

# Methods for conceptualizing and investigating teachers' professional identity in literature reviews\*

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## Abstract

Several studies that reviewed the national and international literature on the identity of students and teachers have been conducted over the last five years to analyze how researchers in the field of mathematics education have used such a concept. This article has made a systematic meta-synthesis review of the five most relevant literature reviews on this topic published in the last two decades inside and outside Brazil. Its objective is to understand and discuss multiple perspectives and conceptualizations of teachers' professional identity, along with its implications for research in this area of investigation. The reviewing process of systematic reviews occurred by recording and interpreting each study to eventually discuss and elaborate an integrative synthesis of the final interpretative syntheses. The results reveal that identity conceptualizations have developed in a pendulum movement that oscillates between the dimensions of the subject and its social context, moving towards an interrelation. Research on the area identified theoretical-methodological problems, which still represent a challenge to formulate more operational conceptualizations. Furthermore, in terms of assumed perspectives and the methodologies of developing analysis, defining the concept of identity consistently and operationally is a path under construction and a challenge to be faced by the professional identity field of study. The study of multiple ways of conceptualizing and investigating identity, besides problematizing an important epistemological issue, provides relevant

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theoretical lenses or tools to analyze and understand the complexity of who and how teachers that work at schools are, particularly in the field of mathematics.

## **Keywords**

Identity – Literature review – Mathematics teacher.

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## **Introduction**

For more than twenty years, researchers in mathematics education have investigated how teachers understand and conduct the work of teaching mathematics. This issue has been approached from different perspectives, and the most relevant are those that focus on the knowledge, beliefs, and teacher identity (SKOTT, 2013). In search of new understandings, some researchers have changed the focus of their research, employing more dynamic, participatory, or interactionist perspectives to investigate the teacher and his practice (SKOTT; MOSVOLD; SAKONIDIS, 2018). Such a change led to what Lerman (2000) called the “social turn”, in which sociocultural perspectives gained strength as they emphasize social activity as a producer of meanings, thoughts, and reasoning. In this new scenario, the teacher’s professional identity emerges as a novel investigative perspective that can contribute to understanding how the teacher is constituted and professionally grows in different social and cultural contexts.

Since then, the number of articles using the notion of identity has increased significantly (DARRAGH, 2016; GRAVEN; HEYD-METZUYANIM, 2019; LOSANO; FIORENTINI, 2018). During this period, many conceptualizations of professional identity were engendered, based on different theoretical frameworks, opening up multiple possibilities to understand the complex articulation between the individual dimension of the teacher and the sociocultural context in which their practice develops. Although the existence of different perspectives to conceive it may bring some theoretical and methodological challenges to be faced (DARRAGH, 2016, LUTOVAC; KAASILA, 2018; GRAVEN; HEYD-METZUYANIM, 2019), we understand that this multiple nature makes professional identity a powerful theoretical tool to investigate different problems involving teachers and their practices. In this direction, it has been used to address different situations such as issues of equity, access, and exclusion of teachers in the training process (HOSSAIN; MENDICK; ADLER, 2013); analyze and understand how are negotiated different discourses of what is to be a “good teacher” in times of reform (CHRONAKI; MATOS, 2014); discuss the relationships between teacher learning in training initiatives and the dilemmas to update them in the classroom (BATTEY; FRANKE, 2008; LOSANO; FIORENTINI, 2020; LOSANO; FIORENTINI, 2021); or even, understand the constitution of the teacher in a scenario of ideological and political struggles related to the adversities and vulnerabilities experienced in exercising the profession (DE PAULA; CYRINO, 2019).

The diversity of themes explored and investigated, based on the notion of identity, as well as the multiplicity of adopted theoretical approaches, justify the execution of systematic reviews of such studies and the production of integrative syntheses of these contributions in order to understand the advances, the strengths, and limitations of this field of research. Thus, in this study, we intend to understand and discuss different conceptualizations of the teacher's professional identity in the field of mathematics education and its implications for research in this area of investigation. Hence, we chose to conduct a systematic review (meta-synthesis type) of literature reviews on the professional identity of the mathematics teacher.

