ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

DOSSIER PPGEM 40 YEARS

Mathematics teacher education processes and perspectives for/of learning and teacher professional identity

Processos formativos de professores que ensinam matemática e perspectivas para/de aprendizagem e identidade profissional docente

Márcia Cristina de Costa Trindade **Cyrino**[*]
ORCID iD 0000-0003-4276-8395
Enio Freire **De Paula**[**]
ORCID iD 0000-0003-0395-4689
Everton José Goldoni **Estevam**[***]
ORCID iD 0000-0001-6433-5289
Paulo Henrique **Rodrigues**[****]
ORCID iD 0000-0002-9807-0183
Renata Viviane Raffa **Rodrigues**[*****]
ORCID iD 0000-0002-5409-1265

Abstract

Based on the marks of different investigative trajectories evidenced in the productions of the first two decades by the Study and Research Group on the Education of Teachers who Teach Mathematics (Gepefopem), this article discusses contexts, actions, and teacher education processes promoted as well as ways of looking at teacher professional learning (TPL) and for the movement to establish the teacher professional identity (TPI). The articulation resulting from this process highlights theoretical and methodological contributions to the field of

[*] Doutora em Educação pela Universidade de São Paulo (USP). Professora Titular da Universidade Estadual de Londrina (UEL), Londrina, Paraná, Brasil. E-mail: marciacyrino@uel.br.
[**] Doutor em Ensino de Ciências e Educação Matemática pela Universidade Estadual de Londrina (UEL). Professor de Ensino Básico, Técnico e Tecnológico do Instituto Federal de Educação, Ciência e Tecnologia de São Paulo (IFSP), Presidente Epitácio, São Paulo, Brasil. E-mail: eniodepaula@ifsp.edu.br.
[***] Doutor em Ensino de Ciências e Educação Matemática pela Universidade Estadual de Londrina (UEL). Professor Associado da Universidade Estadual do Paraná (Unespar), Campo Mourão, Paraná, Brasil. E-mail: evertonjgestevam@gmail.com.
[****] Doutor em Ensino de Ciências e Educação Matemática pela Universidade Estadual de Londrina (UEL). Professor Adjunto da Universidade Estadual do Paraná (Unespar), Paranavaí, Paraná, Brasil. E-mail: hrpaulo.91@gmail.com.
[*****] Doutora em Ensino de Ciências e Educação Matemática pela Universidade Estadual de Londrina (UEL). Professora Associada da Universidade Federal da Grande Dourados (UFGD), Dourados, Mato Grosso do Sul, Brasil. E-mail: reraffa@gmail.com.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

research on mathematics teacher education (MTE), which synthesize perspectives of TPL and the movement for the constitution of TPI to explain the relevance of actions located in the relay between theory and practice. In this sense, the scope of the Postgraduate Program in Mathematics Education (PPGEM) for expanding and consolidating theories in mathematics education, particularly in the education of teachers who teach mathematics, is evident.

Keywords: Teacher Education. Formative Contexts. Mathematics Formative Processes of TTMs. Teacher Professional Learning. Teacher Professional Identity.

Resumo

A partir das marcas de diferentes trajetórias investigativas, evidenciadas nas produções das duas primeiras décadas pelo Grupo de Estudo e Pesquisa sobre a Formação de Professores que Ensinam Matemática (Gepefopem), este artigo discute contextos, ações e processos formativos promovidos pelo grupo, bem como perspectivas para/de aprendizagem profissional docente (APD) e para/do movimento de constituição da identidade profissional docente (IPD) produzidas nessas trajetórias. A articulação resultante desses processos formativos sintetiza a pertinência de ações de pesquisa e de formação situadas no revezamento entre teoria e prática. As análises, apresentadas aqui, ilustram a abrangência e a importância do Programa de Pós-Graduação em Educação Matemática (PPGEM) na expansão e no fortalecimento de teorias no âmbito da educação matemática, especialmente no que se refere à formação de professores que ensinam matemática (FPEM).

Palavras-chave: Formação de professores. Contextos de formação. Processos formativos de PEM. Aprendizagem Profissional Docente. Identidade Profissional Docente.

1 Introduction

The context of the celebrations of the 40th anniversary of the Postgraduate Program in Mathematics Education (PPGEM) at Unesp/RC was a trigger to discussions about some of the trajectory and research results of the Study and Research Group on the Education of Teachers who Teach Mathematics (Gepefopem, in the Brazilian acronym). This article aims to share the group's moral and political commitment to the education of teachers who teach mathematics[1] (TTMs' education), collaboration, and research, considering the theoretical and methodological choices and constructions that support the work.

The completion of the master's degree of the first author of this article at PPGEM, under the guidance of Prof Dr Romulo Campos Lins, inspired her to invest in a more in-depth and professional approach to TTMs' education. During this academic journey, which took place between 1994 and 1997, she dedicated herself to analyzing bibliographical materials used by teachers of the subject *Content and Methodology of Science and Mathematics* at specific centers for teachers' education and improvement (CEFAM, in the Brazilian acronym) in the state of São Paulo (Cyrino, 1997).

After completing her master's degree, she began to develop her research at the State

[1] Whenever we write teacher education, we refer to initial and continuing teacher education.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

University of Londrina (UEL), where, in 2003, she proposed the creation of Gepefopem to understand the formative processes promoted by members of the group and the construction of a formative practice in constant transformation. To this end, research was developed, anchored in the alternation between theory and practice (Foucault, 2003). This rotation aims to produce theories on aspects inherent to TTMs' education and develop principles to be considered in instructional programs that consider the knowledge, professional practice, vulnerabilities, and desires of public school in-service teachers and prospective teachers who will teach mathematics in Paraná.

Since then, undergraduate students in mathematics from the State University of Londrina (UEL), scientific initiation scholarship holders, teachers who teach mathematics already working (in basic and higher education), and master's and doctoral students linked to the Postgraduate Program in Science Teaching and Mathematics Education (PECEM, in the Brazilian acronym), from UEL, meet weekly, on Fridays, to work together on studies and instructions and research initiatives focused on TTMs' education field.

Thus, in this article, in addition to presenting a brief account of the trajectory of Gepefopem and the concerns that triggered methodological strategies and theoretical constructions, we discuss contexts, actions, and educational processes promoted by the group, perspectives for/of teacher professional learning (TPL) and for/of the movement for the constitution of teacher professional identity (TPI), taking into account its agency in educational processes, studies, and theoretical constructions regarding these themes. Finally, we present some considerations and announce perspectives for TTMs' education and future research.

2 Gepefopem trajectories

In the first six years of Gepefopem, the group invested efforts to understand the relationships that can be established between mathematics, education, mathematics education, public policies, emancipation, and the professional development of mathematics teachers.

In continuing teacher education, study groups were formed with teachers who teach mathematics and pedagogical coordinators in public schools in Paraná, focusing on professional development in collaborative groups. The first obstacles to the theoretical contributions of these investigations[2] were related to these groups' dynamics (whether or not they were constituted as

[2] For more information about these and other investigations mentioned below, the reader can consult the introductory chapter of the work: CYRINO, M. C. C. T.; DE PAULA, E. F.; RODRIGUES, P. H. (org.). **Estudos e Pesquisas sobre a Formação de Professores que ensinam Matemática.** Campo Mourão: Fecilcam, 2022.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

collaborative groups) and the way of characterizing participants' possible learning. Regarding initial education, we sought to understand: (i) the formative actions of subjects of the mathematics teaching degree (among which, Philosophy of Mathematics, History of Mathematics, Teaching Practice and Methodology: Supervised Curriculum Practicum), based on the observation and enunciation of students and teachers; and (ii) the proposals for articulation between theory and practice present in pedagogical projects of mathematics teaching degree courses in Paraná.

