupo, lo que permite planificar procesos de reflexión en el profesorado de Matemáticas. Los propósitos del grupo se refieren a los procesos de enseñanza y de aprendizaje y al desarrollo profesional que la reflexión puede promover en el profesorado de Matemáticas. **Palabras clave:** Formación de Profesores; Profesor Reflexivo; Formación Investigadora.

Formação continuada em serviço de professores de Matemática: uma prática com foco na reflexão

RESUMO

O estudo apresentado no artigo se originou de práticas formativas realizadas com um grupo de professores de Matemática de uma escola pública paulista, nas quais se intenciona promover o processo de reflexão docente, considerando as avaliações feitas dos estudantes sobre os professores e suas práticas de ensino e considerando as demandas formativas do corpo docente. A ação formativa integra a formação permanente dos professores, sendo organizada e desenvolvida por um grupo de formadores constituído pelo diretor e pelas coordenadoras pedagógicas. O estudo é orientado pela questão *Qual a potência da escola em se constituir como agência de formação continuada de seu corpo docente de Matemática?*. Trata-se de um estudo incorporado a uma pesquisa maior que focaliza a escola como lócus da formação continuada por referenciais do professore e da escola reflexiva. No artigo, a discussão centraliza-se no processo de planejar os encontros formativos e suas reverberações nos professores. O referencial teórico reporta-se aos conceitos de professor reflexivo e escola reflexiva. A ação formativa enquadra-se no conceito de pesquisa-formação. A partir de questões feitas para o grupo de formadores, evidencia-se o processo de reflexão pelo qual o grupo está inserido, o que propicia planejar processos de reflexão nos professores de Matemática. Os propósitos do grupo referem-se aos processos de ensino e de aprendizagem e ao desenvolvimento profissional reverberados pela reflexão que a ação pode promover nos professores de Matemática.

Palavras-chave: Formação de Professores; Professor Reflexivo; Pesquisa Formação.

INTRODUCTION

The study presented in this article is based on a set of in-service continuing education practices with Mathematics teachers, developed in a public school of the state education system, located in the city of Itapecerica da Serra, in São Paulo, Brazil. The school serves Middle and High School, and in 2025 it will have 25 teachers, 2 vice-principals, 2 pedagogical coordinators and 1 principal.

The study is an excerpt from a post-doctoral research linked to the *Research Group* on *Curriculum in Mathematics Education* (GPCEEM), of the Postgraduate Program in Education of the State University of Montes Claros. The focus here is on the educational actions carried out in the school, with the objective of promoting the professional development of teachers through reflection on practice. The study assumes that in-service continuing education can operate the process of reflection in teachers.

Based on this assumption, we formulated the following question: What is the school's potential to establish itself as an agency for the continuing education of its Mathematics teaching staff?

We understand that teacher education in schools is fundamental, as it is directly based on the practice of these professionals and can respond to the specific demands of the school community. This study, in particular, emerged from the concerns of the first author, schoolmaster, who understands his role as an articulator in the creation of spaces and times dedicated to education, both collective and individual, including Mathematics teachers.

We advocate for teacher education based on practice and oriented towards reflection. We understand that in-service education needs to consider the actions of teachers, carried out in the classroom context, providing opportunities for them to reflect on their choices, experiences and challenges. In this sense, we dialogue with Schön (1983), for whom a reflective teacher is one who critically analyzes his or her practice, seeking continuous improvement and facing the complex problems of everyday school life with greater autonomy.

However, we know that the development of a reflective stance does not occur spontaneously. It is necessary for the school, as an institution, to also assume a reflective role, creating conditions for collective study and spaces where the school community can express its needs. Alarcão (2011) emphasizes that schools need to promote moments of joint reflection, paving the way for teachers' professional growth.

In view of this, we highlight in the article the importance of continuing education specifically aimed at the group of Mathematics teachers. We start from the question: Since the school is a locus of continuing education in-service, how can it facilitate teachers' professional development for reflection? Mathematics teachers need to develop and mobilize skills that go beyond mastering the specific content of the subject; they are expected to articulate pedagogical, technological and socio-emotional knowledge, aligning their performance with the general skills of Basic Education and the specificities of the area, promoting a comprehensive education for students (Brasil, 2017).

Mathematics teachers are also expected to stimulate students' cognitive, socioaffective and ethical development, encouraging curiosity, critical thinking, creativity and collaboration. To this end, they can use digital technologies, integrating tools such as GeoGebra, spreadsheets and educational games to make teaching more dynamic and enable the construction of senses and meanings.

In the specific domain of Mathematics, it is essential that teachers know the content related to the thematic units, as organized in the *Base Nacional Comum Curricular* [National Common Curriculum Base — BNCC] (Brasil, 2017), namely, Numbers, Algebra, Geometry, Magnitudes and Measurements, Probability and Statistics, knowing how to relate them to everyday situations and other areas of knowledge. It is important that teachers encourage different types of reasoning and problem-solving, using a project approach and adopting

different methodological strategies.

Another central aspect is the development of mathematical language, with an emphasis on the interpretation and representation of problems through graphs, tables and formulas, in addition to mathematical argumentation, which allows students to justify their answers in a logical and coherent manner. Formative assessment also stands out as an essential skill, requiring teachers to develop strategies for continuous monitoring of learning, with constant feedback and appropriate pedagogical interventions.

