

THEORETICAL ARGUMENTS ABOUT THE TRAINING OF TEACHERS WHO
TEACH MATHEMATICS, AND PROFESSIONAL DIDACTICS, AND
CONVERGENCES FOR PUBLIC EDUCATIONAL POLICIES

*ARGUMENTOS TEÓRICOS SOBRE A FORMAÇÃO DE PROFESSORES QUE
ENSINAM MATEMÁTICA, E DIDÁTICA PROFISSIONAL, E CONVERGÊNCIAS
PARA POLÍTICAS PÚBLICAS EDUCACIONAIS*

*ARGUMENTOS TEÓRICOS SOBRE LA FORMACIÓN DE DOCENTES QUE
ENSEÑAN MATEMÁTICAS, Y DIDÁCTICA PROFESIONAL, Y CONVERGENCIAS
PARA LAS POLÍTICAS PÚBLICAS EDUCATIVAS*



Marluce Alves dos SANTOS¹
e-mail: maralves@uneb.br



Francisco Regis Vieira ALVES²
e-mail: fregis@ifce.edu.br

How to reference this article:

SANTOS, M. A.; ALVES, F. R. V. Theoretical arguments about the training of teachers who teach mathematics, and professional didactics, and convergences for public educational policies. **Revista Ibero-Americana de Estudos em Educação**, Araraquara, v. 19, n. 00, e024093, 2024. e-ISSN: 1982-5587. DOI: <https://doi.org/10.21723/riace.v19i00.18877>



| Submitted: 01/01/2024
| Revisions required: 23/02/2024
| Approved: 22/03/2024
| Published: 20/07/2024

Editor: Prof. Dr. José Luís Bizelli

Deputy Executive Editor: Prof. Dr. José Anderson Santos Cruz

¹ University of the State of Bahia (UNEB), Salvador – BA – Brazil. Adjunct Professor at UNEB DEDCVIII Collegiate of Mathematics.

² Federal Institute of Education, Science and Technology of the State of Ceará (IFCE), Fortaleza - CE – Brazil. Full Professor at the Federal Institute of Science and Technology Education of the State of Ceará.

ABSTRACT: The post-doctoral text deals with Professional Didactics (PD), a neophyte French aspect at the national level, and Teacher Training, discussed nationally and internationally. It aims to present contributions from Professional Didactics to the Training of Teachers who Teach Mathematics (FoPEM) and relate it to Public Educational Policies. DP emerged in France in the 1990s, with the aim of analyzing the formation of teachers' skills considering their professional environment and training. Contemporaneously, research related to training has been the subject of debates involving broad national reformulations, considering the recognition of FoPEM as a fundamental element in Mathematics Education. For this purpose, a non-exhaustive bibliographic review was conducted to substantiate research possibilities for the area. It is considered relevant, as a contribution to the area in the face of approaches coming from PD, and studies on current Public Educational Policies, expand the discussion, to encourage and stimulate research that can strengthen FoPEM.

KEYWORDS: Professional Didactics. Training Teachers. Training Teachers who Teach Mathematics. Educational Public Policies. Mathematics Education.

RESUMO: O texto, de pós-doutorado, versa sobre Didática Profissional (DP), vertente francesa neófito no âmbito nacional e Formação de Professores, discutida nacionalmente e internacionalmente. Tem como objetivo apresentar contribuições da Didática Profissional à Formação de Professores que Ensinam Matemática (FoPEM) e relacionar às Políticas Públicas Educacionais. A DP surge na França nos idos de 1990, com objetivo de analisar o a formação de competências de professores diante do seu ambiente profissional e da sua formação. Contemporaneamente, pesquisas relacionadas a formação têm sido objeto de debates de amplas reformulações nacionais, pensa-se no reconhecimento da FoPEM como um elemento fundamental à área Educação Matemática. Com esta finalidade, realizou-se revisão bibliográfica, não exaustiva, para consubstanciar possibilidades de pesquisa para área. Considera-se relevante, como contribuição à área diante de aproximações vinda da DP, e estudos sobre Políticas Públicas Educacionais vigentes, ampliam a discussão, para fomentar e estimular pesquisas que possam fortalecer a FoPEM.

PALAVRAS-CHAVE: Didática Profissional. Formação de Professores. Formação de Professores que Ensinam Matemática. Políticas Públicas Educacionais. Educação Matemática.