## **Methodology**

We conducted a meta-synthesis (FIORENTINI; CRECCI, 2017; GEPFPM, 2018) of five relevant literature reviews that examined different perspectives applied to conceptualize and investigate identity. On this ground, we discussed directions taken by the research of this investigative field and the projection of new possibilities of investigation.

Fiorentini and Crecci (2017) and Gepfpm (2018), supported by Godfrey and Denby (2006), understand that the meta-synthesis of research firstly consists in the production of qualitative evidence that is extracted from each research analysis about a problem, phenomenon, or focus of study. Then, it is related, confronted or contrasted, producing other interpretations that eventually allow to compose an integrative synthesis of these interpretations. Meta-synthesis, therefore, “represents a systematic and rigorous attempt to conduct second-order readings regarding the interpretations found in first-order qualitative studies” (GEPFPM, 2018, p. 247). Furthermore, it facilitates a greater conceptual and theoretical-methodological understanding of a theme, phenomenon, or field of investigation, obtaining an integrative synthesis that goes beyond that one produced by previous studies.

Thus, the meta-synthesis process conducted consisted, first, of the analysis of studies of national and international systematic reviews on teacher identity from a more general to a more specific perspective (concerning teachers who teach mathematics) to, from them, select a more restricted and representative corpus of review studies related to the teacher's identity. Then, each of these studies underwent a systematic review process by making records and elaborating an interpretative synthesis of each review study for a later discussion and elaboration of an integrative synthesis of these first-order interpretive syntheses.

To compose the corpus of our meta-synthesis, we selected four international studies and a national one in order to cover an extensive period of publications (1988 to 2019). We started with the pioneering research by Beijaard, Meijer, and Verloop (2004), which highlighted the importance and potential of exploring the theme of identity in research on teachers.

In order to understand the historical evolution of research on identity over the last 20 years in the international scenario, we selected for examination the reviews of Darragh (2016), Lutovac and Kaasila (2018), and Graven and Heyd-Metzuyanım (2019). Each of these

studies discussed different perspectives and ways of conceptualizing identity, pointing out limitations and advances in the construction and use of these conceptualizations.

To place the national research on the professional identity of teachers who teach mathematics (PEM<sup>4</sup>) in the context of mathematics education, we took De Paula and Cyrino's research (2018) as a reference. This study discussed the theoretical and epistemological poles present in Brazilian dissertations and theses on PEM's Identity, defended in Brazil from 2006 to 2016.

The analytical and interpretive work started with a skimming reading of the five reviews. Next, the main characteristics and results of each review were identified and recorded. Thus, for each one we identified, in the first phase: the period of publication considered; the number of studies analyzed; the sources and selection criteria for the analytical corpus of each review; the language of publication of the articles examined; and the manner each review grouped or categorized the reviewed studies, analyzing whether the reviewed research assessed only the teachers' or also the students' identity. At the end of each review, we produced an interpretative synthesis containing the main results of each one along with the review authors' position on the different conceptualizations found in the reviewed studies.

So as to better understand the different perspectives that research on identity may take, we undertook a second analytical-interpretative phase, in which we made an interpretative synthesis of the concept of identity highlighted by the authors of each systematic review analyzed.

The remaining part of the article is organized as follows: in the subsequent section, we present the interpretive syntheses of the five reviews, and we dedicate the last section to the accomplishment of the meta-synthesis, a moment in which we discuss the results found and produce an integrative synthesis of the interpretive syntheses about the multiple ways of conceptualizing and investigating the teacher's professional identity.

## **What do the most relevant literature reviews of the last twenty years reveal about identity in the field of mathematics education?**

### **The review that first highlighted the importance and potential of the study of professional identity to investigate the teacher**

Beijaard, Meijer, and Verloop (2004) conducted a literature review in the area of Education, covering research undertaken on the teacher's professional identity published between 1988 and 2000. The authors searched for the term "Professional identity" in the title or as the most prominent descriptor in the databases linked to the "Web of Science" website and the ERIC<sup>5</sup> database. Twenty-two articles, which were the outcome of this search (all written in English), were analyzed under the following aspects: objectives of

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**4-** Acronym for the translation into Portuguese, "Professores que Ensinam Matemática"

**5-** Educational Resources Information Center - <https://eric.ed.gov/>

the study, definition of assumed professional identity, concepts related to this definition, the methodology developed by the study, and its main results.