Other questions were formulated during these investigations: a) How do (prospective) TTMs learn? b) What contexts are fertile for the learning of these (prospective) teachers? c) How can it be inferred/evidenced that the (prospective) teacher has learned? How does the movement of constituting the identity of in-service teachers and TTMs occur?

When conducting literature reviews on TTMs' education programs, we found many studies discussing the mathematical knowledge necessary for (prospective) TTMs. However, the number of studies covering the necessary knowledge to teach mathematics, the articulation between this knowledge, the contexts involved, and their collaborators for the learning of (prospective) teachers was less representative. In other words, few studies focused on explaining how such contexts enable the learning of those involved.

Given this, the group felt the need and urgency to understand the concepts on which the official policies involving TTMs' education are based and their implications for basic education in order to contribute to the establishment of a minimum research agenda that would allow the development of formative proposals to face the challenges imposed by current educational policies.

This trajectory culminated in the development, starting in 2006, of research projects that were approved with funding from the Araucária Foundation in partnership with the State Secretariat for Science, Technology and Higher Education of Paraná (Secretaria de Estado da Ciência, Tecnologia e Ensino Superior do Paraná - SETI/PR), through the university extension program, University Without Borders (Universidade sem Fronteiras); the Coordination for the Improvement of Higher Education Personnel (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - CAPES) through the Education Observatory program; The National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq) through universal and research productivity grant notices.

To this end, instruction activities were promoted to intensify the connection between the university and the school by forming work groups, in schools and not in universities, that would develop activities aimed at a qualified dialogue between these two levels of education. These

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

actions were undertaken to overcome a model of continuing education conceived from a reductionist and discontinuous perspective, in which the educator is solely responsible for defining actions, content, and management of the educational process. The goal was (and still is), through actions and theoretical discussions in the investigations along with the teachers in continuing education programs, to articulate, enhance, and live experiences (Larrosa, 2002) based on the singularities of their practices and knowledge about aspects inherent to the professionalization of teaching.

These groups[3] and actions developed in courses of the mathematics teaching degree fostered discussions and investigations linked the TTMs' education to themes such as mathematical tasks, algebraic thinking, proportional reasoning, statistical education, the teaching of fractions, perimeter, and area, functions, geometric thinking, and the practice of organizing an area[4], among others. Some of these formative contexts were constituted as communities of practice (CoP) (Wenger, 1998). In them, we investigated the negotiation of meanings as a mechanism for teacher professional learning (TPL) and for the movement of the constitution of teacher professional identity (TPI), which will be addressed in the following sections.

Since 2012, in partnership with Professor Hélia Oliveira (University of Lisbon), Gepefopem has been developing and investigating the use of multimedia cases for/in mathematics teacher education. These cases include video-class episodes developed from the perspective of exploratory teaching associated with other elements, such as lesson plans, interviews with teachers, students' written productions, problematizing questions and texts that can be accessed electronically on an online[5] platform, using a login and password (Cyrino, 2016b). The results of the investigations in which multimedia cases were explored have indicated that they can trigger a process of problematizing the teaching practice of the teacher, who is the protagonist of the case, based on the promotion of a dialogical and reflective environment. In these contexts, it was possible to analyze constituent elements of the formative processes, which promoted learning and the movement of the constitution of the TPI of the teachers and prospective teachers involved.

A cross-sectional analysis of these investigations allows us to observe a methodological

[3] In the next section, we present the characteristics, contexts, and actions of instructional processes.
[4] This teacher education was developed with prospective teachers in East Timor.
[5] The multimedia cases are contextualized narratives that function as instances of more general classes of ideas about teacher performance and allow prospective teachers to have multiple readings and interpretations of classroom experiences. The problematizing questions include an analysis of elements of professional practice and mathematical tasks that can be explored by educators with flexibility. More information is available at: http://rmfp.uel.br/.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

movement of (de)composition of the formative contexts investigated. In addition to systematizing the learning of (prospective) TTMs, taking into account their personal and professional experiences, we also made a retrospective of the trajectory of this learning, identifying the relationships between them and the elements that influenced their mobilization. In this movement, we are guided by the alternation between theory and practice, whose formative practices, while theoretically articulated, offer elements to break down theoretical barriers and enable expansions in our theorizing processes (Foucault, 2003).

3 Contexts, characteristics and actions of instructional processes

In the educational contexts promoted in the Gepefopem studies, historical and sociocultural aspects that the participants experienced (Larrosa, 2002) as students and teachers, their specific professional demands, singularities of their education process, the professional practice, and the elements that support them were considered. The participants were invited to study, share experiences and repertoires, problematize their knowledge and concepts, discuss and reflect on their pedagogical practice[6] and share their vulnerabilities and feelings (frustration, fear, desire to get it right, insecurity). The discussions considered mathematical concepts and content and how they are transformed into teaching content, routines, experienced stories, joint discourses, ways of dealing with classroom problems, and difficulties arising from pedagogical practice, among other elements that included reifying and participatory processes essential for TPL.

Characteristics such as respect, trust, challenge, solidarity, values, vulnerabilities, negotiation, and articulation of undertakings, actions, and dynamics, among others, strengthened participants' cultivation and maintenance of mutual commitment in the educational processes.

The undertakings articulated in the practice of the instructional processes were negotiated with all participants and involved actions such as working with mathematical tasks, exploring multimedia cases, and practices from the perspective of exploratory teaching (Cyrino, 2016b). By investigating these actions, we sought to understand the role of working with mathematical tasks, professional noticing, and communication in/for TTMs' education.

Mathematical tasks play a relevant role in student learning and the professional practice of

[6] We consider practice to be "all implicit relationships, tacit conventions, subtle signals, undisclosed planned rules, recognizable intuitions, specific perceptions, finely tuned sensibilities, embodied understandings, latent assumptions, and shared worldviews." (Wenger, 1998, p. 47).

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

mathematics teachers (Doyle, 1983; Simon; Tzur, 2004; Stein; Smith, 1998; Stein *et al.*, 2009). Cyrino and Jesus (2014) highlight that working with cognitively challenging mathematical tasks in the teacher's pedagogical practice encompasses actions that "go beyond the content that must be mobilized for their completion. They involve cognitive processes related to understanding, establishing strategies and procedures, and validation" (Cyrino; Jesus, 2014, p. 753). Based on these assumptions and the research developed by Gepefopem, Cyrino and Estevam (2023) discuss the role of working with tasks in/for mathematics teachers' education process, explaining its potential with actions of solving and analyzing mathematical tasks; selection, adaptation, elaboration, and exploration of mathematical tasks; and reflections and discussions about working with tasks in the classroom (Table 1).

Solve and analyze mathematical tasks
▪ analyze the solved tasks and discuss types of tasks, characteristics, and potential ▪ characterize cognitively challenging tasks ▪ discuss the role of the teacher in working with mathematical tasks in the classroom ▪ put yourself in the role of a student and construct meanings for strategies, procedures, calculations, and ways of supporting students' activity in the classroom ▪ establish dynamics consistent with the intended activity
Select, adapt, develop, and explore mathematical tasks
▪ relate types of tasks and students' thinking ▪ understand the levels of cognitive demand of tasks and their relationship with the objectives of the lesson ▪ reflect on the organization and management of students' work ▪ discuss the development of questions that maintain students' engagement in complex forms of thinking ▪ understand teacher actions that can influence the cognitive demand of the task ▪ situate mathematical tasks in the context of practice
Reflect and discuss work with mathematical tasks in the classroom
▪ reflect on the work of and with students based on (different types of) mathematical tasks ▪ establish practices to stimulate students' mathematical thinking ▪ contrast beliefs and conceptions about teaching and learning mathematics ▪ (re)think about their actions and their influence on students' activities ▪ recognize the importance of mathematical communication in the classroom ▪ share experiences by expressing, defending, and confronting ideas and (re)elaborating mathematical understandings, as well as teaching and learning mathematics

Table 1 - Potential of practices associated with formative actions involving mathematical tasks.
Source: Cyrino and Estevam (2023, p. 25)

In the exploration of multimedia cases, participants could expand the possibilities of analysis and reflection on aspects of classes that resort to cognitively challenging tasks, based on artifacts from the practice of experienced teachers from the perspective of exploratory teaching, connecting other materials in digital format to the constitution of formative contexts.