RESUMEN: El texto postdoctoral aborda la Didáctica Profesional (DP), un aspecto francés neófito a nivel nacional, y la Formación del Profesorado, discutido a nivel nacional e internacional. Tiene como objetivo presentar aportes desde la Didáctica Profesional a la Formación de Profesores de Matemáticas (FoPEM) y relacionarlo con las Políticas Educativas Públicas. La DP surgió en Francia en la década de 1990, con el objetivo de analizar la formación de competencias de los docentes a la luz de su entorno profesional y su formación. Contemporáneamente, las investigaciones relacionadas con la formación han sido objeto de debates que involucran amplias reformulaciones nacionales, considerando el reconocimiento del FoPEM como un elemento fundamental en el área de la Educación Matemática. Para ello se realizó una revisión bibliográfica no exhaustiva que fundamente las posibilidades de investigación para el área. Se considera relevante, como aporte al área frente a enfoques provenientes del PD, y estudios sobre las Políticas Públicas Educativas actuales, ampliar la discusión, para incentivar y estimular investigaciones que puedan fortalecer el FoPEM.

PALABRAS CLAVE: Didáctica Profesional. Formación de Profesores. Formación de Profesores que Enseñan Matemáticas. Políticas Públicas Educativas. Educación Matemática.

Introduction

The Brazilian Society of Mathematics Education, hereinafter SBEM, began in 1988, and currently brings together 15 Working Groups (GT), with national and international research partners, with the broad objective of disseminating research in the numerous aspects of EM. The National Association of Postgraduate Studies and Research in Education – ANPED, founded in 1976, the site of the main struggles, encourages and strengthens postgraduate research in Education in Brazil, and promotes debate among researchers and support for national postgraduate programs, with international projection. In 1997, GT 19 was created, which researches Mathematics Education (EM) at ANPED, a space that allows the dissemination of a considerable part of academic research production at a national level.

In this text, the broad discussion on the Training of Teachers who Teach Mathematics stands out, with research on initial and/or continuing training, as well as on aspects that constitute teachers in training. In this sense, listing research on this topic is to encourage scientific demand for its dissemination, in addition to problematizing objects of knowledge, study and research on teaching, in all modalities and levels of education.

FoPEM are discussed, specifically, the theoretical-methodological aspects of Professional Didactics are considered, as in the studies of Pierre Pastré, a neophyte French branch at the national level, which aims to analyze the work of professionals with a view to training skills, and Teacher Training. Carlos Marcelo Garcia's studies will be used to outline research horizons on professional structure and organization in Mathematics teaching. Researchers in the area of MS intertwine their investigations into national PPE. Hans Georg Steiner, in turn, is interested in understanding the area of EM as a system and, in this way, establishing research parameters with Mathematics Education and FoPEM as a subsystem.

To this end, the methodological option is related to the theoretical point of view that was adopted by the researchers, such as a research model. It is, therefore, a question of making its phenomena more complex, of concerning where MS could evolve, and the possible associations in a topic considered recent at the national level. Given the increase in scientific production and the speed of dissemination of MS, the Bibliographic Review emerges as an important alternative to understanding the scientific production already researched, in order to recognize the complexity of the researched phenomena, in addition to establishing the necessary rigor to identify gaps in knowledge search.

In this sense, presenting contributions from DP to FoPEM related to PPE has been the concern of many researches in EM, nationally and internationally. It constitutes a fruitful field

of studies with a theoretical-methodological framework, and deepens the understanding of human activity, the learning phenomena of mathematics teachers and their teaching action. It is, therefore, about including DP, still little discussed nationally, bringing light to FoPEM as a highly thought-provoking, intricate and varied process.

Theoretical Reference

The year 1988 marks the emergence of the Citizen Constitution, promulgated by the President of the National Constituent Assembly Ulysses Guimarães, known for expanding essential rights to society. In its Article 5, the Citizen Constitution guarantees equality of all people before the law and the “inviolability of the right to life, freedom, equality, security and property”. In 1990, the President of Brazil Fernando Collor de Melo instituted the Child and Adolescent Statute, a device created to fully protect children and adolescents. In Article 4 of the aforementioned statute, the effective guarantee of the rights to life, in particular, is highlighted. Furthermore, in this text, among all the ideas, the priority of education stands out.

Consider that the laws outlined above were designed to guarantee absolute priority to education for the Brazilian population, but part of this population is still excluded from these rights. At the same time, Teacher Training (FP) is progressing without a consensus as to what should form the basis of preparation, both for the initial teacher and those who opt for graduation, a prior to the professional exercise of the activity teacher, or in continuing education. This reasoning is extended to teacher trainers who train education professionals with a constant updating agenda.