These articles were divided into the three categories, considering the focus of the investigated study: formation of the teacher's professional identity, identification of characteristics of the teacher's professional identity, and professional identity evidenced by/in the stories told and written by the teachers.

The authors conclude that most studies have distinct conceptualizations of identity or do not conceptualize it. Additionally, they state studies that confuse concepts close to identity are frequent and use them as if they were identical, whereas literature regards them as distinct. That is the case of some reviewed studies that use the terms "I" and "identity" interchangeably without clarifying how these terms are conceptually related.

Beijaard, Meijer, and Verloop (2004) finalize the review by suggesting that researchers seek, in their articles, greater conceptual clarity for professional identity. Furthermore, they point to the potential of studying the relationship between the individual stories told by teachers and their identities as a fruitful pathway to theoretically and methodologically support future research on the teacher's professional identity. They also highlighted that in studies in which identity and individual narratives are present, the social context is relevant in the constitution of teachers' identity. The authors, therefore, acknowledge the narrative as a fundamental resource for the analysis and discernment of identity.

When elaborating an interpretative synthesis of the narrative perspective on the identity of this review, we can affirm that, for Beijaard, Meijer, and Verloop (2004), the teacher's professional identity is conceived as having a central nucleus, more or less coherent, constituted by sub-identities that harmonize to some extent. Regarding the relationships established by the sub-identities, the authors emphasize that,

Some of these sub-identities may be broadly linked and can be seen as the core of teachers' professional identity, while others may be more peripheral. It seems essential for a teacher that these sub-identities do not conflict, i.e., that they are well-balanced. (BEIJAARD; MEIJER; VERLOOP, 2004, p. 122).

The path to harmonizing those sub-identities is considered convenient. In addition, this core would be woven from the lived experiences and practical knowledge personally built by the teacher in different times and professional spaces they have been part of throughout life.

The researcher who assumes such a perspective understands that, by exploring the plots an investigated teacher constructs to compose their narratives, they can access this central core of the teacher's professional identity, likewise their most peripheral aspects. Thus, by retelling and reliving their professional histories, such a teacher reflects on them and reconstructs, in time and space, their professional practical knowledge, renovating their identity through the integration of what, individually and collectively, is considered good teaching (BEIJAARD; MEIJER; VERLOOP, 2004). From these narratives, perceptions can emerge about the manners a teacher explains and justifies their relationships with themselves and with various characters (parents, students, principals, teacher trainers)

present in different professional scenarios they participate, such as schools; continuing education groups, among others. On the other hand, when assuming this perspective, the analyzes are based on the stories the teacher tells, leaving in the background data that do not constitute narratives, such as discussions and conversations with their students, colleagues, or teacher trainers. In this direction, it is necessary to consider that such episodes may be absent from the narratives reported by the teacher or reconstructed in order to hide aspects of their professional identity, in case they do not identify themselves or do not want to be identified, with the ways of being a teacher evidenced in the episodes of professional performance.

### **The literature review that jointly addresses the identity of students and teachers who teach mathematics**

Focusing on mathematics education, Darragh (2016) reviewed studies published in English from 1997 to 2014, which dealt with the identity of students and teachers who teach mathematics. The author researched five education databases: Education Sage Full Text Journal Collection, Education Research Complete (EBSCO host), ERIC, JSTOR, and ProQuest Education Journals. She used the terms “Mathematics”, “Education”, and “Identity” in the search performed in each of the five databases. After reading the title and abstract, she selected 188 articles to compose the analytical corpus of the review.

Darragh (2016) analyzed the definition of identity present in each study and its theoretical foundations. The author found five categories that characterize the ways of defining identity in the studies she reviewed, but without distinguishing between student and teacher identity: participatory, narrative, discursive, psychoanalytic, and performative. She noted that some articles did not assume or clearly adopt a definition of identity, although they had revised the definitions of other authors.