Finally, it is equally important for the Mathematics teacher to contextualize the content, connecting it to social, economic and environmental issues, in addition to working to address mathematical anxiety by promoting students' confidence and persistence.

In light of these expectations, we corroborate Canário's (1997) statement that it is at school that one learns to be a teacher. Therefore, we emphasize that it is at school itself that the teacher needs to be continually trained. Initial education, by itself, is insufficient to guarantee the development of all the skills required to develop the curriculum and create learning opportunities for students.

With this study, we seek to highlight the training actions implemented in a public school that aim to develop reflective teachers or, at least, to promote practices that lead to reflection in the context of Mathematics Education. The study is based on the research-education approach and the theoretical assumptions of the concept of a reflective teacher.

REFLECTIVE TEACHER

The notion of a reflective teacher is based on the human capacity to think critically and reflect on one's own practice, recognizing this professional as a creative being, and not as a mere reproducer of external ideas and practices. Alarcão (2011) highlights that this concept attributes to the teacher the role of a professional who, when dealing with often uncertain and unforeseen situations, acts in an intelligent, flexible and situated manner, adapting to the context and responding to the demands of the moment.

The reflective teacher is expected to be able to analyze the environment in which he/she is inserted, adjusting his/her actions to promote learning processes with meaning and significance for the students. This concept suggests that the teacher continually learns from his/her own practice, improving his/her performance in the face of the daily challenges related to teaching.

In the school context, it is important that teachers not only prepare lesson plans, but

that they are encouraged to do so in a continuous and structured manner. Planning goes beyond a bureaucratic task; it constitutes an exercise in reflection on the multiple aspects of the teaching and learning processes. When planning classes, the teacher is encouraged to consider the concepts underlying the teaching objects, the objectives to be achieved, the organization of the class and the possible interactions in class.

Careful planning allows teachers to establish clear guidelines for developing lessons, as well as identify and select teaching strategies that are most appropriate to the needs of their class. Thus, by considering students' educational demands, teachers can choose effective approaches for dealing with content, create opportunities for students to take on argumentative roles, and position themselves as facilitators and coordinators of the process (Januario; Perovano; Lima, 2024). In doing so, they act reflectively, anticipating solutions and fostering a more participatory and dialogic learning environment.

The lesson plan, therefore, becomes an essential tool for the continuous improvement of pedagogical practice. It not only organizes and guides teachers' performance, but also encourages them to maintain a critical and adaptive stance, aimed at constantly improving teaching approaches.

Schön (1983) reinforces the importance of a reflective stance by highlighting the growing complexity of the problems faced in teaching practice, many of which present themselves as unprecedented situations that escape the solutions offered by theories and techniques learned in early education. In these cases, the teacher cannot treat the challenges as instrumental problems, solved by implementing previously learned procedures.

Teachers need to adapt the knowledge they have acquired or, in some cases, develop new knowledge to deal with situations that are not covered by conventional theoretical approaches. Although theories are important, they need to be complemented by practical and contextual reflections, carried out throughout the professional trajectory.

In this sense, the research we developed seeks to reinforce the idea that, although initial education is essential to prepare future teachers for the beginning of teaching, it is not sufficient to meet all the real demands of educational practice. Continuing education in the school environment is, therefore, essential.

We corroborate Zeichner (1993) in stating that learning to teach is an ongoing process throughout the teaching career, and that even the best initial education programs only enable teachers to begin their practice.

In this context, we argue that reflective teacher education needs to be anchored in

collective practices, as proposed by Nóvoa (1995), for whom teacher education goes beyond the acquisition of techniques and knowledge. This is a crucial moment of socialization and professional configuration, in which the sharing of knowledge and collective reflection are essential. Imbernón (1998) reinforces this perspective, arguing that teacher education is, by nature, a collective and situated practice. Although self-education has its value, it is in the school environment that collective training actions should be prioritized.

It is important that the education of reflective teachers be supported by moments of collective study, aimed at analyzing and improving pedagogical practices, always focusing on the greater objective: student learning. As Placco and Souza (2008, p. 27) point out,

any training process and any educational practice can only advance if approached from the perspective of collective work. This presupposes the integration of all school professionals, the non-fragmentation of their actions and practices and, fundamentally, the commitment to the student's education.

It is equally important to highlight the role of individual reflections on teaching practice. It is through them that teachers identify challenges, develop solutions and contribute to the constant improvement of their professional performance. Schön (1983) proposes three main types of reflection expected from a reflective teacher:

- *Reflection-in-action:* occurs during the pedagogical action itself, when the teacher, upon realizing that a certain strategy does not have the desired effect, makes immediate adjustments to his or her approach.
- *Reflection-on-action:* occurs after the experience, allowing the teacher to review and analyze what occurred, identify successes and failures, and plan changes for similar future situations.
- *Reflection-on-reflection-in-action* (or meta-reflection): involves reflecting on the reflective process itself, evaluating how decisions were made, based on what criteria and with what results. This deeper level of reflection allows the teacher to critically examine his or her way of thinking and acting.