Researchers seek to unravel and unveil the FP phenomenon by presenting constituent theoretical and methodological elements in their studies that may contribute to the development of research that focuses on the action of teaching and learning. Nóvoa (1999) proposes to create the school again, highlighting teachers in its various paths; (Tardif; Lessard; Gauthier, 2001, p. 29) discuss that training is permanent in all instances until retirement; Roldão (2007, p. 5, our translation) emphasizes that the connection between theory and practice is broad and corresponds to professional teaching knowledge”; Garcia (1999, p. 24, our translation) is inspired by Medina and Dominguez (1989) to work on FP as “[...] a powerful disciplinary matrix”.

However, given the limitations of this text, studies on FP from the research by Garcia (1999) were chosen. Medina and Dominguez (1989, apud Garcia, 1999, p. 23, our translation)

consider the concept of FP as the “professional preparation and emancipation of the teacher to carry out critically, reflectively and effectively a teaching style that promotes meaningful learning in students and achieves a innovative thinking-action [...]”. A unique style that reflects the way students produce meaningful learning.

[...] the area of knowledge, research and practical theoretical proposals that, within the scope of Didactics and School Organization, studies the processes through which teachers – in training or in practice – are involved individually or as a team, in learning experiences through which they acquire or improve their knowledge, skills and dispositions, and which allow them to intervene professionally in the development of their teaching, curriculum and school, with the aim of improving the quality of education that students receive (Garcia 1999, p. 26, our translation).

FP, a powerful disciplinary matrix, as evidenced by Medina and Dominguez (1989) a projection in scientific consolidation, permanent epistemological validation, and in the rigor of the paradigms involved, and its own methods.

Schwab (1981) indicates that a discipline has a conceptual and a syntactic structure. The conceptual are the theoretical principles that guide and direct the inquiry and the syntactic represents heuristic methods that can reach the truth. Understood as a discipline, Gimeno (1993) establishes that VT now has a conceptual structure that, in turn, presents specific characteristics, and elaborates theories and practices for teaching and learning; and in relation to syntactic structure, since FP has developed its own area of investigation, it tries to study the various academic productions that point to its own power.

As a disciplinary matrix, Teacher Training has as its singular object the training processes, criteria, consolidated methodological paths, and the active participation of the protagonists, who are teachers, essential for educational improvement. (Garcia, 1999). This proposition is related to the ideas of Pierre Pastré called DP, which aims to analyze work with a view to training competence. In this direction, Alves (2021, p. 9, our translation) proposes that “[...] the scenario of training and competence with a professional bias gained prominence in the face of DP”. In this sense, the

[...] DP is the result of training engineering and continuing education, consisting of a field of analyzed practices that gave rise to professional didactic engineering, an aspect that uses work analysis to build training devices aimed at professional competence. [...] (Alves, 2021, p. 7, our translation).

Pastré's (2017) work has in its origins two currents for analyzing work: the work psychology of Jacques Leplat and Jean-Marie Faverge, which emphasizes the cognitive

dimension of work; and the developmental psychology of Jean Piaget, Lev Vygotsky, Gerard Vergnaud, in relation to developmental psychology, which emphasizes the concept of action.

Jean Piaget's works are directed by the theory of action and knowledge that is linked to action. Gerard Vergnaud works on the idea of action through the notion of scheme and operational invariant, which makes it possible to understand the development of intelligence when teachers are carrying out activities that they present to their students. Lev Vygotski emphasizes the notion of activity, in language, and in the condition of the concept formation process.

Jaques Leplat precedes Jean-Marie Faverge, as he was concerned, in his studies, with the cognitive analysis of the mental processes involved in work, with the transformations of work linked to the automation of the activities carried out, and with computerization with increasingly more information, signs and symbols, whose focus is the cognitive analysis of the mental processes evidenced in the work. Pastré (2017) draws inspiration from Jean-Marie Faverge for the study of human behavior at work from the notion of competence, and supports his studies in the cognitive analysis of activity, in which he relates work and the diagnosis of situations, which involves resolving important issues, planning and using techniques.

In developmental psychology, the role of conceptualization in Piagetian action, human activity is organized in the form of schemes, whose central core is made up of pragmatic concepts. DP seeks a balance between two perspectives: a theoretical and epistemological reflection on the foundations of human learning; as well as a concern to operationalize its analysis methods so that they can serve educational engineering. Almost everyone is guided by a need for a theory of action and knowledge coming from action (Santos; Alves, 2023, p. 2, apud Pastré, 2017, our translation).