Among those who have assumed a conceptualization for identity, it was predominant the use of theoretical perspectives from fields outside mathematics education and education, particularly Lave and Wenger (1991) and Wenger (1998), followed by Holland et al. (1998) and Gee (2000). In the field of mathematics education, Sfard and Prusak (2005) have been the most cited in the studies reviewed. Furthermore, the author found theoretical-methodological inaccuracies and inconsistencies in this research, such as the existence of articles that assumed a conceptualization of identity within a sociological framework but deployed analytical procedures linked to a psychological perspective of identity.

In her review, Darragh (2016) advocated a sociological and performative conceptualization of identity. For her, identity is not something inside us but something we do (identity as action). When we tell stories, gather in groups, act in a particular way at a given time, or position ourselves and others through discourse, we enact our identities for specific audiences, which may or may not recognize us as we wish to be. Thus, identities are the result of processes of self-identification or identification by others. Recognizing identity as a performance that may or not be recognized as desired is also pointed out by Darragh (2016) as an effective and promising direction for future studies.

Making an interpretative synthesis of Darragh's (2016) sociological and performative conception of identity and how to investigate it, we can say this perspective moves away from the idea of identity existence, with a central or essential core constituted throughout the professional life of a teacher, to assume the existence of multiple identities evidenced at specific moments when the teacher acts professionally in the different educational and training contexts he participates. From this perspective, it is possible to interpret the enactments of their various "I – teacher" focusing on the moment they are acting in their classes, negotiating with their students and managers, and with other participants in the school context, without necessarily telling us these stories.

In this sense, it is crucial that the researcher, when investigating the teacher's identity, make audio and video records of the teacher's professional practice and select dialogues and performances in class or with the professional community they participate, prioritizing moments of negotiation. Such a procedure allows the researcher to access the different "staged" identities when acting as a teacher. From a sociological perspective, the researcher can identify, analyze and understand the relations of power that permeate the different moments of action and how the teacher welcomes, incorporates, or rejects the way they are acknowledged and positioned in their school or group (professional or investigative) they participate, endorsing their professional identity assumed in a performative perspective.

### **A literature review centered on the identities of mathematics teachers**

The study developed by Lutovac and Kaasila (2018) focuses on the field of mathematics education and has the mathematics teachers' identities as the seat of attention. To select the articles, these researchers analyzed studies published in academic journals in the realms of mathematics and teacher education. Furthermore, they conducted searches in the *Education and Social Sciences* and ERIC (ProQuest) databases, using the keywords *Identity*, *Mathematics*, and *Teacher*. Eventually, forty peer-reviewed articles were chosen – written in English and published between 2000 and 2015.

Lutovac and Kaasila (2018) recognized six central themes about teacher identity: theoretical models and what constitutes identity; contextual factors in identity and its development; the development of identity at the beginning or continuing education; affective relationships with mathematics and changes in the teacher's identity; post-structural studies and issues of power, social justice, gender and race in identity discourses; and the link between identity and teaching practice.

The authors found multiple definitions of identity that vary according to the adopted theoretical frameworks. However, they observed that all these studies presented at least an operational conceptualization (SFARD, PRUSAK, 2005) for identity. In addition, they found that most of these conceptualizations were borrowed from other fields of research and based on established theories. For example, Lave and Wenger's *Situated Learning* (1991); Wenger's *Communities of Practice* (1998); or Foucault's works on discourse, knowledge, and power. They also found studies that portrayed individuals as storytellers with their identities constituted by these stories or defined by them. In the conclusions,

Lutovac and Kaasila (2018) suggest that researchers in mathematics education incorporate, more frequently, theories from the realm of Education in their research, thus avoiding the isolation of this field of study.

Although Lutovac and Kaasila (2018) admit that social context molds teachers' identities, they emphasize the importance of affection and emotions related to mathematics in the constitution of the teacher's identity. These researchers argue that sociocultural and post-structuralist perspectives focus on social structures, leaving the participant's inner world in the background. Thus, they recommend taking a more balanced psychosocial theoretical perspective on the conceptualization of identity – an aspect found in many of their studies. For example, Kaasila, Hannula and Laine (2012) argue that the way people position themselves socially (or are positioned) influences how they express their emotions or not. Lutovac and Kaasila (2018) argue that research relating affection and cognition to identity can provide a broader understanding of identity, linking it to learning and teaching.

