

Secondary Mathematics Teachers' Professional Identity: Systematic Literature Review

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The development of professional identity among mathematics teachers has been well explored in terms of specific attributes needing to be enhanced and catalysts that impact this development. The aim of this systematic review was to identify, describe, and categorise catalysts of professional identity development among secondary mathematics teachers, as well as to explore identity development across studies. The review applied Hanna et al.'s (2019) six domains of teacher identity—self-image, motivation, commitment, self-efficacy, task perception, and job satisfaction—to gain insights into the focal points of identity development in 51 studies. The analysis revealed a notable lack of precision in both defining and interpreting the development of professional identity among mathematics teachers. It is argued that while the term "professional identity" is widely used, it is often not properly defined, and there is rarely any indication as to which aspects of professional practice contribute to its development. Although most studies were focused on self-image and task perception, job satisfaction received comparatively less attention. Furthermore, the studies reviewed do not provide sufficient scope to determine which catalysts are most effective in fostering professional identity among mathematics teachers. Specific research is sought to address the gaps identified.

Keywords • mathematics teacher education research • professional identity • secondary mathematics teachers • retraining • out-of-field

Introduction

Within the field of education and particularly teacher education, there is a wide corpus of research asserting the critical importance of cultivating teachers' professional identity (Beauchamp & Thomas, 2009; Hsieh, 2015; Thomas & Beauchamp, 2007). This process of identity development is described as dynamic and flexible, involving the interplay of individual and collective perceptions and distinctions (Beauchamp & Thomas, 2009; Beijaard et al., 2004). Identity in relation to teaching mathematics has been connected to one's knowledge in the field, and this perspective builds on the idea that knowledge is not isolated but is influenced by its context, is a social construct, and is shared among individuals (Hodgen & Askew, 2007). The concepts of "story" and "narrative" are often used in the context of developing teachers' professional identities, illustrating the idea that teacher knowledge is shaped by their specific circumstances and experiences (Stein et al., 2013). The process of becoming a mathematics teacher inherently involves a transformation of one's identity, which is complex and multifaceted in nature.

The aim for this review was to examine the process of identity development among secondary mathematics teachers and the practices or interventions that may influence this development. Lutovac and Kaasila (2019) reviewed 52 studies published between 2000 and 2017, focusing on teacher identity in mathematics education. They offered a comprehensive overview of the methodologies employed in these studies. They collected information on study design, participants, data collection methods, and data analysis methods. Their review addressed solely the methodologies utilised and did not incorporate



any analysis of the findings pertaining to mathematics teacher identity development across the 52 articles reviewed. Similarly, other prolific reviews in the field of mathematics teacher identity (Darragh, 2016; Graven & Heyd-Metzuyanim, 2019) focused on aspects of identity research such as methodological issues or issues with defining and operationalising professional identity but did not discuss in-depth the process of identity development. Therefore, this review focuses on the fundamental discoveries of each study on how mathematics teachers develop their professional identity.

To understand the complex nature of developing professional identity among mathematics teachers, 51 studies focusing on the professional identity of secondary mathematics educators published between 2000 and 2023 were examined. The goals of the exploration were to shed light on the evolution of professional identity, and to identify the prevailing research methods and aspects of identity that remain unexplored. To achieve these goals, the studies were explored using Hanna et al.'s (2019) six domains of teacher identity—self-image, motivation, commitment, self-efficacy, task perception, and job satisfaction. This article details the characteristics of practices, as well as an overview of methods and instruments used to measure the effectiveness of practices that have an impact on secondary mathematics teachers' professional identity. Comprehensive insights into the characteristics and key findings from the studies reviewed are presented with the intention of supporting the development of a retraining program specifically designed for out-of-field (OOF) secondary mathematics teachers. The primary aim was not to compare the identity development process of secondary mathematics teachers with other groups, but rather to explore and synthesise existing research on how secondary mathematics teachers develop their professional identity. Given the ongoing shortage of secondary mathematics teachers in Australia where many schools rely on OOF teachers (Hobbs, 2012; Shah et al., 2022; Wyatt & Hobbs, 2024), it was vital for the review to examine how qualified mathematics teachers form their professional identity in order to better understand their experiences and challenges.