Later, Pastré (2017) discusses the concept discussed by Faverge (1958), Ergonomics, which means adapting work to the worker. Faverge's (1958) idea about Ergonomics is questioned by Falzon (2015) who considers it as a limited and static idea, which does not correspond to the needs of people, societies and organizations. This last author proposes that the objective of ergonomics should be the development of individuals, based on situations or actions that increase their know-how, knowledge and skills, enabling reflective processes on the work they perform, which can emphasize freedom of action, to the point of including the ability to construct and reconstruct rules of action in the work carried out.

For Pastré (1997), some individuals are capable of making use of their mistakes, failures and successes; others repeat the same behaviors several times, but are unable to adapt. The author uses the term “taking advantage” of previous experiences as a way of explaining that

these people are unable to adapt their mistakes, failures and successes. This way of thinking would equate the concept of reflective practice, a crucial condition for conceptualization. The author proposes two types of experiences: experiences in which the subject is trapped in the automation of their own conduct, and experiences that, although limited, go beyond the perspectives of the subjects involved.

Pastré (1997) analyzes that experience is constructed based on the ability of the subject who, when living the experience, returns to the past as a way of analyzing and reconstructing their know-how at another cognitive level. The use of the past helps the subject to expand their ability to anticipate other possible futures, which is characterized as an essential condition for the development of gestures, which is, for ergonomists, a crucial aspect. Lemonie and Chassaing (2015) point out that gestures are contextual creations that help the subject answer questions posed by the task, which means having an active role in producing a solution via gestures. In other words, it is a requirement to respond to the task, but also for solutions when the subject is placed in restricted situations.

Theoretical reflections regarding the constitution of the nature of the teacher's work in the classroom become increasingly potentially necessary. Given the contemporary national educational scenario, investigations that epistemologically validate paradigms, research models and specific methods aimed at teacher training also permeate PPE for teaching.

[...] seeks to respond to the demands imposed by the system when the aim has the central objective of improving teaching. [...] it is understood that just a well-prepared teacher is not decisive for achieving satisfactory educational goals, a set of factors must be cultivated. The socialization of students must be worked on in order to ensure a good relationship with educators and the institution, which makes the environment harmonious, facilitates the learning process, leads to attitudes of good relationships, which generates self-esteem, greater confidence and makes the relationship between both less unequal, without fears and insecurities, since the responsibility and demand for the commitment to learn generate expectations and require an atmosphere of reliability between both (teacher/student) (Carvalho, 2023, p. 45-46, our translation).

The transformations that occurred in society end up being reflected in the legislative process, which leads to demanding a new way of thinking about the School Institution from Basic Education to Higher Education and FoPEM, as well as the PPE included there.

Burigo (2019) presents research on the productions and materials collected on the SBEM website, the society mentioned at the beginning of the introduction. The author points out that in the statute of Sbem (2013, p. 2, our translation) it is described that one of the purposes of the Society is to undertake, “[...] together with government bodies in the formulation,

implementation and evaluation of national education policies and, in especially those related to MS”.

But what were the policies considered worthy of debate or demonstration by the Society and how did these debates take place? How have the ways of thinking, influencing or positioning ourselves in relation to educational policies changed over these thirty years? What values or principles motivated SBEM's engagement in the discussion and implementation of policies? (Burigo, 2019, p. vii-viii, our translation).

These questions point to a scenario of possible changes that make up SBEM's movements. According to Burigo (2019, p. x, our translation), there was no major progress and explains that the financing problem, and a PPE that values teaching were “undermined by the precariousness of hiring and working conditions [...]. Resource optimization policies have even justified the closure of schools, contradicting the logic of school education built according to the demands of the communities”. Pressure is also growing for business to promote new paths for education, assumed by the Ministry of Education and Culture (MEC).

And, according to this author, these pressures apply to all large-scale national assessments, without exception, and they indicate that the central purpose of education at school is to establish skills. Highlights include mathematics measured by student performance and the comparison of teaching quality (Frigotto, 2011; Cabrito, 2009). In 2007, according to Saviani (2008), the business community continued to put pressure on and presented the All for Education campaign and the Basic Education Development Index (IDEB), a mechanism that regulates PPE as a whole (Saviani, 2008). In 2013, according to Macedo (2014), the new pressure from the business community is for the National Common Curricular Base (BNCC), to include school curricula with standardization of teaching materials and VT, under the aegis of effectiveness in the constitution of competent subjects.

Therefore, we seek to delimit SBEM manifestations, according to Burigo (2019), which are present and available on the SBEM page, through researchers in mathematics education. The letter written by the president, Cristiano Muniz, in 2010, to the Minister of Education, emphasizes:

SBEM has based its history on the strong participation of its mathematics educators in the conception, development and implementation of important public policies in the educational area, such as SAEB, PROVA BRASIL, ENEM, ENADE, ENCEJA, PNLD, GESTAR, Pró-Formação and, more recently, Pró-Letramento (Sbem, 2010a, p. 1, our translation).