In particular, studies have emphasized the digital possibilities of using video in the process of *learning to notice* important aspects that stand out in classroom interactions (Van Es; Sherin, 2002). Even so, research in the area highlights that the development of *professional*

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

teacher noticing, supported by the use of video in teacher education, depends on integrated strategies that guide its use (Kang; Van Es, 2019; Van Es; Sherin, 2017).

Learning to perceive involves complex work, especially when aiming to develop ways of perceiving characteristics of an "ambitious pedagogy" that values communication and collaboration among students when dealing with demanding tasks that generate different resolutions (Van Es; Sherin, 2017, p. 166). Thus, we consider important formative actions and processes that offer opportunities for teachers under instruction to know what to observe and how to interpret interactions of this type (Kang; Van Es, 2019). However, these actions require planning regarding the selection of resources that will be used, the questions that will be asked about them according to the objectives of the instruction, the experiences of the participants, and the time available.

Particularly in initial teacher education, considering the influence that instructional actions have on how prospective teachers decide to conduct mathematics teaching, it is relevant to adopt a dynamic of exploring the multimedia case compatible with the perspective of exploratory teaching. To this end, the learning processes mobilized in these contexts have been promoted through actions such as presentation and appropriation of the proposal with general guidelines for its involvement and development, production of written responses to multimedia questions based on interactions in small groups, written feedback from the trainer on these productions, regarding the breadth of the aspects identified in the materials, the consistency of the argumentation and the coherence with the purpose of the questions; and collective discussions on the aspects that stand out in the resources explored, aiming to explain the basic ideas of the reasoning of the groups or individuals about the practice of the teacher protagonist of the case, articulated with its importance in the learning of the students in the context of exploratory teaching (Rodrigues; Cyrino; Oliveira, 2018).

Since learning is not developed in isolation or only in the relationship between agent, object, and action but is also situated in the interpersonal relationships between the participants in the activity and discourse that they produce together (Wells, 2004), communication is a distinctive process identified in these actions, above all, through dialogical interactions. In this context, dialogue "is a shared inquiry in which answers give rise to more questions that form a continuous chain of questions and answers" (Wegerif, 2010, p. 25). Thus, the educator's questions are a fundamental strategy in this process. However, the questions must make sense to the prospective teachers, challenging them to construct the joint discourse as professionals who share the same context of action (Goodwin, 1994; Rodrigues; Cyrino; Oliveira, 2018).

Thus, the questions the teacher educator poses are interpretative because they mainly

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

intend for the prospective teachers to explain aspects relevant to them in classroom interactions and how they understand them. Therefore, it is not about validating ideas but about understanding what *affected* (Larrosa, 2002) the teacher and the prospective teacher in the interactions that caught their attention in the classroom. In the same vein, the participation expected of mathematics teachers in these educational processes does not correspond to brief and factual answers but to explanations, formulations, or doubts on which it is possible to build knowledge collectively (Wells, 2004; Wegerif, 2010). To this end, the teacher educator's feedback has worked as a kind of lever for the extension or improvement of thinking since it challenges prospective teachers also to take a stand as teachers, situating them in the teaching events analyzed and offering opportunities to develop their professional vision (Rodrigues; Cyrino; Oliveira, 2018).

In times marked by standardization, categorization and hierarchization of teaching knowledge, this set of actions discussed here, and not just one of them, can trigger continuous formative processes that expand the possibilities of thinking about TTMs' education since it conceives the situational and contextualized nature of TPL, in which (prospective) teachers are conceived as potential agents of individual and collective change (Rodrigues; Cyrino, 2023).

4 Teaching Professional Learning (TPL)

While conducting its research, Gepefopem adopted a TPL perspective that considers individuals and social contexts analytically distinct but mutually constitutive and articulated. In parallel, it developed strategies to observe this movement. Teachers and their activities are always situated in social, cultural, political, and historical contexts, and therefore, any learning can only be understood within a broader system. In this sense, situated learning in COP (Lave; Wenger, 1991; Wenger, 1998) is a promising contribution to education processes and research programs with a particular focus on teaching knowledge and the movement of constituting the professional identity of the mathematics teacher.

Thus, as a learning mechanism, the negotiation of meanings can be fertile for TTMs' education, based on the interaction between prospective teachers' participation trajectories in their communities and the reifications they produce in these communities. Based on the dual processes that support learning in social terms –participation and reification– both the changes in the practice carried out in the classroom and the meanings attributed to support them are indicative of learning, consequently reverberating in the movement of constituting these professionals' identity. Thus, the changes in the patterns of participation of the teacher in the

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

practices they carry out related to their profession can manifest themselves beyond what they do, in what they say (and what they do not say), especially in the meanings and interpretations that support their sayings and actions, which draw on knowledge, concepts, emotions, and images.

Therefore, the methodological strategies developed by the group to analyze TPL in progress aim to highlight elements that allow dealing with the complexity that surrounds it, giving prominence to: *group interactions; the analysis of videos (and audios) of class episodes and their respective problematization; the analysis and problematization of written productions of students and teachers; individual and collective interviews; and narratives.*

In *group interactions,* negotiation is sometimes synonymous with an agreement between two or more people. However, Wenger (1998, p. 53) uses it to convey "[...] the idea of an ongoing interaction, of a gradual achievement and of a process of give and take". Thus, interactions offer clues as to how meanings are constructed in negotiations between group participants, in the changes in what we do, and in who we are and how we interpret what we do.

Interaction is more than a sequence of actions and reactions because the participant tends to monitor his/her actions according to what he/she assumes to be the others' understandings, expectations, etc. At the same time, the other participants give meaning to this action, adopting what they believe to be the understandings, intentions, etc. of the initial action. The subsequent actions of the other participants are interpreted based on the previous one concerning their expectations and may lead to a reconsideration, and so on. From a methodological point of view, interactions allow us to identify individual understandings, conceptions, and expectations that are shaped by the movement of mutual conquest and persuasion among participants. In the context of TTMs' education, these interactions provide clues about what the mathematics teacher does, how they do it, why they do it, how they see themselves, and how others see them in carrying out these actions.

Therefore, when analyzing interactions, attention should be paid to the (mis)understandings expressed, even without explicit argumentation, and especially, attention should be focused on conflicts and how the negotiation movement of different points of view occurs, taking into account the relationships with the context, the experiences, and actions negotiated and developed in the group and, above all, the interpretations raised among participants. In this process, ambiguities related to understanding teaching and learning mathematics stand out –associated with the different aspects referred to in the third section of this article– and about mathematics itself, considering its dependence on symbols and representations.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

Over time, the negotiation of meaning forms commitments between participants and stable expectations and repertoires from the individual's point of view, contributing to the continuity and authenticity of interactions.

The analysis of videos (and audio) of classroom episodes and their respective problematization highlights the importance of teachers' access to representations of ambitious teaching practices (Van Es et al. 2017), allowing them to address their central aspects. With the advancement of digital technologies, different records of practice can be called upon so that teachers have access not only to the interactions that occur in the classroom but also to a wider set of materials, such as lesson plans, materials produced by students, and interviews, as explained in the exploration of multimedia cases (Cyrino, 2016b; Gallagher, 2019).