Literature Review

Beijaard et al. (2004) proposed that identity is a dynamic, continuously evolving process rather than a stable construct, influenced by both individual factors and the surrounding context. In specific contexts, teachers acquire professional attributes, but these are uniquely interpreted and adopted by each individual. Professional identity is closely tied to teachers' perceptions of their work and is often connected to their proactive pursuit of professional growth in alignment with their career goals. Consequently, teacher professional identity is positioned at the core of the teaching profession, shaping their understanding of "how to be," "how to behave," and "how to perceive" their roles and contributions to society (Kompf & Denicolo, 2005).

The development of a professional identity is portrayed as a journey with no fixed path, influenced by both contextual factors and individual experiences (Raveh & Shaharabani, 2019). This formation can occur through teacher preparation, professional development (Dunleavy et al., 2021; Lieberman, 2009), and teaching practices (Horn et al., 2008; Skott, 2019). Teachers forge their professional identities through a nuanced interplay of subject-specific responsibilities, such as planning, teaching, assessing, and reflecting on their practice. This process is intertwined with the broader school environment, where power dynamics and subject positioning within social contexts exert influence and shape teachers' professional journey (Horn, 1957). Teachers' professional identities are significantly influenced by their perspectives on education, evolving over time through lived experiences (Lamote & Engels, 2010; Raveh & Shaharabani, 2019). Identity development for teachers is also linked to creating a narrative about themselves through interactions with others. Particularly for new teachers, their connections with colleagues, students, and families are pivotal in shaping their identities. Successful identity building occurs in professional environments that embrace new perspectives, supported not only by experienced colleagues but also through self-realisation, empowering teachers to navigate difficulties and enhance their resilience (Pearce & Morrison, 2011).

A study conducted by Delima (2015) upheld theoretical assumptions regarding the influence of professional identity and commitment on teacher performance. The study is grounded on the



assumption that teachers' professional identity and professional commitment significantly and positively affect their performance, serving as vital motivational components for effective teaching. Notably, the research uncovered robust positive correlations among professional identity, professional commitment, and teacher performance. Both professional identity and commitment emerge as key factors in moulding teachers, contributing substantially to internal motivation, enthusiasm, and job satisfaction. These elements collectively exert a profound influence on students' educational success. Furthermore, Labbaf et al. (2019) also asserted that a teacher's professional identity significantly impacts the quality of their teaching, which influences students' educational journey.

Conceptual Framework

This study uses Hanna et al.'s (2019) six domains of teacher identity: self-image, motivation, commitment, self-efficacy, task perception, and job satisfaction as a theoretical lens to understand the professional identity of secondary mathematics teachers.

Self-image in Hanna et al.'s (2019) domain explains how and in what way individuals view themselves as teachers (Friesen & Besley, 2013; Hasinoff & Mandzuk, 2005). Self-image can be influenced by interactions with others (Friesen & Besley, 2013), especially interactions with other teachers, parents, mentors, and stakeholders while becoming a teacher (Isbell, 2008). The self-image domain is especially useful for capturing research that explores how teachers understand and describe themselves as teachers.

The second domain described by Hanna et al. (2019) is motivation, which is conceptualised as the impetus to be or become a teacher (Watt & Richardson, 2007). This construct investigates teachers' behaviour, engagement, and willingness to join the profession, and encompasses the desire to be a teacher or to become one in the future (Zhang et al., 2016). Motivation can also be defined as the way in which teachers perceive the value of their jobs and whether they view their work as rewarding or not. The motivation domain is particularly useful for capturing research that investigates how teachers' motivational orientations shape their professional identity development.

The third domain is commitment, or dedication to becoming a teacher (Abu-Alruz & Khasawneh, 2013). This includes the affective side of commitment (Lamote & Engels, 2010), along with normative elements (Canrinus et al., 2011). Hanna et al. (2019) described "normative commitment" with phrases such as "I do not feel any obligation to remain in the teaching profession." More specifically, this domain focuses primarily on teachers' commitment and dedication to remaining in their current positions. It centres on understanding the factors that influence teachers' decisions to stay in their jobs. Studies that examined secondary mathematics teachers' commitment to their jobs and their dedication to remaining in the profession were classified in order to understand teachers' professional identity as part of the commitment domain.