It is clear, according to Burigo (2019), that SBEM values the participation of its partners in implementing large-scale evaluation policies. However, according to the author

[...] records of debate about large-scale assessments as policies, about the motivations of these policies, about the discourses that justify these assessments - including the financial resources spent on them - and about their effects on education are sparse and scarce. (p. vii-viii, our translation).

In this sense, Burigo (2019) refers to the first International Research Seminar on Mathematics Education (SIPEM) in 2000, which presents the investigation of the Basic Education Assessment System (SAEB) and its indicators of low student achievement. In 2007, the IX National Meeting of Mathematics Education (ENEM) discussed the conclusion of large-scale mathematics assessment programs at the state, national and international levels. In the X ENEM, in 2010 and the V SIPEM, in 2012, subsidies for education professionals at all levels of education were discussed, as a way of rethinking the curriculum.

Carvalho (2001, apud Burigo, 2019) indicates the

[...] small correspondence between the objectives of Mathematics teaching, stated in the National Curricular Parameters for Secondary Education (PCNEM), and the Mathematics descriptors of the SAEB Reference Curricular Matrix [...] by reading the two documents we can realize that teachers were not called upon to prepare either of them. An assessment of detailed skills as described in the SAEB document descriptors ends up linking classroom work to the effectiveness of the test (Carvalho, 2001, p. 4, apud Burigo, 2019, p. xiii, our translation).

For Burigo (2019), all these provocations did not find much echo in SBEM demonstrations. On October 18, 2018, between the two rounds of the presidential election, the Sbem board (2018) published a text pointing out the alignment of SBEM with the option of a reflective, creative school, with conditions to produce knowledge, autonomously and free. For the author, the diversity claimed by social movements is included in Article 15 of the Law of Guidelines and Bases for National Education (LDBEN), and is included in normative documents for Youth and Adult Education and for Rural Schools. In LDBEN, there is the present idea of the right to equal provision of teaching, training and remuneration of teachers, and, at this time, there was an increase in the offer of distance education for degrees, in FoPEM, proposed by the Brazilian Mathematics Society (SBM).

In 2018, with the BNCC, standardization in Basic Education was established, linked to the Basic Education Development Index (IDEB) and Brazilian evaluation systems, listed above, with the aim of improving the quality of education offered to students at the same time in which

he values the teacher. Furthermore, review the guidelines for pedagogy and mathematics courses, focusing on practices, pedagogical knowledge and skills provided for in the BNCC. Furthermore, there is a proposal to work on VT in a systemic view, including all training and career development, as an essential articulated action in a PPE.

The analysis that this study requests is to seek logic from the texts researched on DP and FP, and underlying PPE; It is therefore inspired by Alves (2016, 2019), and if related, they can subsidize FoPEM, in its FI and/or FC, and in this sense, it allows the teacher to carry out a self-analysis of their work, not necessarily describing the situation-activity that is involved, as discussed in the DP, making it possible to visualize FoPEM, as a disciplinary matrix, in its conceptual and syntactic structure and the representation made of it by these actors.

Methodology

In Mathematics Education, an important epistemological discussion is whether the area has a set of discourses that enable researchers to expand their field of investigation, and whether these discourses diverge, depending on the specificity, of their object of study. This idea leads to reflection on methodology, and it is essential to think that it must be accompanied by epistemological considerations.

As a proposal, reflecting on the methodological aspects may lead the researcher to return to the question of the aspects that constitute his practice, as well as his training as a mathematics educator. Each approach has a methodological preference, its own instruments, assumptions and values. Likewise, each approach imposes different limitations and topic constructions considered appropriate for research. The research review contributes to broadening the researcher's perspective of concern. It is a method in which the researcher performs a first-degree review that includes several sources of data that improve the researcher's understanding of the topic of interest.

Expanding the discussion on carrying out a literature review with quality and rigor is necessary. The literature review must serve [...] “two basic aspects: (a) the contextualization of the problem in the study area; and (b) the analysis of the theoretical framework” (Alves, 1992, p. 54, our translation). Associated with the ideas outlined above, it is important to be clear that there are many approaches available in terms of methodological approaches. And, for this purpose, the review is appropriate to define the context and theoretical framework. For this text,

bibliographical studies on FP, Professional Didactics and PPE are used to outline the possibility of contributing to the area and its subsystem, FoPEM. Each of these studies is examined below.