However, the search for promoting TPL is not spontaneous and resides in the educator's anticipation of strategies providing reflective, critical, and constructive discussions related to teachers' professional practice. Thus, learning can be analyzed in the interpretations produced for what is observed in the established relationships, the reflections raised, and their connections with the teacher's practice. By prioritizing ambitious teaching practices, the aspects raised in the trajectory of teachers' participation in actions that explore representations of practice while provoking them to think about their actions offer them elements to envision other actions and the conditions that make them feasible.

Cyrino and Estevam (2023) point out that teachers need support to identify the potential of a given task, for example, as well as possibilities for its implementation in the classroom, particularly to benefit from the different strategies, procedures, and records that support students' problem-solving processes. Integrating the broader scenario of study in the area, Gepefopem's research has resorted to *the analysis and problematization of the written production* of students and teachers themselves to expand their perceptions focused on the reasoning used, the resolutions and the problematization of teaching practices to explore tasks with a high level of cognitive demand (Stein; Smith, 1998; Stein et al., 2009).

Studies indicate that, unlike video recordings, when analyzing written production, teachers' attention and interpretation tend to focus on mathematically significant aspects of students' thinking, focusing, for example, on how students analyze patterns, generalization strategies, and justifications linked to understanding the structure of a pattern. However, Gepefopem's work emphasizes that actions developed in formative contexts based on written production should problematize mathematical content and cognitive processes related to understanding, establishing strategies and procedures, and validating resolution strategies (Cyrino; Jesus, 2014).

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

The analyses of the interpretations raised during the formative activities highlight processes of negotiation of meanings that show how teachers interpret the potential of tasks and different resolution strategies, as well as their articulation with daily practice. These processes involve intentional actions by educators with problematizations that aim to mobilize elements that trigger negotiations based on different interpretations, which attempt to: a) identify how teachers consider the different types of tasks and the different resolution strategies in their practices; b) reflect on the possible strategies to be used in solving a given task, as well as the potential and limitations of each one, and the relationships between them; c) relate and contrast teachers' strategies, procedures and representations in solving the task with those expressed by the students; d) discuss ways of addressing the task in the classroom, to benefit from different strategies and encourage students' thinking; and e) analyze the support offered by the teaching materials used by teachers to support their classes and promote students' reasoning.

Thus, the changes that mathematics teachers can glimpse from the analyses and problematizations of written productions (their own and those of students) are analyzed, with a predominance of mathematical aspects and those related to a focus on ambitious teaching practices, such as exploratory teaching.

Individual and collective interviews allow an exchange of perspectives or visions between two or more people to generate data that enable plausible readings of the other's understandings and meanings, revealing what is not observable. As Silverman (2001) points out, the interview situation can produce new understandings, both in the interviewee and interviewer, leading them to reflect on their situation, perspectives, etc.

The interviews conducted in Gepefopem's work tend to be semi-structured, presenting open-ended themes and central questions to generate reflective data that reveal situated aspects and meanings (and movements of change) of the practices developed by teachers. Reflection is an active and judicious action of experiences, theories, ideas, actions, or discourses that make it possible to support the development of conclusions, new ideas, or understandings (Wells, 2004). Collectively, they assume the perspective of sharing, collaborating, and contrasting ideas, expanding perceptions and reflections. Sometimes, interviews are associated with narratives to enhance their provocations for reflection.

The literature has addressed and understood the work with *narratives* as a promising strategy for TTMs' education and a methodological strategy. It is essential that teachers are heard and that their knowledge is taken into account and problematized to promote their autonomy and professional identification, even enthusiasm for the teaching profession. It is about recognizing the teacher, in fact, as a fundamental element of the teaching and learning

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

process because “their knowing and their know-how-to-do are significant and essential for the creation of new theoretical and methodological perspectives” (Lopes, 2014, p. 847). Leal (2009, p. 12) explains that “narratives about our educational work involve conjugating verbs in a reflexive form: seeing ourselves, thinking about ourselves, questioning ourselves, doubting our words”. Thus, narration mobilizes different aspects of the TPL, and narratives highlight this movement, indicating how we interpret and change in giving and receiving, conquering and being conquered, gradually and continuously. These reflexive records highlight our trajectory and the interpretations we produce based on our experience participating in the social communities of which we are a part, in this case, the mathematics teachers.

Finally, the research trajectory on TPL has shown that learning changes who we are and creates personal stories of transformation in the formative context (Cyrino, 2017). From this, it makes sense to envision research on the movement of the constitution of TPI.

5 Characterization of the TPI constituting movement

Being a teacher does not only encompass cognition but also motivational and affective dimensions that value care, trust, agency and equity, transacting in different ways in various socio-cultural-historical contexts, which provoke movements of the constitution of teacher professional identity.

Thus, challenged by the production of new experiences of thought and action, we ask: *What factors can be considered in formative contexts to guide the movement of the constitution of TTM's PI? What dimensions can be considered to analyze the movement of the constitution of the TPI?*

The literature in the area reveals that TPI involves the perception and self-understanding of the teacher about him/herself that emerges while working in the profession (Clandinin; Connelly, 1998; Day; Sammons; Stobart, 2007; Kaplan; Garner, 2017; Kelchtermans, 2009, 2018). TPI is characterized in several ways, depending on the researcher's focus and theoretical framework. In recent years, we have identified four approaches widely used in research: *dynamic systems model of role identity* (DSMRI), *self-understanding, personal, professional, and situational dimensions of TPI, and narrative investigations*.

In *DSMRI*, Garner and Kaplan (2018) consider TPI as a complex dynamic system involving four interdependent elements that continually emerge in the reciprocal relationship with their contexts: self-perception and self-understanding, epistemological conceptions, purpose and objectives, and perceived possibilities for action. For the authors, the processes of

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

TPI development are limited by the control parameters of systems, such as culture, social contexts, subject matter domain, and dispositions.

Kelchtermans (2009, 2018) discusses the term *self-understanding*, intentionally avoiding using *identity*, as he believes this word has a static connotation of passivity, which contrasts with the dynamic and biographical nature of the research. For him, individuals are continually making sense of their experiences. In-service and prospective teachers, throughout their lives, develop a personal framework of interpretation of what the teaching profession is, and this functions as a lens through which they look at their (prospective) professional field, giving it meaning and acting upon it (Kelchtermans, 2009). *Self-understanding* is narrative in nature and encompasses five components: self-image (how teachers see themselves as teachers), self-esteem (an evaluative component that determines how they see themselves as teachers), perception of the task (identification of what their roles and responsibilities are), work motivation (what led them to become a teacher or remain in the profession); and future perspective (how the teacher imagines themselves in the future). These components are intertwined but can be distinguished analytically to provide insights into how understandings of the *self* are integrated into teaching.

For Christopher Day and his collaborators, TPI is a dynamic process that assumes three interactive dimensions: *personal, professional, and situational*. A positive sense of identity is a fundamental defining characteristic of the teaching profession (Day et al., 2006; Day; Sammons; Stobart, 2007). Each dimension is influenced by positive and negative events throughout teachers' lives and work. Teachers' dynamic relationships of efficacy, agency, emotional well-being, and resilience are key aspects of their capacity and are mediated by contexts such as the workplace, personal biographies, and cultures. They argue for the need to build and sustain a positive teacher identity environment through which teachers commit to teaching "to the best of their ability" (Day, 2018, p. 61).