For example, we can think of these three types of reflection in the following context. *Reflection-in-action* occurs during the act of teaching, when the teacher realizes that the strategy adopted is not producing the expected effect and, therefore, needs to make immediate adjustments. For example, when teaching first-degree polynomial equations, the teacher may notice that some students are confused about the concept of transposition of terms. In view of this, instead of continuing with the initial explanation, he decides to interrupt the presentation and propose an analogy with everyday situations, such as the idea

of keeping a scale balanced. This change in approach, made in the heat of the moment, is a clear example of reflection-in-action, in which the teacher reacts sensitively and creatively to the students' needs.

Reflection-on-action occurs after practice, when the teacher looks back on the lesson with the intention of understanding why certain strategies did or did not have the expected effects. Returning to the previous example, at the end of the lesson the teacher may realize that, even with the use of the scale analogy, some students still do not understand the concept of an equation. Based on this observation, the teacher analyzes the points that caused confusion and decides to prepare a practical task for the next lesson, using paper scales and simulated weights, with the aim of making the concept more concrete. This process of reassessment and replanning characterizes reflection-on-action, which allows the teacher to improve his or her practice based on lived experiences.

Reflection-on-reflection-in-action, or meta-reflection, represents a deeper and more critical level of reflective practice. In this case, the teacher analyzes his or her own decision-making process during the pedagogical act, questioning not only what he or she did, but also how and why he or she made certain choices. For example, after reflecting on his or her decision to use the analogy of a scale to explain equations, the teacher asks himself or herself why he or she chose this resource and whether this choice was influenced by his or her education, previous experiences, or a momentary perception of students' difficulties. He or she then considers whether this approach takes into account students' prior knowledge or whether other strategies could have been more effective. This meta-reflection helps the teacher develop greater awareness of his or her pedagogical beliefs and decision-making criteria, contributing to the construction of a more coherent and intentional practice.

Thus, reflective practice, as described by Schön (1983), is not restricted to a specific action, but constitutes a continuous stance of analysis, evaluation and transformation of teaching practice. In teaching Mathematics, this stance is essential for teachers to be able to deal with the specific challenges of the discipline, adapting to the needs of students, valuing the pedagogical knowledge built on experience and permanently improving their professional performance.

Thus, in the context of Mathematics Education, the notion of a reflective teacher acquires even more specific contours, since teaching in this area involves not only the mastery of conceptual and procedural content, but also the ability to mobilize it in a didactic, critical and contextualized way (Lima; Bianchini; Gomes, 2018). Mathematics teachers need

to be able to interpret students' difficulties, create differentiated teaching strategies, articulate abstract concepts with everyday situations and, above all, reflect on the effects of their practice on student learning.

Being a reflective teacher in Mathematics involves not only reviewing the content taught, but also critically analyzing how this content is appropriated by students. This is a movement that requires constant observation and reworking of teaching strategies, as well as openness to error, questioning and active listening to students' difficulties. In this sense, the teacher begins to understand that simply presenting content or mechanically solving exercises is not enough. It is necessary to consider what students understand, how they construct meanings and what conceptual obstacles they face throughout the process.

Furthermore, reflection on the practice of Mathematics needs to consider the language specific to the area. The use of symbols, expressions, graphic representations and models requires teachers not only to have technical mastery, but also to have didactic sensitivity to identify which mediations favor or hinder understanding. When reflecting on the way they present an equation or interpret a graph, teachers go beyond the content; they analyze their own pedagogical stance, the clarity of their communication, the resources used and the way in which these elements impact the construction of mathematical knowledge by students.

Another relevant aspect is the reflection on pedagogical relationships in the teaching of Mathematics. This subject is often seen by students as difficult, inaccessible or uninteresting (Bueno; Alencar; Oviedo, 2017). A reflective teacher is one who is sensitive to this scenario and seeks ways to make learning more meaningful and engaging. This can occur by choosing contextualized problems, using digital technologies, promoting investigative activities or creating collaborative learning situations. The most important thing is for teachers to constantly analyze their own teaching practices, seeking to understand why certain approaches work better than others in certain contexts.

We understand that developing a reflective stance in teaching Mathematics also involves valuing ongoing education. Schools should be places for studying, exchanging experiences, and collectively constructing knowledge. When Mathematics teachers have the opportunity to discuss their practices with colleagues, analyze real situations experienced in the classroom, and explore new teaching methodologies, they expand their ability to critically reflect and transform their practices. Thus, the education of reflective teachers is not restricted to the individual level; it is strengthened when it occurs in collective training environments that recognize the complexity of teaching Mathematics and promote conditions for critical analysis of teaching practices.

Finally, as evidenced, for Schön (1983), the reflective teacher is constituted, above all, by the ability to reflect and act critically on his/her own practice, in an autonomous and continuous way. This reflection aims to promote more intentional teaching, capable of favoring student involvement and contributing to more significant learning processes. However, some questions emerge: Is it possible for a teacher, in isolation, without institutional support and without training opportunities, to become a reflective teacher? And, more than that, how to train this teacher? What strategies can be adopted to favor the construction of this reflective stance? These are the questions that guide the discussions in the following sections, in which we seek to explore possible paths for the constitution of a teaching practice based on reflection.

METHODOLOGICAL ASPECTS

The study was qualitative in nature, an approach chosen based on the understanding shared by different researchers and supported by Goldenberg (2011), who emphasizes that qualitative research does not aim to establish universal laws, but rather to promote a consistent understanding of the data analyzed. In this sense, we sought to interpret the phenomenon studied as a whole, with the objective of understanding the process in its entirety.