In an interpretative synthesis of the identity perspective of a mathematics teacher assumed by Lutovac and Kaasila (2018) and how to investigate it, we can highlight that the researcher needs to gather narratives of multiple professional experiences of that teacher in order to evidence and understand their different identities constituted in their stories, considering the context and the interlocutors present in each narrated plot. From a story about a teacher's conflicting relationship with formal mathematics, told in a narrative interview with a researcher, a mathematical identity can emerge (KAASILA, 2007) associated with overcoming actions and positive emotions. However, the same story told to teachers participating in their training group may reveal another identity connected to negative emotions and actions of distancing from mathematics. In this perspective, different identities can arise from different situations, and the same teacher may have many narrative identities connected to other contexts or social relationships (KAASILA; HANNULA; LAINE, 2012). Identities are understood as means of argumentation and modes of positioning (KAASILA; HANNULA; LAINE, 2012) being, therefore, something the teacher uses and not something they have inside.

### **Current trends in international research on the identities of mathematics students and teachers in literature reviews**

In the field of mathematics education, Graven and Heyd-Metzuyanim (2019) conducted a review of the literature reviews on identity published in the last three years (2016-2018). The analytical corpus of this study consists of reviews<sup>6</sup> that deal with the mathematics teachers' and students' identity. The common findings and criticisms revealed by the reviews were summarized and compared to the results of 47 recent studies (2014-2018), aiming to establish the current research trend in this field. The articles, written in English, dealt with the identity of mathematics learners or teachers. To select them,

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**6-** (DARRAGH, 2016; LANGER-OSUNA; ESMONDE, 2017; HEYD-METZUYANIM; LUTOVAC; KAASILA, 2016; RADOVIC; BLACK; WILLIAMS; SALAS, 2018; LUTOVAC; KAASILA, 2018).



the word *identi*\* was used in several fields in a search performed in the twenty most prominent peer-reviewed journals in the Academic Search Premier and ERIC databases.

Graven and Heyd-Metzuyanım (2019) analyzed the articles considering two dimensions: quantitative (statistical) and qualitative. Descriptive statistics on the regional location of studies, the object of study (teachers' or students' identity), methods, and sample sizes, were performed and compared with those of the other reviews discussed. They used a qualitative approach to group the articles, analyze, and discuss them in terms of the following: the theoretical reference used, the definitions of identity and the ways to operationalize them, the presence/absence of mathematical objects in the studies, the "Ontological Collapses"<sup>7</sup> and the goals and functions for using the concept of identity.

Graven and Heyd-Metzuyanım (2019) also identified a predominance of socio-cultural frameworks to study the identity of both students and teachers, in addition to the prevalence of empirical studies over theoretical studies. They found that Holland et al. (1998), Sfard and Prusak (2005), Lave and Wenger (1991), and Wenger (1998) theoretically supported most of the reviewed studies. Furthermore, they found that conceptual inaccuracy and inconsistency were still present in research on students' and teachers' identity, despite obtaining some advances. They verified that articles published in the last five years already contained explicit definitions of identity. Such an advance paves the way for a new challenge – how to operationalize such definitions. In this direction, Graven and Heyd-Metzuyanım (2019) argue that the researcher must, in addition to stating what identity means to them, explain how this conception of identity will be studied and treated analytically and empirically.

Graven and Heyd-Metzuyanım (2019) are closer to studies that use narrative conceptualizations where identity is acknowledged as a discursive action, along the lines of Sfard and Prusak (2005), whose coherence of the results is related to an analysis focused on the narrative itself and its structure.

By making an interpretative synthesis of the narrative perspective of identity evidenced by Graven and Heyd-Metzuyanım (2019) and how to investigate the teacher's identity, we understand that the discourse of this teacher about their experiences in different contexts and told to different audiences express their identities. Story Collections of their lives as beginning math learners or teachers experimenting with new investigative practices in classes or training groups can convey aspects of their multiple identities. When grouped and given meaning by the researcher, they can tell about their way of being a math learner, investigative, or teacher-researcher. Understanding the structures of stories in different contexts – an interview or a video-recorded discussion of a collaborative group meeting – is a possible way to highlight identities. In this perspective, it is fundamental to analyze what, about whom, and to whom this teacher speaks, besides why they express themselves in a certain way in each context. Identity is considered a discursive action (SFARD; PRUSAK, 2005). Therefore, observed linguistic and discursive resources can be beneficial to help understand it. On the other hand, the researcher's

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**7-** The authors understand Ontological Collapses as an implicit unification of different types of narrative identities.

interpretations of interactions observed and not spoken by the teacher or others involved remain in the background.