Theoretical considerations about this research

The PPE theme is characterized in Brazilian laws and normative documents as actions at the federal, state and municipal levels, aimed at structuring the levels and modalities of Education, enabling improvements that favor the formation of citizens.

In Brazil, state public policies are practically non-existent when it comes to social, educational and economic inequalities. What we have had throughout our history are public government policies with a palliative effect that meet momentary demands and that are in line with the interests of the groups in power (Silveira *et al.*, 2021, p. 27, our translation).

From the perspective of these understandings, a PPE directly interferes with school organization and functioning, and the needs of the context may point to the reformulation of new PPE possibilities.

Recently, the 2022 Program for International Student Assessment (PISA), translated from Program for International Student Assessment, which takes place every three years by the Organization for Economic Cooperation and Development (OECD), carried out an international comparative study to evaluate students aged between 15 and 16 years old (probable completion of Basic Education), in order to verify whether are able to understand a text, a scientific phenomenon that brings entry into society that allows them to engage in society as a "literate citizen" (Inep, 2023; OECD, 2023)

The PISA 2022 result indicates that performance in mathematics is below the global average in all Brazilian social strata. Some analyzes point to the problem for FoPEM, with evidence that the teaching career is not attractive, and this idea is the same for both the public and private systems. Other analyzes point out that, even if PISA was not carried out in 2021 due to the pandemic, the result in 2022 is still a reflection of what was faced because of COVID-19.

According to Burigo (2019), the debate on large-scale evaluation is still insufficient. The author explains that the PISA tests are organized according to the perspective of Mathematical Modeling (MM), which is a trend in EM. However, the MM trend is mentioned in normative documents, but is not present in Basic Education curricula. Another important and current issue, regarding the High School Reform (established by federal law 13,415 of 2017),

is also discussed by the author, when discussing that over more than 30 years the SBEM has manifested itself, advancing the democratic debate on PPE.

FoPEM is a complex and multifaceted process with different dimensions, namely: teaching knowledge, profession, theory and practice, teacher/school, professional development, professional choice and other multiple dimensions. That said, there are factors that influence the importance of FoPEM in contemporary times, such as PPE, the nature and organization of teaching work and its transformations, advances in technology and information, among others.

The Theory in Mathematics Education (TEM), worked by Steiner (1984), can inspire studies on FoPEM as a phenomenon and its circumstances, and emphasize the importance of understanding its complexity. In this sense, EM as an area would be considered as a system, made up of parts, subsystems, and their interrelations, guaranteeing their specificities. Thinking about a systemic view will mean treating FoPEM as a subsystem of the EM system, and its interpellations that do not always work well, due to a lack of interconnection and/or mutual cooperation between them. It is inspired by Neves (2006) bringing the idea of Complexity, which means the totality of events and circumstances in the area of MS since the researcher's ability may not be able to grasp this complexity, and it is, at this point, the systems take over, excluding certain possibilities and selecting others for research.

Regarding FoPEM, there is a set of theories that lead to the improvement of teaching and learning for professionals in training or graduates. However, it is not possible to neglect the discussion without analyzing the work of the education professional; is reiterated both by those who are trained and those who train, also illuminated by the PPE, despite still providing a complex context that contemplates the work and its important discussions, requiring understanding the study on DP as a way of evaluating the activities that are developed by Mathematics Teachers.

Therefore, within the scope of FoPEM, there are few studies on the analysis of professional activity, study of representations, reasoning and strategies, conceptualization in process management, with theoretical reference to the formation of skills, PPE related to the area, as evidenced in Santos and Alves (2023). Furthermore, there is a gap in FoPEM, understood as a disciplinary matrix, inspired by the studies outlined above by Carlos Marcelo Garcia, which seeks to identify a conceptual and syntactic structure.

Studies on FoPEM cover Mathematics and Pedagogy degrees, professionals, (Sbem 2010, 2018), although interdependent, which present specific characteristics in their conceptual and syntactic structure, such as disciplinary matrix, which distinguish it from teaching theory,

curriculum and teaching methodologies. These are adjusted, transformed and adapted from the more comprehensive/general perspective of FP teachers through the PPE in force in our educational system. Furthermore, the syntactic structure seems to have been developed as its own area of investigation into problems of the conceptual structure and in a substantive way it could be worked on in a broad sense in FoPEM.

The systemic view makes it possible to understand the place of FoPEM as a subsystem, its relationships, its object of study, appropriate theory, methodologies, and the specificity of the target audience. All these questions, guided by the teacher's audience, understanding that he is the most interested in his educational change, in the recognition of his work, in his limits and possibilities of professional work, backed by PPE that comply with the laws federal, state and municipal institutions, and with actions carried out within deadlines that enable quality of life, will, as a consequence, improve education for all Brazilian citizens.