Connelly and Clandinin (1999) argue that (prospective) teachers use their professional identity *narrative* to construct and negotiate who they are as teachers, intertwining personal and professional stories. They use the metaphorical phrase "*stories we live by*" to frame a narrative conception of TPI. And professional identity is one such narrative. When teachers tell stories about their professional lives, they integrate practical knowledge from the contexts in which they work and live and reflect on these contexts (inside and outside of school) at a given time (past and present). Stories tend to change over time and vary between contexts and interactions. Thus, in line with other identity models, the narrative approach conceptualizes TPI as dynamic and constantly evolving (Beijaard; Meijer, 2017). For Sfard and Prusak (2005), identity is a discursive practice constituted by a collection of stories about the person related to

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

mathematical learning.

Given this scenario, in recent years, Gepefopem has sought to understand TPI from a more integrative point of view. To this end, based on experiences and research in formative processes, we seek to expand existing theoretical frameworks and highlight the need to take other dimensions into account in the constitution of the TPI of prospective teachers.

Since we consider that identity should not be understood as a characteristic predetermined by our personality but as something constantly (re)negotiated throughout our lives, we use the word *movement* based on Stuart Hall's research. For the author, identity is "continuously formed and transformed about how we are represented or questioned in the cultural systems that surround us. [...] A fully unified, complete, secure and coherent identity is a fantasy" (Hall, 2015, p. 11-12). This does not necessarily mean that our TPI changes every second; instead, it is shaped and reshaped through our experiences limited by time and context, considering its complexity.

The TPI perspective that we adopt assumes that the movement constituting the professional identity of mathematics teachers is a continuous, complex, dynamic, temporal, and experiential process (De Paula; Cyrino, 2020). A phenomenon that connects "personal, professional, intellectual, moral and political aspects of the groups in which the subjects are involved. [...] It does not consist only of what others think or say about us, but of how we see ourselves and the ability to reflect on our experience" (Cyrino, 2016a, p. 168).

A person's description of themselves and others is not neutral; quite the opposite, it expresses their orientations, tastes, values, and their (future) professional practice. This description brings emotions which are not essentially idiosyncratic (of personality or style) but constitute a fundamental aspect of teaching work. Emotions are a fundamental part of educational practice, driven by the teacher's commitment and empathy in the form of action. Empathy goes beyond the ability to identify, to feel the emotions of others, to understand them; it involves our actions as educators, an action *for and with others*, which reverberates our solidarity and political commitment.

Thus, in the characterization, we propose[7] that *the movement of constituting the professional identity of TTMs occurs based on a set of conceptions of the prospective teacher, interconnected with their self-knowledge, their emotions, and the knowledge necessary for the exercise of their profession, associated with autonomy (vulnerability and sense of agency) and political commitment* (Cyrino, 2016a, 2017, 2018). In this process, the knowledge and

[7] This proposal does not have the slightest intention of being totalizing.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

representations of their profession are structured and modified based on the reflective and significant interactions between the teacher and the social, cultural, and structural conditions that form the context of their work.

Although the professional knowledge of the prospective mathematics teachers can be organized into themes (content/discipline, teaching, curriculum, for example), the knowledge teachers must have is not restricted to instrumental issues or to a set of universal techniques that also function as a means to resolve some issue. The mobilization of knowledge and concepts of the prospective teacher also means thinking about other elements[8].

In the instructional processes, (prospective) teachers bring concepts interconnected to their professional self-knowledge, which can be used in producing meanings for their learning experiences and in the understanding of their students' learning. This production of meanings is fundamental for developing their autonomy (vulnerability and sense of agency) and political commitment to students and education.

Autonomy is characterized by freedom and the individual's ability to make decisions, make choices, conduct their actions critically, "assume oneself as a social and historical being, as a thinking, communicating, transforming, creative being [...]" (Freire, 2000, p. 18-19). It underlies the idea that "the assumption of oneself does not signify the exclusion of others. Because it is the otherness of the 'not I' or the 'you' that makes me assume the radicality of the 'I'" (Freire, 2000, p. 18-19, author's emphasis).

When in-service and prospective teachers face experiences of vulnerability, the search for a sense of professional agency contributes to developing their autonomy. According to Lasky (2005), the search for a sense of agency is a dynamic and complex process, which shapes and is shaped by structural and cultural characteristics of society and school cultures, and, as such, "is always mediated by the interaction between the individual (attributes and inclinations) and the tools and structures of a social environment" (Lasky, 2005, p. 900). Therefore, it makes sense to speak of a *mediated agency*. Each decision the teacher makes, each action, is related to the past and the present and shapes the context for future action. Teachers are active agents in the educational process, even when acting passively in certain situations. Their actions are mediated by the structural elements of their environment, available resources, norms, and external policies (Day, 2018; Kelchtermans, 2018; Lasky, 2005).

Vulnerabilities and the search for a sense of agency influence and shape the way teachers and prospective teachers develop their professional trajectories, as well as how they act (or not) in

[8] The conceptions of prospective teachers regarding mathematics are related to their idiosyncratic convictions, through different experiences, built throughout their personal and professional trajectory.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

different social environments, such as when faced with curriculum changes, relationships with the school community (parents of students, school coordination and management, educators, colleagues, etc.), political decisions, salary issues, working conditions, among others. In the professional practice of mathematics teachers, some political relationships are not always explicit and permeate the relationship between the teacher and the student, the school context, the educational organization, public educational policies, and mathematics.

The teacher's political commitment can also be expressed through empathy, as it is not limited to the ability to project oneself onto others, but as a commitment to the other to help them develop their agency.

Rodrigues and Cyrino (2023) discussed the actions of prospective mathematics teachers in the supervised practicum associated with emotions, moral commitment, and political commitment and stated that, considering the role of mathematics in education in the formative process, sharing experiences, frustrations, and expectations; recognizing limitations; discussing the school routine and planning; sharing information about nervousness and the desire to be well-evaluated, all of these can promote the movement of constituting TPI.

The constituent dimensions of TPI present in our characterization (conceptions, self-knowledge, emotions, knowledge necessary for teaching mathematics, autonomy - vulnerability and sense of agency, and political commitment) are inseparable and mutually related. However, in our investigations, for analytical purposes, we often bring up specific discussions around each dimension or a set of them in the teacher education process. In the next section, we discuss precautions in studies that propose investigating TPI.

6 Investigations and the movement to establish the TPI

The studies on the TPI constitution movement developed at Gepefopem have collaborated with the community of researchers in the field of mathematics education, as they problematize the dimensions that constitute it and present academic complaints related to the care regarding the methodological approach of works that propose to investigate this theme.

Meyer, Losano, and Fiorentini (2022), for example, when carrying out a meta-synthesis of publications on the theme published in the last 20 years in Brazil and abroad, point to one of the group's productions (De Paula; Cyrino, 2018) as a reference for situating national research and one of the five central literature reviews on the theme. The study to which the authors refer discussed aspects of the theoretical and epistemological poles present in a corpus of dissertations and theses defended in Brazil from 2006 to 2016.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

The contributions articulated to the methodological approaches of the investigations and presented as proposals to researchers who intend to investigate the theme have two natures, not mutually exclusive. The first of them deals with the *elements that we consider to be important guides to the process of constructing an investigative proposal on TPI*. The second refers to *understanding the formative processes as potentializers for the movement of the constitution of TPI*. Both constitute a coherent and representative *amalgam* of our characterization of TPI since this conception *(amalgam)* highlights *the complexity, dynamism, temporality, and experientiality* as present and relevant aspects of the processes of its constitution (De Paula; Cyrino, 2020).

In general terms, when we assume TPI as a *movement* of a complex, dynamic, temporal and experiential nature, we demarcate research aligned with the *evidentiary* paradigm (Ginzburg, 1989), in which the researcher needs to pay attention to the *subtle details* (in movement!) involved in the investigative processes outlined by him.