### **The review of Brazilian research on the professional identity of teachers who teach mathematics**

De Paula and Cyrino (2018) aimed to analyze the theoretical and epistemological<sup>8</sup> poles underlying the Brazilian theses and dissertations that proposed to investigate the PEM's professional identity, published between 2006 and 2016.

There were two stages to conducting the corpus definition of the analysis. The first occurred when the authors examined 858 dissertations and theses involving PEM. After that, there was a selection of 15 studies published from 2006 to 2012, chosen through their abstract readings. In the second stage, the time frame was extended to 2016, when a new survey was performed with the Capes Theses Bank, using "identity professional" as a search descriptor between 2013 and 2016. Eventually, nine further studies were found, totaling 24, all written in Portuguese, and became the corpus of the review study analysis.

Initially, the studies were organized into the following seven categories: the PEM's working conditions, public policies, programs or development projects, different contexts of teaching training and development, the community of practice or study groups; initial PEM's training and pedagogical practices, the PEM's training in distance learning; and PEM as a secondary approach. In a second analysis, the studies were grouped according to the authors' theoretical choices. Most of the research was based on Claude Dubar's research, followed by Selma Pimenta's and Stuart Hall's (DE PAULA; CYRINO, 2018). The authors found four epistemological perspectives for the PEM's professional identity: sociological, cultural, psychological/psychoanalytic, and generalist, not being mutually exclusive.

As for the theoretical references used, they observed that most were external to the field of mathematics education, and it was up to each researcher to make the necessary approximations to discuss the identity of these teachers. They detected that few studies published in a foreign language were used as theoretical support in Brazilian research. The authors concluded that there is a scarcity of national studies that specifically discuss the PEM's identity and suggest the expansion of theoretical discussions aimed at the specific characterization of this professional identity. In addition, they highlighted that, in general, when the analyzed studies present their theoretical foundation regarding the teacher's professional identity, different perspectives of this identity are mentioned without the researcher taking a position or indicating the choice/adoption of a specific reference.

De Paula and Cyrino (2018) understand the PEM's professional identity as "a movement that takes place in view of a set of beliefs and conceptions interconnected with self-knowledge and knowledge about their profession, associated with autonomy (vulnerability and sense of agency) and political commitment" (DE PAULA; CYRINO, 2019, p. 637). As a result, they admit complexity, dynamicity, temporality, and experientiality as qualifying aspects of the movements that constitute such a professional identity (DE PAULA; CYRINO, 2019).

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**8-** The term "pole" is used in the sense of "central issue" or "reference point", according to Lessard Herbert, Goyette and Boutin (1994 *apud* DE PAULA; CYRINO, 2018).

Making an interpretative synthesis of the identity perspective assumed by De Paula and Cyrino (2019) and how to investigate it, we can say that the teacher's identity can be seen as mutable in a movement of a permanent constitution and associated with their ways of dealing with the possibilities (and impossibilities) they experience in their profession. Their understandings – constructed from beliefs and conceptions, as well as what they know about themselves and others – about what it means to be a “good math teacher”, are highlighted. These can change depending on the context (educational group, school, and society) and the moment they live their experiences of being a teacher and participating in different professional communities. Their understanding of possible ways of being a mathematics teacher (such as a mediator, teacher-researcher, communicator of knowledge, promoter of social equity, and others) in a given context may constitute indications of the constitution movement of their identity, for example, teacher-investigative, teacher-trainer, teacher-militant, or teacher-traditional. The modes of participation in the different groups and the political and social positions gain evidence.

## **Discussions and integrative synthesis**

Based on the investigation presented in this article, we were able to observe that the perspectives for conceptualizing identity experienced a pendulum movement that seems to oscillate between the subject and sociocultural contexts.