In addition, we adopted research-education, a modality that seeks to expand the process of humanization through critical reflection on educational practices and their theoretical foundations. This methodology is based on the education of people in and for the collective, promoting a continuous circulation of information. According to Alvarado-Prada (2005, p. 631), research-education "is characterized by the creation of conditions so that all participants have equitable possibilities to communicate".

This type of research is related to the concept of professional development, as it creates conditions for the emergence of new things in teaching practice, contributing to the continuous improvement of the teacher. According to Damiani et al. (2013), this approach is also called Pedagogical Intervention Research and is structured in three main moments:

- Plan Anticipate and organize actions, plans, tasks or scenarios to achieve defined objectives;
- Implement Put planned actions into practice;

• Evaluate — Compare the results obtained with the theoretical results predicted in the planning.

During the planning stage, trainers play a central role in organizing and structuring the actions that will guide the entire training process. This stage involves carefully selecting texts and materials that theoretically support discussions and encourage critical reflection among participants. The texts are chosen based on their relevance to the topics covered, the clarity of their ideas, and their ability to provoke questions that engage with teachers' daily practices.

In addition, trainers are dedicated to carefully developing guiding questions, seeking to ensure that they are thought-provoking and open-ended, capable of fostering in-depth and reflective debates, favoring the collective construction of knowledge. The activities are also planned to create conditions that encourage active participation, the exchange of experiences, and the critical analysis of practices, ensuring that the process is not just expository, but dynamic and collaborative. To this end, various strategies are devised, which may include discussion groups, case studies, group work, and other methodologies that promote interaction and engagement among participants.

Thus, planning is not limited to organizing content, but is a strategic moment to stimulate the development of reflective skills and strengthen the role of educators as mediators of collective learning. This methodology is aligned with the objectives of the present study, which seeks to understand how in-service teacher education occurs, focusing on promoting reflective practices that favor the development of critical and autonomous professionals.

For this article, we focus the analysis on the planning stage, highlighting its fundamental importance for the education of educators and, consequently, for the establishment of a reflective school.

HOW TO TRAIN A REFLECTIVE MATHEMATICS TEACHER?

To answer this question, we seek support from the ideas of Alarcão (2011), who helps us understand that the constitution of a reflective teacher goes beyond individual action. Collective education is necessary, but not only that. The author emphasizes that schools also need to be reflective. She clarifies that teachers cannot act in isolation at school. It is in this place, their workspace, that they, together with their colleagues, build their teaching professionalism. However, if the teacher's life is inserted in its own context, the school must be organized in such a way as to create conditions for individual and collective reflectivity. The school needs to think about itself, its mission and the way it organizes itself to fulfill it. In other words, the school, like the teacher, needs to be reflective.

We understand that being a reflective school implies creating, in the school's daily routine, a way of acting in which all members of the community — teachers, administrators, students and other employees — rethink their roles and seek strategies together to improve student learning. Alarcão (2011) emphasizes that schools cannot turn their backs on society, just as society cannot ignore the role of schools. Likewise, teachers should not remain isolated in their classrooms; they need to collaborate to collectively build a way of thinking about schools and the reality they live in. In this context, study circles and discussion groups gain strength.

In the field of Mathematics Education, this understanding is fundamental. As D'Ambrósio (2003) and Skovsmose (1994) point out, teaching Mathematics is not just about transmitting content, but also about promoting a critical and contextualized stance. D'Ambrósio (2003) draws attention to an *educational mathematics* that dialogues with the culture and daily lives of students, making learning meaningful and connected to their realities. Skovsmose (1994) emphasizes that teachers need to develop *critical competence*, that is, the ability to question practices and content, considering the social impact of Mathematics.

Educating reflective teachers in Mathematics needs to include spaces for discussion that promote this critical and culturally sensitive view. For Lins and Santos (2005), the construction of professionalism in Mathematics Education is directly linked to continuing education that articulates theory and practice, always focused on reflection on teaching and learning, as also highlighted by Barbosa and Lopes (2020).

Alarcão (2011) proposes several strategies for teacher education, such as case analysis, narratives, portfolio development, questioning other educational agents, comparing opinions, discussion groups, self-observation, collaborative supervision, and pedagogical questions. In the in-service education process, these strategies can be combined, although some are more frequent, such as discussion groups and study circles.

In the school unit where data production took place, we identified that this action occurs in three moments: the first with the group of trainers, who study the materials and texts that will be the basis for the discussions; the second with the group formed by all teachers; and the third with Math teachers, who delve deeper into the same topics with a focus on their discipline.

At the school where the research was conducted, teacher education follows a structured and ongoing plan, aimed at improving teaching practices and the quality of education. This plan begins with the analysis of the materials that will be worked on in the following weeks, in meetings on Fridays, when the principal, pedagogical coordinators and the area coordinator meet to study and select content that will support discussions and formative reflections. The goal is to ensure that teachers have access to innovative strategies and methodologies, aligned with the needs of students.