Aware of these difficulties, De Paula and Cyrino (2018) relied on Bruyne, Herman, and Schoutheete (1977), who indicate attention to the four poles *–epistemological, theoretical, technical, and morphological–* in the course of scientific practice, to carry out the study mentioned by Meyer, Losano, and Fiorentini (2022).

Lessard-Hebert, Goyette, and Boutin (1994), based on the proposal of Bruyne, Herman, and Schoutheete (1977), defend the quadripolar model as an interactive system that constitutes the dynamic investigative processes (Table 2).

Poles	Dimensions
Epistemological	It ensures the construction of the object of knowledge, directly involving the discursive dimension and the paradigms related to the research problem.
Theoretical	It corresponds to the methodological instance in which hypotheses are organized, and concepts are defined. The theoretical pole encompasses both the theoretical context of the investigation and the methodological procedures. During the research or after the data collection process, the theoretical pole also assumes an analytical function by interpreting the data.
Technical	It establishes the relationship between the construction of the scientific object and the world of events. It is the dimension in which information about the real world is collected and in which this information is converted into pertinent data in light of the research problem. It corresponds to the technical data collection operations (observation unit and systems, research methods).
Morphological	It is related to structuring the scientific object, involving the presentation of the object of knowledge; the style in which the researcher presents the results, referring to a space of causation (articulating scientific facts in an operative configuration) for explanation and understanding.

Table 2 – Informational summary of the four poles of the investigative process
Source: De Paula and Cyrino (2021, p. 8)

We can associate the dialogic, dialectical, and diachronic perspectives in the quadripolar

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

model as a pertinent signal to the first nature of the group's contributions (*dimensions that we consider important guides to constructing an investigative proposal on TPI*).

De Paula and Cyrino (2021), when associating the specificities of this model with the dimensions of the TPI constitution movement, list actions associated with the guiding elements for future investigations on the topic (Table 3).

Poles	Actions associated with elements
Epistemological	Assume a characterization of the TTM's PI. Clarify the understanding of a TTM. Adopt a theoretical perspective of the TTM's PI. Pay attention to moments of tension/fragility during the investigation. Recognize the dialogic, diachronic, and dialectical nature of the TTM's PI.
Theoretical	Choose theoretical support from the field of mathematics education. Be careful not to make theoretical generalizations when dealing with PI. Be careful not to confront disparate situations/contexts. Harmonize theoretical choices and analysis perspectives.
Technical	Consider the number of participants. Recognize the importance of the context in which data/information is collected. Provide (and foster) a group environment for research. Be careful when constructing/selecting data/information collection instruments.
Morphological	Structure the writing, in the case of dissertations and theses, in a multi-paper format. Explain and disseminate the main results to the community of interested researchers. Point out the limitations of the study and indicate future directions.

Table 3 – Actions associated with the elements that can be considered in an investigation regarding the professional identity of the teacher who teaches mathematics
Source: De Paula and Cyrino (2021, p.11)

In an exotopic movement, like an excess of vision (Bakhtin, 2011), these indicators result from the authors' investigative process and Gepefopem's investigations into TPI.

In Table 3, we explain the *amalgamation* to which we referred previously. The suggestions that signal the need to, for example, (i) recognize that the scope of these studies is broad and involves multiple investigative themes; (ii) it is imperative for the researcher to take a position regarding what he understands as TPI; and (iii) highlight the *locus* in which the participants are immersed during the process of obtaining data/information, are representative of the researcher's role in the process that, although investigative, is also formative. This perception results in the second nature that we listed: *the understanding of formative processes as potentializers for the movement of the constitution of the TPI.*

In this articulation, there are many tools available for the researcher to gather information and enrich their analyses. In addition to traditional written records and recordings, such as audio or video, which explicitly discuss meanings, interviews, autobiographical accounts, diaries, and even metanarratives can also be explored. Taking on the investigative activity as a political commitment based on coherent epistemological and theoretical perspectives is a premise. After all, "recognizing investigative limitations when embarking on

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

studies on the professional identity of the teacher who teaches mathematics is not a demerit; it is maturity" (De Paula; Cyrino, 2021, p. 18).

7 Final considerations

When discussing the Gepefopem research trajectory, the concern of the studies in offering subsidies for developing programs to educate teachers who teach mathematics (TTMs) that consider implementing differentiated formative practices is made clear. At the same time that these practices are theoretically supported, they constitute elements that contribute to expanding and overcoming the theoretical limitations that sometimes exist in works involving the topic. The discussion on this trajectory thus highlights contributions that encompass both theoretical and methodological aspects, collectively systematizing elaborated understandings about teaching professional learning (TPL) and the movement to establish teacher professional identity (TPI) and providing perspectives for studies based on these themes. Contrary to totalizing and definitive elaborations, this trajectory plays a central role in the approaches discussed. They seek to highlight the conducive, collaborative, and sensitive dynamics that the alternation of theory and practice confers on research that uses contexts, actions, assumptions, and perspectives of TTMs' education, as discussed here, involving and respecting multiple agents.

Thus, the dialogic link between these points constitutes, among other conditions, reverberations of the formative process of a researcher who graduated from PPGEM. Gepefopem, conceived and coordinated since its inception by a graduate of the program, echoes concerns consolidated by PPGEM over its 40 years, such as (i) having a political commitment to the human development of teachers who teach mathematics; (ii) establishing itself as a plural space, attentive to the personal trajectories and perspectives of its participants; and (iii) enabling the consolidation of interinstitutional partnerships with ways to expand discussions important to the field of mathematics education in various contexts of Brazilian Education. These aspects reverberate in the actions of other Gepefopem graduates (other authors of the article) who, in addition to various actions in the field of TTMs' education, are currently accredited teachers in other postgraduate programs, expanding the scope and actions resulting from the trajectory discussed here, making their role in the nucleation process explicit.

In this movement, other aspects emerge in the Gepefopem research agenda: a) investigating ways to make viable the movement of constituting TPI for teachers at the beginning of their teaching careers and for teachers who work from the perspective of inclusive

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

mathematics education, considering professional noticing, among other aspects; b) deepening the investigations of the connections between dimensions that constitute TPI, taking into account the singularities of mathematics and the contexts in which teachers who teach mathematics are inserted; c) discussing the possibility of building a theoretical-methodological dialogue between the movement of constituting TPI and the concept of becoming of Gilles Deleuze's philosophy of difference, in the search for a "becoming teacher" that moves between experientiality, temporality, dynamism and complexity in TTMs' education. Indeed, other aspects and challenges will emerge in this movement and be the object of future work.

Acknowledgements

We thank the National Council for Scientific and Technological Development (CNPq) for the research productivity grant (Proc. 315393/2023-8) to the first author and for supporting the research Call CNPq/MCTI No. 10/2023 (Proc. 405785/2023-2).

Authorship contributions

All authors contributed substantially to the conception and planning of the study, obtaining, analyzing and interpreting data; writing and critical review; and approving the final version to be published.

References

BAKHTIN, M. M. **Estética da criação verbal**. São Paulo: Martins Fontes, 2011.

BEIJAARD, D.; MEIJER, P. Developing the personal and professional in making a teacher identity. *In*: CLANDININ, D. J.; HUSU, J. (eds.). **Research in teacher education**. London: Sage, 2017. p. 177–192.

BRUYNE, P.; HERMAN, J.; SCHOUTHEETE, M. **Dinâmica da Pesquisa em Ciências Sociais**: os polos da prática metodológica. Tradução de Ruth Joffily. Rio de Janeiro: Francisco Alves, 1977.

CLANDININ, D. J.; CONNELLY, F. M. Stories to live by: Narrative understandings of school reform. **Curriculum Inquiry**, Toronto, v. 28, n. 2, p. 149-164, 1998. https://doi.org/10.1111/0362-6784.00082. Disponível em: https://www.jstor.org/stable/1180132. Acesso em: 22 jan. 2025.