REFERENCES

ALDA J. A. A revisão da bibliografia em teses e dissertações: meus tipos inesquecíveis, **Cadernos de Pesquisa**, n. 81, 1992.

ALVES, F. R. V. Didática da Matemática: seus pressupostos de ordem epistemológica e cognitiva. **Interfaces da Educação**, v. 7, n. 21, p. 131-150, 2016.

ALVES, F. R. V. A vertente francesa de estudos da didática profissional: implicações para a atividade do professor de matemática. **Vidya**, v. 39, n. 1, p. 255-275, 2019.

ALVES, F. R. V. Sobre o trabalho e a aprendizagem do professor: uma contribuição da vertente francesa de didática profissional. **Trabalho & Educação**, v. 30, n. 2, p. 81-101, maio/ago. 2021. Available in: <https://doi.org/10.35699/2238-037X.2021.21893>. Access: 25 June 2023.

BRASIL. Programa Internacional de Avaliação de Estudantes. Brasília, DF: Inep, 2023. Available in: <https://www.gov.br/inep/pt-br/areas-de-atuacao/avaliacao-e-exames-educacionais/pisa>. Access: 27 Dec. 2023.

BURIGO, E. Z. A Sociedade Brasileira de Educação Matemática e as Políticas Educacionais. **Bolema**, Rio Claro, SP, v. 33, n. 64, p. vii-xxvi, ago. 2019

CABRITO, B. G. Avaliar a qualidade em educação: Avaliar o quê? Avaliar como? Avaliar para quê? **Cadernos Cedes**, Campinas, SP, v. 29, n. 78, p. 178-200, maio/ago. 2009.

CARVALHO, M. S. P. **Impactos da formação docente continuada no Índice de Desenvolvimento da Educação Básica**. Boa Vista: Editora IOLE, 2023. Available in: <https://editora.ioles.com.br/index.php/iole/catalog/view/236/411/679-1>. Access: 27 Dec. 2023.

FALZON, P. (ed.). **Constructive ergonomics**. CRC Press - Taylor & Francis Group, 2015.

FAVERGE, J. M.; LEPLAT, J.; GUIGUET, B. **L'adaptation de la machine à l'homme**. Paris: PUF, 1958.

FRIGOTTO, G. Os circuitos da história e o balanço da educação no Brasil na primeira década do século XXI. **Revista Brasileira de Educação**, v. 16, n. 46, p. 235-274, Jan./abr. 2011.

GARCIA, M. C. **Formação de professores**. Para uma mudança educativa. Porto: Porto Editora, 1999.

GIMENO J. S. Consciencia y Acción sobre la práctica como Liberación profesional de los profesores. In: IMBERNÓN, F. (coord.). **La formación permanente del profesorado em los países de la CEE**. Barcelona: ICE/Horsori, 1993. p. 53-92.

LEMONIE, Y; CHASSAING, K. From the adaptation of movement to the development of gesture. In: FALZON, P. (ed.). **Constructive ergonomics**. France: CRC, 2015.

MACEDO, E. Base nacional curricular comum: novas formas de sociabilidade produzindo sentidos para educação. **Revista e-curriculum**, São Paulo, v. 12. n. 03, p.1530-1555, out./Dec. 2014.

MEDINA, A. DOMINGUEZ, C. **La Formación del Profesorado em uma Sociedade Tecnológica**. Madrid: Cincel, 1989.

NEVES, C. E. B.; NEVES, F. M. O que há de complexo no mundo complexo? Niklas Luhmann e a Teoria dos Sistemas Sociais. **Sociologias**, Porto Alegre, v. 8, n. 15, Jan./June 2006, p. 182-207. Available in: <https://seer.ufrgs.br/index.php/sociologias/article/view/5569/3180>. Access: 03 Dec. 2023.

NÓVOA, A. Os professores na virada do milênio: do excesso dos discursos à pobreza das práticas. **Educação e Pesquisa**, v. 25, n. 1, 1999.

OECD. **PISA 2022 Results (Volume I): the State of Learning and Equity in Education, PISA**. Paris: OECD Publishing, 2023. Available in: <https://www.oecd.org/publication/pisa-2022-results/>. Access: 27 Dec. 2023.

PASTRÉ, P. Didactique professionnelle et développement. **Psychologie française**. n. 42-1, p. 89-100, 1997.