The plan is then implemented in two main moments during the week. On Monday, there is a collective education session led by the pedagogical coordinators, with all the teachers, to discuss the texts and demands of the school environment, normally those texts already analyzed in the planning meeting. On Wednesdays, there is education by area of knowledge, coordinated by the respective coordinator, in this case, Mathematics, which delves into the content with a specific focus on the subject. These training sessions last around two class hours and take place within the school, at times when the teachers are not in class.

These moments of collective study are important spaces for the exchange of experiences and for collaborative learning, promoting reflection on practices and continuous professional development.

In this way, we reaffirm the importance of teacher education being understood as a dynamic, collective and contextualized process, in which the school and its agents act in an integrated manner to build a reflective practice, capable of responding to contemporary challenges, especially in Mathematics Education, which requires a critical, culturally sensitive and committed view of the students' reality.

EDUCATIONAL PROCESS FOR REFLECTION

We present an analysis of the formation of the training group, its teacher education strategies, and how these collaborative meetings encourage rethinking of pedagogical practices, promoting the idealization of the reflective teacher. The objective is to understand not only the organization of the group, but also the impact and results that the training provides to the educational process, supporting the discussion in the field of Mathematics Education and its specific contributions.

To better understand the dynamics of this group, we developed some guiding

questions. The first of these sought to investigate the intentionality of the training group when meeting to plan the training activities: *What is the central purpose of these meetings?* The trainers, when answering, highlighted that the main objective of the meetings, held weekly on Fridays, is to plan the school's pedagogical activities, with a special focus on the needs of Mathematics teachers, an area that is recognized as challenging in terms of teaching and learning. According to Niss (2003), the complexity of teaching Mathematics requires training that promotes not only the acquisition of technical knowledge, but above all the development of pedagogical and reflective skills.

The group recognizes weaknesses and challenges that permeate daily teaching practice, seeking to fill these gaps with targeted training strategies. An emblematic example of these weaknesses is related to the methodological approaches adopted in the classroom. Not all teachers planned their classes in a way that ensured active student participation in the learning process, a fact that converges with the studies of Borba (2011), Ponte (2007) and Oliveira and Lopes (2023), which highlight the need for practices that encourage student participation and protagonism in the teaching of Mathematics. In many cases, the traditional model prevailed, centered on expository classes, with little or no effective interaction from students.

Given this reality, the training group understands that meetings are essential to offer continuous support to teachers, encouraging critical review and constant improvement of pedagogical practices. The trainers act according to the propositions of Alarcão (2011), who emphasizes the importance of encouraging teachers to promote not only the transmission of content, but above all the meaningful learning of students. Thus, the teacher is understood as a coordinator of knowledge, a role also defended by Skovsmose (2010) from the perspective of Critical Mathematics Education, which sees him as an agent capable of fostering critical thinking and social reflection through teaching.

Another question explored with the group was: *What criteria does the group consider when planning teacher training*? The trainers explain that several aspects are considered. Initially, they observe the training demands of the school and the Secretariat of Education, which guide the education priorities. In addition, the teachers themselves have an active voice in this process, indicating bimonthly themes and concepts that they would like to explore in greater depth during the training. This democratic participation strengthens the sense of belonging and engagement of the teachers in the proposed actions.

Additionally, classroom observations conducted by trainers play a crucial role in

identifying specific needs, especially among Mathematics teachers, an area that demands special attention due to the difficulties encountered by many students. Data collected during the second half of 2023, from a school assessment conducted by students, indicate that most Mathematics teachers in the group predominantly adopted expository classes, and a few encouraged interactive activities. This finding reinforces the need for education focused on more dynamic and participatory pedagogical practices. Analyses of student assessments are also discussed during meetings with the teaching group and individually with each teacher, serving as important sources for diagnosing critical points and guiding the choice of the most appropriate and contextualized training strategies.

These actions by the training group are aligned with the concept of a reflective school, as outlined by Alarcão (2011), which highlights the autonomy and self-assessment capacity of the school as institutions of continuous learning, a reflective school. It is in this environment that the reflective teacher, idealized by Schön (1983), is envisioned in the school where the research is conducted. We understand, as Tardif (2002) does, that teacher education develops fully, integrating theory and practice through continuous processes of reflection.

The responsibility that teacher educators assume towards the group of teachers, especially those of Mathematics, but also of other disciplines, is evident. They develop impactful training strategies, encouraging teachers to reflect critically on their pedagogical practices and to become active and conscious agents of their professional trajectory.

The selection of texts that guide studies throughout the weeks is another fundamental aspect. The trainers explain that the choice of materials seeks to provide an updated and relevant theoretical basis that directly addresses the real demands of teachers. Such texts are essential to promote the connection between theory and practice, enabling trainers to base their pedagogical interventions on solid foundations.

The trainer responsible for the Mathematics group emphasizes that prior study of the texts is essential for her work. Before the meetings, she conducts in-depth reflections on the selected materials, which contributes to more productive, focused discussions that are aligned with the needs of teachers. This prior preparation is in line with the recommendations of professionals in teacher education, such as Zeichner (2010), who emphasizes the importance of in-depth knowledge of the content and didactics for the effectiveness of teacher education.

Finally, we exemplify the positive impact of these trainings with a report from the

trainer of the Mathematics group herself. Initially, one of the teachers was reluctant to monitor classes, a fundamental practice for the training process. However, after a collective discussion about the objectives of this observation and the support of a previously studied text, this teacher began to understand the importance of systematic observation in the classroom. Currently, she responds promptly to the trainer's requests, incorporating this practice as a resource for her professional development.