CONNELLY, F. M.; CLANDININ, D. J. **Shaping professional identity:** Stories of education practice. Ontario: Althouse Press, 1999.

CYRINO, M.C.C.T. **Levantamento e análise de material de referência na Formação do Professor de Matemática de 1ª a 4ª série do Ensino Fundamental**. 1997. Dissertação (Mestrado em Educação Matemática) - Universidade Estadual Paulista, Rio Claro, 1997.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

CYRINO, M. C. C. T. Mathematics teachers' professional identity development in communities of practice: Reifications of proportional reasoning teaching. **Bolema**, Rio Claro-SP, v. 30, n. 54, p. 165-187, abril 2016a. https://doi.org/10.1590/1980-4415v30n54a08. Disponível em: https://www.scielo.br/j/bolema/a/sTfV4kwdKx3s3TwYKMjM8MQ/. Acesso em: 22 jan. 2025.

CYRINO, M. C. C. T. **Recurso multimídia para a formação de professores que ensinam matemática**: elaboração e perspectivas. 1. ed. Londrina: EDUEL - Editora da UEL, 2016b.

CYRINO, M. C. C. T. Identidade profissional de (futuros) professores que ensinam Matemática. **Perspectivas da Educação Matemática**, Campo Grande-MS, v. 10, p. 699-712, 2017. Disponível em: https://periodicos.ufms.br/index.php/pedmat/article/view/5518. Acesso em: 22 jan. 2025.

CYRINO, M. C. C. T. Prospective mathematics teacher's professional identity. *In*: STRUTCHENS, M. E.: HUANG, R.; POTARI, D., LOSANO, L. (org.). **ICME-13 Monographs**. 1.ed. Switzerland: Springer International Publishing, v. 1, p. 269-285, 2018.

CYRINO, M. C. C. T.; JESUS, C. C. Análise de tarefas matemáticas em uma proposta de formação continuada de professoras que ensinam matemática. **Ciência & Educação**, Bauru-SP, v. 20, p. 751-764, 2014. https://doi.org/10.1590/1516-73132014000300015. Disponível em: https://www.scielo.br/j/ciedu/a/FmP58nhXWgg8ZNQ3Q4gBCht/. Acesso em: 22 jan. 2025.

CYRINO, M. C. C. T.; DE PAULA, E. F.; RODRIGUES, P. H. (org.). **Estudos e Pesquisas sobre a Formação de Professores que ensinam Matemática.** Campo Mourão: Fecilcam, 2022.

CYRINO, M. C. C. T.; ESTEVAM, E. J. G. Tarefas matemáticas na formação de professores que ensinam matemática. **Perspectivas da Educação Matemática**, Campo Grande-MS, v. 16, n. 42, p. 1-30, 30 maio 2023. Disponível em: https://periodicos.ufms.br/index.php/pedmat/article/view/18262. Acesso em: 22 jan. 2025.

DAY, C. Professional identity matters: agency, emotions, and resilience. *In*: SCHUTZ, P.; HONG, J.; CROSS FRANCIS, D. (eds.), **Research on teacher identity**, Cham: Springer, 2018. p. 61-70. https://doi.org/10.1007/978-3-319-93836-3_6. Disponível em: https://link.springer.com/chapter/10.1007/978-3-319-93836-3_6. Acesso em: 22 jan. 2025.

DAY, C.; KINGTON, A., STOBART, G.; SAMMONS, P. The personal and professional selves of teachers: stable and unstable identities. **British Educational Research Journal**, London, v. 32, n. 4, p. 601–616, 2006. https://doi.org/10.1080/01411920600775316. Disponível em: https://bera-journals.onlinelibrary.wiley.com/doi/epdf/10.1080/01411920600775316. Acesso em: 22 jan. 2025.

DAY, C.; SAMMONS, P.; STOBART, G. **Teachers matter:** Connecting work, lives, and effectiveness. [*S.l.*]: McGraw-Hill, 2007.

DE PAULA, E.F.; CYRINO, M.C.C.T. Polos teórico e epistemológico presentes em pesquisas brasileiras sobre identidade profissional de professores que ensinam Matemática. **Imagens da Educação**, Maringá-PR, v. 8, n. 2, e42751, 2018. Disponível em: https://doi.org/10.4025/imagenseduc.v8i2.42751. Acesso em: 22 jan. 2025.

DE PAULA, E. F.; CYRINO, M.C.C.T. Aspectos a serem considerados em investigações a respeito do movimento de constituição da Identidade Profissional de professores que ensinam matemática. **Educação**, Santa Maria-RS, v. 45, n. 1, e28, p. 1–29, 2020. https://doi.org/10.5902/1984644434406. Disponível em: https://periodicos.ufsm.br/reveducacao/article/view/34406. Acesso em: 22 jan. 2025.

DE PAULA, E. F.; CYRINO, M. C.C.T. Identidade profissional de professores que ensinam matemática: Elementos e ações para a construção de uma proposta para futuras investigações. **Pro-**

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

Posições, Campinas-SP, v. 32, p.e20180109, 2021. https://doi.org/10.1590/1980-6248-2018-0109. Disponível em: https://www.scielo.br/j/pp/a/fVYbZ8dDXXYCFFrSSKGvgdJ/. Acesso em: 22 jan. 2025.

DOYLE, W. Academic work. **Review of Educational Research**, Washington, v. 53, n. 2, p. 159-199, 1983.

FREIRE, P. **Pedagogia da autonomia:** saberes necessários à prática educativa 25. ed. São Paulo: Paz e Terra, 2000.

FOUCAULT, M. **Estratégia, Poder-Saber.** Rio de Janeiro: Forense Universitária, 2003 (Ditos e Escritos, vol. IV).

GALLAGHER, C. The use of a multimedia case to prepare classroom teachers of emergent bilinguals. **Teaching and Teacher Education**, [*S.l.*], v. 84, [s.n.], p. 17-29, 2019. https://doi.org/10.1016/j.tate.2019.04.011. Disponível em: https://www.sciencedirect.com/science/article/abs/pii/S0742051X18306590. Acesso em: 22 jan. 2025.

GARNER, J. K.; KAPLAN, A. A complex dynamic systems perspective on teacher learning and identity formation: An instrumental case. **Teachers and Teaching**, [*S.l.*], v. 25, n. 1, p. 7-33, 2018. https://doi.org/10.1080/13540602.2018.1533811. Disponível em: https://www.tandfonline.com/doi/full/10.1080/13540602.2018.1533811 . Acesso em: 22 jan. 2025.

GINZBURG, C. **Mitos, emblemas, sinais**. São Paulo: Companhia das Letras, 1989.

GOODWIN, C. Professional vision. **American Anthropologist**, [*S.l.*], v. 96, n. 3, p. 606-633, 1994.

HALL, S. **A identidade cultural na pós-modernidade**. 12. ed. Tradução de Tomaz Tadeu da Silva e Guacira Lopes Louro. Rio de Janeiro: Lamparina, 2015.

KANG, H.; VAN ES, E. A. Articulating design principles for productive use of video in preservice education. **Journal of Teacher Education**, [*S.l.*], v. 70, n. 3, p. 237-250, 2019. https://doi.org/10.1177/0022487118778549. Disponível em: https://journals.sagepub.com/doi/abs/10.1177/0022487118778549. Acesso em: 22 jan. 2025.

KAPLAN, A.; GARNER, J. A complex dynamic systems perspective on identity and its development: The dynamic systems model of role identity. **Developmental Psychology**, Washington, v. 53, n. 11, p. 2036–2051, 2017. https://doi.org/10.1037/dev0000339. Disponível em: https://pubmed.ncbi.nlm.nih.gov/29094968/. Acesso em: 22 jan. 2025.