The fourth domain, self-efficacy, is described as a teacher's belief in their ability to effectively organise and perform their daily teaching activities. It is an individual's belief in their capacity and skills as a teacher to act in the ways necessary to reach specific goals (Abu-Alruz & Khasawneh, 2013; Bandura et al., 1999). Studies where researchers measured secondary mathematics teachers' belief in their ability, capacity, and skills as mathematics educators, were classified according to the self-efficacy focus of those studies. The fifth domain, task perception, conceptualises beliefs about what a teacher considers good teaching (Hermans et al., 2008). Broadly, it refers to their feelings about teaching and the duties of a teacher. It involves teachers' belief in their responsibility to contribute to society as one of their professional duties. Studies that measured secondary mathematics teachers' feelings about teaching and their duties, including their belief in their responsibility to contribute to society as part of their professional role, were assigned to the task perception domain.

Hanna et al. (2019) introduced the sixth and last domain, job satisfaction, and defined it as how teachers feel about the school or institution they work for. Job satisfaction is an attitude based on evaluating relevant aspects of the work and work situation, as defined by Canrinus et al. (2011). This domain also considers how teachers perceive their emotional and professional worth in their teaching environments. It accounts for whether teachers feel emotionally drained by their work, or if they



experience a sense of emotional and professional fulfillment in their roles. As with the other domains, the aim was to classify studies that measured secondary mathematics teachers' feelings about the school or institution for which they worked and how they perceived their emotional and professional value in their teaching settings as job satisfaction.

Despite their utility, Hanna et al. (2019) domains have certain limitations. First, the domains do not explicitly account for the deeply sociocultural and situated aspects of identity development, which are central to many qualitative studies in education (Goos, 2005; Goos, 2013). By applying these domains, there is a risk of oversimplifying or imposing rigid classifications onto inherently fluid and context-dependent identity processes. Second, the domains were not originally designed for analysing secondary mathematics teacher identity research. As a result, certain domains, such as job satisfaction, did not emerge prominently in our review, likely because identity research in secondary mathematics education does not often frame identity development in terms of workplace attitudes. However, rather than seeing this as a weakness, using the domains in secondary mathematics teacher identity context presents an opportunity for further interdisciplinary dialogue, incorporating broader perspectives from other fields such as teacher beliefs and affective aspects of teaching. Lastly, while Hanna et al. (2019) domains offer a structured approach for reviewing literature, it may not fully capture the longitudinal and evolving nature of identity development.

Methodology

To examine the process of professional identity development among secondary mathematics teachers a systematic literature review (Borrego et al., 2014; Kitchenham et al., 2009; Tranfield et al., 2003) was conducted using the Preferred Reporting Items for Systematic Meta-Analyses (PRISMA) guidelines (Moher et al., 2009). The review included 51 studies published between 2000 and 2023, selected through this structured search and screening process. The process encompassed three key phases. In the first phase, the research question was formulated and the review protocol designed. The second phase involved evaluating the literature identified based on specific criteria set in the first phase. Finally, in the third phase, the literature sourced was analysed, categorised and synthesised to construct a comprehensive overview of the state of the field during the time frame defined.

Phase 1: Planning the Review

Research questions

The following primary research question was developed to set the scope for the review and guide the selection of search terms.

Overarching Question: *What evidence exists for practices which enhance the development of the professional identity of mathematics teachers?*

To answer this research question, two secondary research questions were developed to focus the analysis of literature returned from the review. In the analysis, two questions were explored before answering the primary research question.

Question 1: *What are the characteristics of practices aimed at developing the professional identity of mathematics teachers?*

Question 2: *What methods and instruments are used to measure the effectiveness of practices that have an impact on mathematics teachers' professional identity?*

Development of review protocol

A review protocol was developed to locate all relevant literature for the review. Table 1 specifies the parameters of the search.



Table 1
Terms Used in Search String

Components	Terms used
Component 1: Compulsory	Teacher*
Component 2: Compulsory	"Professional identity" OR "teacher identity"
Component 3: Compulsory	Develop*
Component 4: Compulsory	Math*
Component 5: Must NOT include	Primary OR elementary

Validation of review protocol

The terms identified for the search string (Table 1) were planned to validate the review protocol, ensuring that only articles relevant to the study objectives were incorporated. Firstly, the terms to be used in the search string for screening of the literature were identified. Secondly, to accommodate syntactic differences in the boundaries, criteria were identified for inclusion in individualised Boolean search strings for use in the database searches. For all the databases, advanced-level search used "Teacher* AND ("professional identity" OR "teacher identity") AND develop* AND math* NOT (primary OR elementary)" as the search string to create the most comparable search across data sources as possible.