This report shows that both teachers and trainers are involved in a continuous process of reflection and review of their practices. Data collected through questionnaires administered after the training sessions indicate that the teachers participating in the education program began to feel more prepared and motivated to implement innovative pedagogical practices after the meetings. The discussions promoted generate new reflections, translated into more qualified classes, better interaction with students and constant professional development. This collaborative movement contributes significantly to improving the quality of education. As Alarcão (2011, p. 54) reinforces,

> groups of teachers are emerging in almost every school to study a subject or find a solution to a problem in their daily lives. This shows a commitment to the profession, a desire for professional development and an expression of interest in improving the quality of education.

In our understanding, the group of teachers and trainers studied embodies these principles, demonstrating a genuine and ongoing commitment to improving teaching practices and developing quality education for all.

CHALLENGES FOR REFLECTIVE TEACHER EDUCATION IN THE SCHOOL CONTEXT

Continuing education in-service is one of the central pillars for improving the quality of education. In everyday school life, there is a clear need for constant updating on the part of teachers, who face various challenges: difficulties in approaching content, in adopting innovative methodologies and, mainly, in paying attention to the specific needs of students. This scenario requires training actions that are articulated with the context of the school itself, both in its management and in its internal environment. Education cannot be alien to teaching practice; it must emerge from it and for it.

However, planning and implementing meaningful continuing education in the school environment is a complex challenge. Management teams, overburdened by administrative tasks and goals imposed by educational systems, often do not have the time, structure or institutional support to promote study and planning opportunities. Even so, it is the school's role to ensure training actions that are consistent with its political-pedagogical project, curriculum and dialogue with the community.

In this sense, research-education (Alvarado-Prada, 2005; Damiani et al., 2013) emerges as a methodological approach that articulates education and action, by proposing a reflective process based on three axes: planning, implementation and evaluation. The planning moment assumes a structuring role, as it allows the selection of texts, elaboration of guiding questions and definition of teaching strategies that favor the active participation of teachers. This approach transforms formative moments into collaborative experiences, in which teachers and coordinators build knowledge based on their experiences and practices.

However, despite the existence of public policies that seek to institutionalize continuing education, many of them do not reflect the reality of schools. It is common for teachers to teach subjects for which they have no specific training, such as professionals in the areas of Administration or Computing teaching Mathematics. This reveals a gap in initial education and requires that continuing education in-service fulfill a compensatory function, which in itself highlights a structural weakness in educational policies.

The role of the pedagogical coordinator, in this context, is crucial. As Gouveia and Placco (2015) discuss, it is up to this professional to organize training times and spaces, propose collective studies, monitor practices and promote pedagogical reflection. However, for this coordinator to assume such a leading role, he or she himself or herself needs time and opportunities for teacher education and self-education, an investment still neglected by many education networks.

In view of this, the autonomy of schools to plan their teacher education is often only apparent. When the results of external assessments are positive, there is greater freedom to organize one's own training processes. However, when performance is unsatisfactory, standardized training that is disconnected from local reality is imposed. This logic, centered on control rather than emancipation, compromises the effectiveness of teacher education.

In this scenario, the concept of agency gains strength, in which principals, coordinators and teachers find ways to re-signify the imposed training, adapting it to the real demands of the school. This stance, supported by authors such as Imbernón (2017) and Placco and Souza (2008), values collective work, active listening and commitment to student learning. Continuing education only fulfills its transformative role when it is built with

intentionality, sharing and a connection with daily practice.

The concept of a reflective teacher, according to Schön (1983) and Alarcão (2011), becomes essential in this process. Being reflective is not just rethinking what one does, but acting with critical awareness, flexibility and creativity in the face of real classroom situations. This materializes in pedagogical planning, which needs to be more than a bureaucratic requirement; it needs to be a moment of analysis of content, strategies, interactions and anticipated challenges. The lesson plan, in this sense, becomes an instrument of empathy, as it requires the teacher to put himself in the student's shoes, anticipate difficulties and define ways to overcome them.

Reflective practice unfolds at different levels, as suggested by Schön (1983): reflection-in-action, when the teacher adjusts his strategy during the class; reflection-on-action, when critically analyzing the class after it has been carried out; and reflection-on-reflection-in-action, or meta-reflection, when the teacher investigates the foundations of his own pedagogical decisions.

In teaching Mathematics, this reflective stance is even more necessary, considering the challenges inherent to the subject: symbolic language, abstract concepts, and conceptual obstacles. Mathematics teachers need to go beyond simply presenting content — they need to be able to articulate theory and practice, adapt approaches, listen to students, and value mistakes as learning opportunities. As Ponte (2002) and Weisz (2002) argue, reflecting on practice and observing classes are essential for teachers to understand the impact of their teaching choices.

Therefore, continuing education cannot be isolated, one-off, or decontextualized. It must be collective, continuous, and situated, as proposed by Nóvoa (1995) and Imbernón (1998). Schools must function as spaces for study and shared construction of knowledge. It is in this environment that teachers develop their professional identity, expand their methodological repertoire, and strengthen their commitment to student learning (Januario; Perovano; Lima, 2024).