KELCHTERMANS, G. Who I am in how I teach is the message: self-understanding, vulnerability and reflection. **Teachers and Teaching**: Theory and Practice, [*S.l.*], v. 15, n. 2, p. 257-272, 2009. https://doi.org/10.1080/13540600902875332. Disponível em: https://www.tandfonline.com/doi/full/10.1080/13540600902875332. Acesso em: 22 jan. 2025.

KELCHTERMANS, G. Professional Self-Understanding in Practice: Narrating, Navigating and Negotiating. *In*: SCHUTZ, P., HONG, J.; CROSS FRANCIS, D. (eds.) **Research on teacher identity**. [*S.l.*]: Springer, 2018. p. 229-240. https://doi.org/10.1007/978-3-319-93836-3_20. Disponível em: https://link.springer.com/chapter/10.1007/978-3-319-93836-3_20. Acesso em: 22 jan. 2025.

LARROSA, J. Notas sobre a experiência e o saber de experiência. **Revista Brasileira de Educação**, São Paulo, [s.v.], n. 19, p. 20-28, jan./abr. 2002. https://doi.org/10.1590/S1413-24782002000100003. Disponível em: https://www.scielo.br/j/rbedu/a/Ycc5QDzZKcYVspCNspZVDxC/. Acesso em: 22 jan. 2025.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

LASKY, S. A sociocultural approach to understanding teacher identity, agency and professional vulnerability in a context of secondary school reform. **Teaching and Teacher Education**, [*S.l.*], v. 21, n. 8, p. 899-916, 2005. https://doi.org/10.1016/j.tate.2005.06.003. Disponível em: https://www.sciencedirect.com/science/article/abs/pii/S0742051X0500079X. Acesso em: 22 jan. 2025.

LAVE, J.; WENGER, E. **Situated learning***:* legitimate peripheral participation. Cambridge: Cambridge University Press, 1991.

LEAL, B. Escrever é inscrever-se (na forma de um prefácio). *In:* LACERDA, M. P. (org.). **A escrita inscrita na formação docente**. Rio de Janeiro: Rovelle, 2009, p. 11-16.

LESSARD–HEBERT, M.; GOYETTE, G.; BOUTIN, G. **Investigação qualitativa**: fundamentos e práticas. Lisboa: Instituto Piaget, 1994.

LOPES, C. E. As narrativas de duas professoras em seus processos de desenvolvimento profissional em Educação Estatística. **Bolema**, Rio Claro-SP, v. 28, n. 49, p. 841-856, 2014. https://doi.org/10.1590/1980-4415v28n49a19. Disponível em: https://www.scielo.br/j/bolema/a/yvG76gVS4B5vYBWdk9pqYTK/?format=pdf&lang=pt. Acesso em: 9 jan. 2025.

MEYER, C.; LOSANO, L.; FIORENTINI, D. Modos de conceituar e investigar a identidade profissional docente nas revisões de literatura. **Educação e Pesquisa**, São Paulo, v. 48, [s.n.], p. 1-19, 2022. https://doi.org/10.1590/S1678-4634202248246037por. Disponível em: https://www.scielo.br/j/ep/a/jQ9Kt9LD6hbbKDq3TZjCXQQ/?format=pdf&lang=pt. Acesso em: 9 jan. 2025.

RODRIGUES, P. H.; CYRINO, M. C. C. T. The mobilization of emotions, moral commitment, and political commitment as dimensions of the movement for the constitution of the professional identity of prospective Mathematics teachers: the Supervised Teaching Practice. **RIPEM: Revista Internacional de Pesquisa em Educação Matemática**, Brasília-DF, v. 13, n. 4, p. 1-19, 2023. https://doi.org/10.37001/ripem.v13i4.3626. Disponível em: https://www.sbembrasil.org.br/periodicos/index.php/ripem/article/view/3626. Acesso em: 22 jan. 2025.

RODRIGUES, R. V. R.; CYRINO, M.C.C.T.; OLIVEIRA, H. M. Comunicação no Ensino Exploratório: Visão profissional de futuros professores de Matemática. **Bolema**, Rio Claro-SP, v. 32, n. 62, p. 967-989, 2018. https://doi.org/10.1590/1980-4415v32n62a11. Disponível em: https://www.scielo.br/j/bolema/a/nVGHnxMrQPxPFJ7LkHWRr9M/. Acesso em: 22 jan. 2025.

SFARD, A.; PRUSAK, A. Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. **Educational Researcher**, [*S.l.*], v. 34, n. 4, p. 14-22, 2005. https://doi.org/10.3102/0013189X034004014. Disponível em: https://www.jstor.org/stable/3699942. Acesso em: 22 jan. 2025.

SILVERMAN, D. **Doing Qualitative Research**: a practical handbook. Thousand Oaks: Sage, 2001.

SIMON, M. A.; TZUR, R. Explicating the role of mathematical tasks in conceptual learning: an elaboration of the hypothetical learning trajectory. **Mathematical Thinking and Learning**, Philadelphia, v. 6, n. 2, p. 91-104, 2004. https://doi.org/10.1207/s15327833mtl0602_2. Disponível em: https://www.tandfonline.com/doi/abs/10.1207/s15327833mtl0602_2. Acesso em: 22 jan. 2025.

STEIN, M. K.; SMITH, M. S. Mathematical tasks as a framework for reflection: from research to practice. **Mathematics Teaching in the Middle School**, Reston, v. 3, n. 4, p. 268-275, 1998. Disponível em: https://api.semanticscholar.org/CorpusID:172781690. Acesso em: 22 jan. 2025.

ISSN 1980-4415
DOI: http://dx.doi.org/10.1590/1980-4415v39a2400671

STEIN, M. K. *et al*. **Implementing standards-based mathematics instruction**: a casebook for professional development. New York: Teachers College Press, 2009.

VAN ES, E. A.; SHERIN, M. G. Learning to notice: Scaffolding new teachers' interpretations of classroom interactions**. Journal of Technology and Teacher Education**, [*S.l.*], v. 10, n. 4, p. 571-596, 2002.

VAN ES, E. A.; SHERIN, M. G. Bringing facilitation into view. **International Journal of STEM Education**, [*S.l.*], v. 32, n. 4, p. 1-6, 2017. https://doi.org/10.1186/s40594-017-0088-x. Disponível em: https://stemeducationjournal.springeropen.com/articles/10.1186/s40594-017-0088-x. Acesso em: 22 jan. 2025.

VAN ES; E. A. *et al*. Learning to Notice Mathematics Instruction: Using Video to Develop Preservice Teachers' Vision of Ambitious Pedagogy. **Cognition and Instruction**, [*S.l.*], v. 35, n. 3, p. 165-187, 2017. https://doi.org/10.1080/07370008.2017.1317125. Disponível em: https://www.tandfonline.com/doi/full/10.1080/07370008.2017.1317125. Acesso em: 22 jan. 2025.

WEGERIF, R. **Mind expanding:** Teaching for thinking and creativity in primary education. [*S.l.*]: Open University Press, 2010.

WELLS, G. **Dialogic inquiry:** Towards a sociocultural practice and theory of education. Cambridge: Cambridge University Press, 2004.

WENGER, E. **Communities of Practice**: learning, meaning and identity. New York: Cambridge University Press, 1998.

Submetido em: 24 de Fevereiro de 2024.
Aprovado em: 11 de Outubro de 2024.

Editor-chefe responsável: Prof. Dr. Marcus Vinicius Maltempi
Editor associado responsável: Prof. Dr. Carolina Tamayo-Osorio