PASTRÉ, P. A análise do trabalho em didática profissional. **Revista Brasileira de Estudos Pedagógicos**, v. 98, n. 250, p. 624-637, 2017. Available in: <https://doi.org/10.24109/2176-6681.rbep.98i250.3368>. Access: 07 June 2023.

PASTRÉ, P.; MAYEN, P.; VERGNAUD, G. La didactique professionnelle. **Revue Française de Pédagogie**, v. 154, n. 1, p. 1-55, 2006. Available in: <https://journals.openedition.org/rfp/157>. Access: 25 June 2023.

ROLDÃO, M. C. Função docente: natureza e construção do conhecimento profissional. **Rev Bras Educ [Internet]**, v. 12, n. 34, p. 94–103. Available in: <https://doi.org/10.1590/S1413-24782007000100008>, 2007. Access: 25 Dec. 2023.

SANTOS, M. A. ALVES, F. V. A. Reflexões teóricas sobre didática profissional para formação de professores que ensinam matemática. **Revista Interdisciplinar em Ensino de Ciências e Matemática**, v. 3, n. 1, 2023. Available in: <https://sistemas.uft.edu.br/periodicos/index.php/RIEcim/article/view/17739>. Access: 17 Jan. 2023.

SAVIANI, D. **A pedagogia no Brasil: história e teoria**. Campinas, SP: Autores Associados, 2008.

SCHWAB, J. J. Structure of the disciplines: meanings and significances. In: FORD, G.W.; PUGNO, L. **The structure of knowledge and the curriculum**. Chicago: Rand McNally & Company, 1964. p. 6-30.

SILVEIRA, A. P., RECCO, G. M., FERREIRA, P. G. N. de O., VETORAZO, F. H. G. Da performatividade à práxis: por um novo modelo de formação docente. **Boletim de Conjuntura (BOCA)**, Boa Vista, v. 6, n. 18, p. 26–34, 2021. Available in: <https://revista.ioles.com.br/boca/index.php/revista/article/view/354>. Access: 12 Dec. 2023.

SOCIEDADE BRASILEIRA DE EDUCAÇÃO MATEMÁTICA (SBEM). **Estatuto**. Brasília, DF: SBEM, 2013.

SOCIEDADE BRASILEIRA DE EDUCAÇÃO MATEMÁTICA (SBEM). **Carta ao Excelentíssimo Sr. Ministro de Estado de Educação, prof. Fernando Haddad**. Brasília, DF: SBEM, 2010a. Available in: <http://www.sbembrasil.org.br/sbembrasil/index.php/noticias/372-carta-ao-excelentissimo-sr-ministro-de-estado-de-educacao-prof-fernando-haddad>. Access: 26 Dec. 2023.

SOCIEDADE BRASILEIRA DE EDUCAÇÃO MATEMÁTICA (SBEM). **SBEM frente à proposta de mestrado profissional da SBM**. Brasília, DF: SBEM, 2010b. Available in: <http://www.sbembrasil.org.br/sbembrasil/index.php/noticias/358-sbem-frente-a-proposta-de-mestrado-profissional-da-sbm>. Access: 26 Dec. 2018.

SOCIEDADE BRASILEIRA DE EDUCAÇÃO MATEMÁTICA (SBEM). **Nota pública**. Brasília, DF: SBEM, 2018. Available in: <http://www.sbembrasil.org.br/sbembrasil/index.php/noticias/837-nota-publica>. Access: 26 Dec. 2023.

SOCIEDADE BRASILEIRA DE MATEMÁTICA (SBM). **Mestrado Profissional em Matemática em Rede Nacional - PROFMAT**. Rio de Janeiro, 2018. Available in: <http://www.profmtat-sbm.org.br/organizacao/apresentacao/>. Access: 26 Dec. 2018

STEINER, H. G. Theory of Mathematics Education (TME): an introduction. Quebec, Canadá. **For the Learning of Mathematics**, v. 5, n. 2, p. 11-17, 1984.

TARDIF, M.; LESSARD, C.; GAUTHIER, C. **Formação dos professores e contextos sociais** Porto: Rés, 2001.

CRediT Author Statement

Acknowledgments: I would like to thank the Postgraduate Program in Teaching at the Northeast Teaching Network Polo RENOEN – UFC, for accepting the Post Doctorate.

Financing: Not applicable.

Conflicts of interest: There are no conflicts of interest.

Ethical approval: Not applicable.

Availability of data and material: The data and materials used in the work are available for access, see the links.

Author contributions: The second author was the Post-Doctoral supervisor.

Processing and editing: Editora Ibero-Americana de Educação.
Review, formatting, standardization, and translation.