Therefore, training reflective teachers is an urgent imperative. It is not enough for them to master disciplinary content; they must be agents in their professional development; they must learn from experience, from colleagues, from students, and from their own practice. More than ever, it is necessary to invest in public policies that value schools as educational spaces and recognize the role of teachers as agents of their own education.

CONSIDERATIONS

In-service teacher education is an essential practice for the professional development of teachers and for improving teaching and learning processes. It goes beyond updating content; it is an opportunity for critical reflection, collective construction of knowledge and redefinition of pedagogical practices based on the concrete needs of the school and students. Strategies such as study groups, classroom observation, collaborative planning, active listening to students and the use of questionnaires as instruments for reflection prove to be effective in promoting a more conscious, dialogic and situated teaching practice.

Listening and dialogue between trainers, coordinators and teachers become central elements of this process. Education ceases to be an isolated act and begins to be understood as a collective construction, experienced in the daily life of the school and focused on practice. The pedagogical coordinator plays a fundamental role in coordinating this process, articulating training actions in collective schedules, promoting study groups and collaborating in didactic planning. For this educational role to be effective, the coordinator must also have access to study and self-education opportunities, so that he or she can deepen his or her knowledge and engage in dialogue with teachers with authority and sensitivity.

Reflection on one's own practice is addressed in the relevant literature as the basis for significant transformations in teaching. Education, therefore, is not a technical act, but an intentional and contextualized process that requires involvement, sharing, and commitment. When teachers recognize themselves as agents of their education and actively participate in collective spaces for analysis and debate, such as weekly pedagogical meetings, conditions are created for the construction of a more collaborative, critical school focused on improving learning.

In this sense, it is also necessary to consider that many teachers, despite having mastered the specific content of their area, face difficulties in didactic mediation, that is, in effectively creating learning situations that engage with students' reality and promote the development of skills. In-service education, anchored in practices such as classroom observation and joint planning, can directly help overcome these gaps by providing moments of listening, feedback, and redefining pedagogical work.

Therefore, we understand that continuing education carried out in the school context must be collaborative, critical, and sustained in the daily teaching routine, and is an essential pillar for transforming educational challenges into opportunities for professional growth. Education must be understood as an ongoing process, whose knowledge is constructed at the intersection between teaching practice, theoretical studies, and life experiences. In this way, we strengthen a school that values reflective practice, dialogue, and co-responsibility in teacher education and student learning. The in-service education process is an important practice for the continuous development of teachers and for improving the quality of teaching. Strategies such as discussion groups, collaborative supervision, pedagogical questions and the use of questionnaires with students have proven to be effective tools for promoting reflection on teaching practice and aligning pedagogical actions with the real needs of the school and students.

These practices not only strengthen the relationship between theory and practice, but also create opportunities for teachers to expand their skills and adapt their teaching strategies in a more conscious and targeted way. The focus on feedback and dialogue between educators and teachers contributes to a more meaningful education, while active listening to students reinforces the commitment to teaching that values the demands and expectations of the school community.

Therefore, in-service education, carried out in a collaborative and reflective manner, is essential for transforming everyday challenges into opportunities for professional growth, especially with regard to the education of reflective teachers and improving the learning process. We understand that these actions are only possible if the school and school community are guided by reflective practices.

Furthermore, we understand that the study of these instruments by educators, carried out during collective meetings on Fridays, plays a fundamental role in stimulating critical reflection and professional development among teachers. This moment of deepening and exchanging ideas allows educators to revisit their pedagogical practices, generating a positive impact on teaching approaches. As a direct consequence, this reflection and continuous learning resonate among teachers and, in turn, are transferred to students, creating a more dynamic and, consequently, reflective educational environment. In this way, it contributes to the construction of a school that values reflective practice and the constant development of both teachers and students.

It is therefore concluded that in-service education, especially when carried out continuously, collectively and integrated into the school routine, is fundamental for improving teaching practice and qualifying the educational process. By promoting critical reflection, dialogue and the shared construction of knowledge, it enables teachers and coordinators to become protagonists of their own professional development, capable of responding to the real demands of the school and students. Thus, continuing education becomes an indispensable instrument for creating a more collaborative, democratic school culture, geared towards the constant improvement of learning, contributing decisively to the transformation of pedagogical practices and the strengthening of education.

For future studies, we intend to present teachers' perceptions of the instruments used to train reflective teachers and also to what extent these trainings impact the students' learning process.

REFERENCES

ALARCÃO, Isabel. **Professores reflexivos em uma escola reflexiva**. 10. ed. São Paulo: Cortez, 2011.

ALVARADO-PRADA, Luis Eduardo. Pesquisa coletiva como um caminho na formação de professores. In: **Anais do 3º Encontro de Pesquisas em Educação**. Uberaba, 2005, p. 626-637.

BARBOSA, Cirléia Pereira; LOPES, Celi Espasandin. Um estudo sobre a identidade profissional de futuros professores de Matemática no Estágio Curricular Supervisionado. Educação Matemática Debate, v. 4, n. 10, p. 1-25, 2020. https://doi.org/10.46551/emd.e202035

BORBA, Marcelo de Carvalho. Ensino e aprendizagem de Matemática mediado por tecnologias digitais. Campinas: Mercado de Letras, 2011.