We also observed that in the first studies on teacher's identity, there was a prevalence of cognitivist and biographical perspectives, which considered the teacher's voice as the only source of data, expressed through oral and written narratives (BEIJAARD; MEIJER; VERLOOP, 2004). The emphasis was on the teacher's personal knowledge and understanding of their practices and role.

With the “social turn” in mathematics education research, studies on identity had a new trend, and sociocultural perspectives started to predominate in this field. Then, the notions about Communities of Practice (WENGER, 1998) and Situated Learning (LAVE; WENGER, 1991) were assimilated by researchers and started to support most investigations on identity (DARRAGH, 2016; GRAVEN; HEYD-METZUYANIM, 2019). The ways of constituting the teachers' and future teachers' identities through participation and engagement in social groups (different schools, initial and continuing education groups) have become the object of study of several researchers (GRAVEN, 2004; GOOS; BENNISON, 2008; HORN et al., 2008; LOSANO; FIORENTINI, 2018; LOSANO; FIORENTINI, 2021). Professional identity perspectives based on post-structuralist theories, using mainly Foucault's ideas about the power of discourse in the construction of the subject, were widely used to address power relations and equity issues in different educational contexts (HOSSAIN; MENDICK; ADLER, 2013; WALSHAW, 2004). Aspects of the structure and social context in which the teacher works, and their relationships with various actors in the educational scenario, began to gain presence in research on professional identity.

However, the perception that the constitution of the teacher's identity goes beyond the role of their participation and their interaction with others in different educational contexts guided new understandings of identity that would complement the existing ones.

What the teacher thinks and does is not only the result of the social context they are inserted but also of their attitudes towards their particular goals, their convictions about teaching and learning mathematics, as well as their ways of dealing with mathematics with the contingences imposed by this social context (BEIJAARD; MEIJER; VERLOOP, 2004; LOSANO; FIORENTINI; VILLARREAL, 2018). Their understanding of the profession guides their practice and constitutes their professional identity. Identity perspectives that considered the teacher's personal and social dimensions began to emerge. In this sense, Lutovac and Kaasila (2018) claimed for studies that presented interrelated psychosocial perspectives, arguing that the individual cannot be neglected, leaving in the background what the teacher thinks, feels and who they are. In the same direction, Graven and Heyd-Metzuyanım (2019), when noting in their literature review the absence of studies with purely psychological approaches to address identity, assume that the unanimous choice of researchers for social perspectives can leave behind paths potentially enlightening and productive. Therefore, there is a new movement towards the valorization of approaches that bring back to the discussion the subject's identity and its own world but without neglecting the role and strength of the social context.

From this perspective, we consider that the conceptualization of identity proposed by Holland *et al.* (1998) can be particularly fruitful for including such dialectical interdependence. Such a perspective assumes that identity results from self-understandings and ways of being and acting in different contexts and practices. Therefore, identity is understood as a notion with two interrelated faces, as we see in Losano and Fiorentini (2018):

On the one hand, as identities are social, they are keyways in which collective life is organized, coordinated, and controlled. At the same time, because identities are personal, they are keyways in which people organize, coordinate, and attempt to control their everyday lives and intimate experiences. According to [Holland], there is a bidirectional relationship between these two faces: social identities make public part of personal activity, and personal identities make social identities intimate. (LOSANO; FIORENTINI, 2018, p. 5).

We can say that this conceptualization seeks to study not how people live history but how people make history (HOLLAND; LAVE, 2009). It is a perfect gateway to dialectically analyzing the relationship between the teacher (as an individual) and the school. Likewise, to evaluate the training settings as sociocultural contexts. From this point of view, self-understandings are not accepted only as a personal and subjective construction but as being socially and historically constructed with other participants in the world of education. The teacher's identity comes to be seen as dialectically constituted at the interface between their intimate domain and the practices and discourses to which they are exposed and conditioned (LOSANO; FIORENTINI; VILLARREAL, 2018).