Phase 2: Conducting the Review

Identification of relevant research

Database searches conducted on August 14, 2023, generated the results detailed in Table 2. After removing duplicates, 146 articles remained. The full citation details for these 146 articles were then uploaded to Covidence (<http://www.covidence.org>) to facilitate the review process for selecting primary studies. The identification, screening, and inclusion process is illustrated in Figure 1.

Table 2
Number of Results Returned from Database Searches

Database	Field searched	Number of results
EBSCO (All fields)	All fields	138 (77 sent to EndNote as EBSCO automatically removes duplicates)
ProQuest	Anywhere except full text	20
Scopus	Article, abstract, keywords	73
Web of Science	Topic	67
Citation searching	Relevant articles were identified via the reference list of a relevant literature review (Lutovac & Kaasila, 2019)	21
Total records identified		319
Total after duplicates removed		133
Studies screened		146



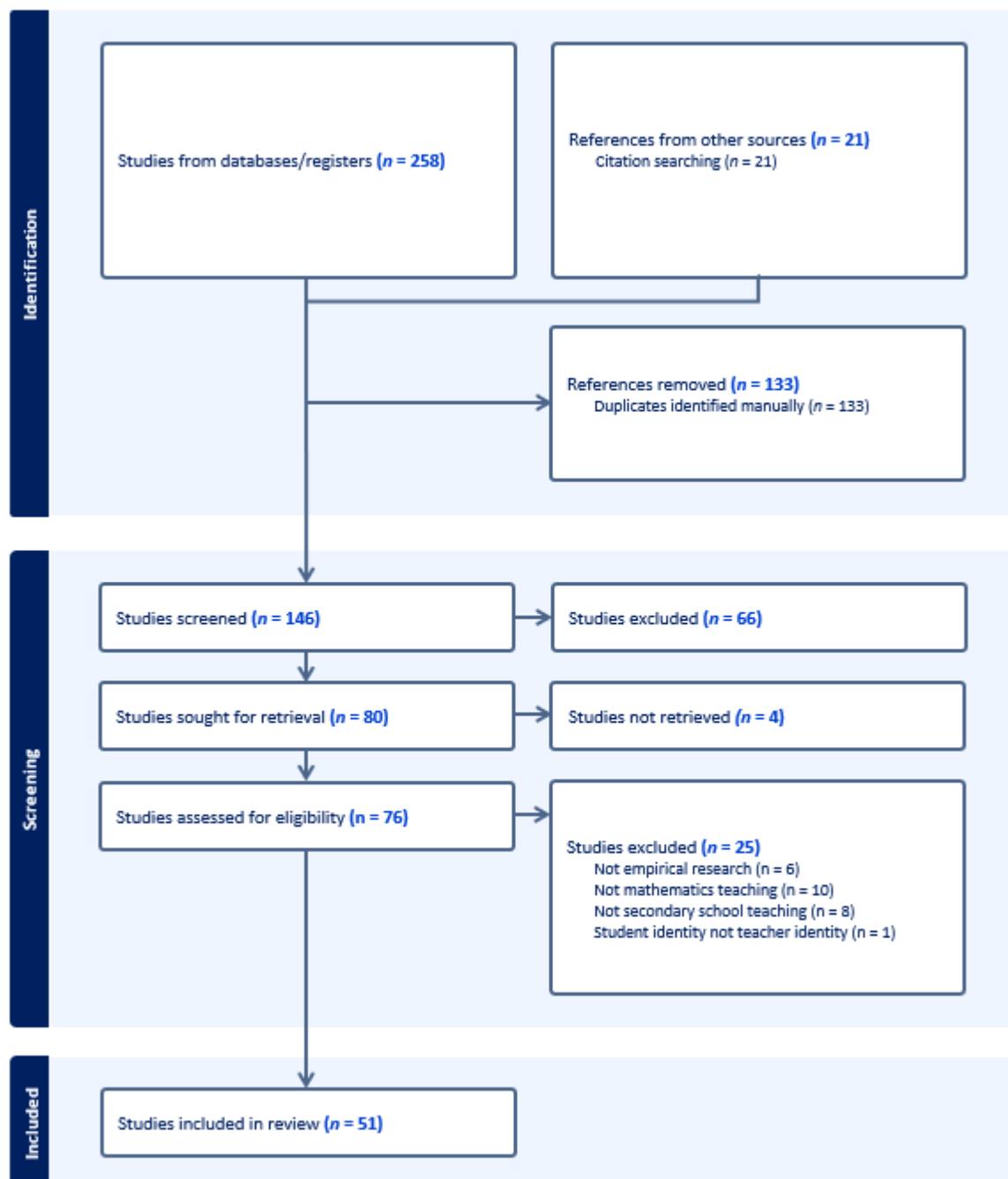


Figure 1. The PRISMA flow diagram of the screening and selection process (Moher et al., 2009).

Selection of primary studies

The screening process first considered the relevance of each article to the review research questions based on article titles and abstracts only. Each article was reviewed by two members of the research team. Where both reviewers were in agreement, the article was removed or retained accordingly. When a disagreement occurred, the article in question was discussed by the research team until a final decision was reached. Relevance was determined based on the inclusion and exclusion criteria detailed in Table 3, which facilitated the identification of studies specifically aimed at secondary mathematics teachers' identity and which described their methods and sample population. This process resulted in the removal of 66 articles deemed irrelevant to the study, leaving 80 articles to be evaluated for eligibility

based on their full text. Again, each paper was reviewed by two members of the research team, following the same process as the initial screening stage.

Table 3
Review Protocol Parameters and Search Sources

Inclusion criteria/scope	Literature exclusively related to the development of secondary mathematics teachers' professional identity. Written in English. Published between 2000-2023. Peer-reviewed.
Exclusion criteria/possible scope creep	Literature focused on teachers of subjects other than mathematics. Literature focused on teachers of mathematics at the elementary or tertiary level. Literature focused on professions other than teaching (e.g., nursing or social work). Not in English. Non-empirical research. Published prior to the year 2000. Not peer-reviewed.