BRASIL. Ministério da Educação. Secretaria de Educação Básica. **Base Nacional Comum Curricular:** Educação Infantil e Ensino Fundamental. Brasília: MEC/SEB, 2017.

BUENO, Simone; ALENCAR, Edvonete Souza; OVIEDO, Teresa Sofía. Reflexões e desafios da resolução de problemas nas aulas de Matemática: um ensaio teórico. **Educação Matemática Debate**, v. 1, n. 1, p. 9-27, jan./abr. 2017. https://doi.org/10.24116/emd25266136v1n12017a01

CANÁRIO, Rui. A escola: o lugar onde os professores aprendem. **Psicologia da Educação,** n. 6, p. 9-27, jan./jun. 1998.

D'AMBROSIO, Ubiratan. **Etnomatemática:** elo entre as tradições e a modernidade. Belo Horizonte: Autêntica, 2003.

DAMIANI, Magda Floriana; ROCHEFOR, Renato Siqueira; FONSECA, Rafael Fonseca; DARIZ, Marion Rodrigues; PINHEIRO, Silvia Siqueira. Discutindo pesquisas do tipo intervenção pedagógica. **Cadernos de Educação**, n. 45, p. 57-67, maio/ago. 2013.

GOLDENBERG, Mirian. A arte de pesquisar: como fazer pesquisa qualitativa em Ciências Sociais. 12. ed. Rio de Janeiro: Record, 2011.

IMBERNÓN, Francisco. **Formação permanente do professorado:** novas tendências. Tradução de Sandra Trabucco Valenzuela. São Paulo: Cortez, 2017.

IMBERNÓN, Francisco. La formación y el desarrollo profesional del profesorado: havia una nueva cultura profesional. Barcelona: Graó, 1998.

JANUARIO, Gilberto; PEROVANO, Ana Paula; LIMA, Katia. Materiais curriculares (de Matemática) como gênero discursivo. In: **Anais do IX Seminário Internacional de Pesquisa em Educação Matemática.** Natal, 2024, p. 1-13.

LIMA, Gabriel Loureiro; BIANCHINI, Barbara Lutaif; GOMES, Eloiza. Conhecimentos docentes e o Modelo Didático da Matemática em Contexto: reflexões iniciais. Educação Matemática Debate, v. 2, n. 4, p. 116-135, jan./abr. 2018. https://doi.org/10.24116/emd25266136v2n42018a06

LINS, Rômulo Campos; SANTOS, João Ricardo Viola. Para uma outra formação matemática na licenciatura em Matemática. **Perspectivas da Educação Matemática**, v. 8, n. 1, p. 1-16, jan./jun. 2005.

NISS, Michael. Mathematical competencies and the learning of Mathematics: the Danish KOM project. In: **Proceedings of the Third Congress of the European Society for Research in Mathematics Education**. Bellaterra, 2003, p. 115-124.

NÓVOA, António. Formação de professores e profissão docente. In: NÓVOA, António. (Org.). **Os professores e a sua formação.** 2. ed. Portugal: Dom Quixote, 1995, p. 15-34.

OLIVEIRA, Saulo Macedo; LOPES, Rieuse. O Júri Simulado como metodologia ativa no curso de Licenciatura em Matemática. Educação Matemática Debate, v. 7, n. 13, p. 1-17, 2023. <u>https://doi.org/10.46551/emd.v7n13a13</u>

PLACCO, Vera Maria Nigro de Souza; SOUZA, Vera Lucia Trevisan. Desafios ao coordenador pedagógico no trabalho coletivo da escola: intervenção ou prevenção? In: PLACCO, Vera Maria Nigro de Souza; ALMEIDA, Laurinda Ramalho. (Org.). **O** coordenador pedagógico e os desafios da educação. 2. ed. São Paulo: Loyola, 2008, p. 25-36.

PONTE, João Pedro. Formação de professores de Matemática: perspectivas internacionais e desafios para Portugal. In: FONSECA, Ana Lúcia; PENTEADO, Maria Alice; BOTELHO, Maria José (Org.). **Formação de professores de Matemática em Portugal e no Brasil.** São Paulo: Casa do Psicólogo, 2007, p. 19-40.

SCHÖN, Donald Alan. **The reflective practitioner:** how professionals think in action. New York: Basic Books, 1983.

SKOVSMOSE, Ole. **Educação matemática crítica: a questão da democracia**. Tradução de Abgail Lins; Jussara de Loiola Araújo. 5. ed. Campinas: Papirus, 2010.

SKOVSMOSE, Ole. Towards a philosophy of Critical Mathematics Education. Dordrecht: Kluwer Academic Publishers, 1994.

TARDIF, Maurice. **Saberes docentes e formação profissional.** Tradução de Francisco Pereira. Petrópolis: Vozes, 2002.

WEISZ, Telma. O diálogo entre o ensino e a aprendizagem. São Paulo: Ática, 2002.

ZEICHNER, Kenneth M. A formação reflexiva de professores: ideias e práticas. Tradução de Maria Nóvoa. Lisboa: Educa, 1993.

ZEICHNER, Kenneth M. Rethinking the connections between campus courses and field experiences in college- and university-based teacher education. **Journal of Teacher Education**, v. 61, n. 1-2, p. 89-99, 2010. <u>https://doi.org/10.1177/0022487109347671</u>.