As for its conceptualization, researchers initially defined professional identity in different ways or often did not define it at all. The stated definitions lacked clarity, and studies that claimed to be about professional identity sought general characterizations of the teacher's identity, ignoring the dynamic, procedural, and contextual nature of their constitution. Such studies could be considered on "professional characteristics" and

not professional identity (BEIJAARD; MELJER; VERLOOP, 2004). The beliefs and personal knowledge about the teachers' professional practice, expressed in their biographical narratives, were considered crucial in the constitution of their identity.

After advances regarding the need to clearly explain how the researcher conceptualizes identity, the focus of attention turned to the theoretical-methodological issues that permeate the investigation task. The central question was no longer whether the researcher had defined identity or not but how the conceptualization of defined identity was compatible (or not) with the procedures for analyzing and discussing the results (DARRAGH, 2016). There are still frequent studies that build excessively ample definitions to include the complexity that involves identity. Thus, it is difficult to operationalize them in the data analysis processes and the discussion of results (GRAVEN; HEYD-METZUYANIM, 2019). On the other hand, some definitions escape this complexity, focusing on some aspect or associated concept that is more operational but does not precisely deal with identity. Then, we can conclude it is possible to acknowledge advances in the conceptualization of identity. However, we still have the challenge of formulating more operational conceptualizations (from an analytical point of view).

In turn, the meta-synthesis shows that some conceptual issues about identity remain under discussion. Some stances still divide opinions (DARRAGH, 2016; LUTOVAC; KAASILA, 2018): whether or not teachers' beliefs and conceptions constitute their professional identity (SKOTT; MOSVOLD; SAKONIDIS, 2018), whether or not we should include affective and emotional aspects regarding mathematics when building conceptualizations of teacher's identity.

Furthermore, our research shows that, in the field of mathematics education, research on teachers' professional identity in Brazil shows similarities and differences concerning the international scenario, as highlighted in this systematic review process. Brazilian and international researchers have made the research on PEM's identity a way to facilitate understanding of the beginning and ongoing teacher training and propose discussions that help elaborate and improve public policies (DE PAULA; CYRINO, 2019). The difficulties in conceptualizing and operationalizing identity in national studies are similar to those discussed in international research. Thus, several Brazilian studies debate the PEM's identity without presenting/assuming a particular understanding/comprehension of it. Other studies prove to be incompatible with the theoretical perspectives presented to support them (DE PAULA; CYRINO, 2018), although they explain the assumed conceptions of identity.

Our study highlights that Brazilian research diverges from the others, mainly in the theoretical perspectives adopted and themes of interest. According to De Paula and Cyrino (2018), most Brazilian studies base their conceptualizations of professional identity using the ideas of Claude Dubar, Selma Pimenta, and Stuart Hall. Such theoretical references are not frequent in international research on identity in the field of mathematics education and were not evidenced by any of the reviews examined. In most cases, they are present in studies that investigate professional identity in general, not particularly the identity of mathematics teachers (DE PAULA; CYRINO, 2019). The themes examined through professional identity are also distant from those present in the international literature.

Most of the studies are related to the conditions, contingencies, vulnerabilities, and challenges of exercising the profession of the teacher who teaches mathematics in our country. Public policies for beginning and ongoing teacher training and issues concerning movements against these policies gain relevance (DE PAULA; CYRINO, 2019).

How this identity is constituted in these socio-political scenarios prevails in Brazilian research. We consider the hypothesis that the particularities acquired by research on the PEM's identity in Brazil could enrich and broaden debates at the international level and where several types of research are developed in sociopolitical contexts that are totally different from the Brazilian or Latin American context.

In mathematics education, the multiple conceptualizations of professional identity based on different theoretical perspectives make identity a versatile tool to investigate how the teacher acts and constitutes himself professionally in different practice contexts. However, as we have seen in this systematic review, this diversity may pose problems.

We acknowledge that conceptualizations of identity that are consistent in terms of the assumed and operational perspectives within the analysis methodologies developed are a path under construction and a challenge to be faced by the field of study of professional identity (GRAVEN; HEYD-METZUYANIM, 2019). On the other hand, the richness of the teacher's professional identity aspects that can potentially emerge when we place ourselves in different theoretical perspectives shows us that identity and its multiple conceptualizations can constitute a powerful theoretical tool that helps us understand the complexity of who is the math teacher that works in our schools, and how they are formed and grow professionally.

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