Of the remaining 80 articles, 25 were deemed ineligible and the full text of four others could not be located, leaving 51 articles as relevant. The 51 studies located were primarily published in peer-reviewed journals. Twenty-nine were published in first quartile (Q1) journals, 10 were from Q2 journals, six were from Q3 journals and one was from a Q4 journal according to the SCImago Journal and Country Rankings (SJR: <https://www.scimagojr.com/>). Five articles came from journals with no ranking. As of 29th of September 2023, the articles located had received a combined total of 2958 citations, equating to an approximate average of 58 citations per article. Due to the diversity in publication outlets, these citation counts were obtained from Google Scholar and thus are likely to be overstated due to the inclusion of self-citations.

Phase 3: Extraction and Synthesis of Data

Phase 3 of the systematic review process involved the extraction of data from the studies and an analysis of the data in order to answer the research questions. This section provides the results of the extraction and synthesis. Further analysis of the results as it relates to the research questions together with a broader discussion of their implications are presented in the following section.

The extraction and synthesis of the data were completed manually. The process of analysis involved reading through each paper's definition of professional identity and the way the concept was measured to identify components which aligned with one or more of Hanna et al.'s (2019) six domains. Using deductive analysis, that is, "the structure of analysis is operationalised on the basis of previous knowledge" (Elo & Kyngäs, 2008, p. 109), Hanna et al.'s (2019) domains were used to create nodes and guide the analysis of themes that emerged from each paper. Hanna et al. (2019) originally proposed these domains for quantitative measurement of teacher identity, but they provide a comprehensive conceptual framework encompassing the key dimensions of professional identity relevant across methodologies. These domains are broad and conceptually robust enough to guide the synthesis of qualitative data, allowing for systematic comparison across studies while capturing diverse, context-dependent experiences of mathematics teachers. Using these domains as an analytic lens enabled the study findings to be structured coherently without imposing a rigid quantitative framework, preserving the richness of the nuances inherent in the data. Utilising these domains responds to Lutovac and Kaasila's (2019) call for more research on mathematics teacher identity to be connected to general



education research to avoid isolating mathematics education research from other disciplines and limiting the transfer of knowledge. The following section briefly introduces the domains, beginning with self-image. Figure 2 illustrates how the six domains inform our study's focus and the classification of studies reviewed.

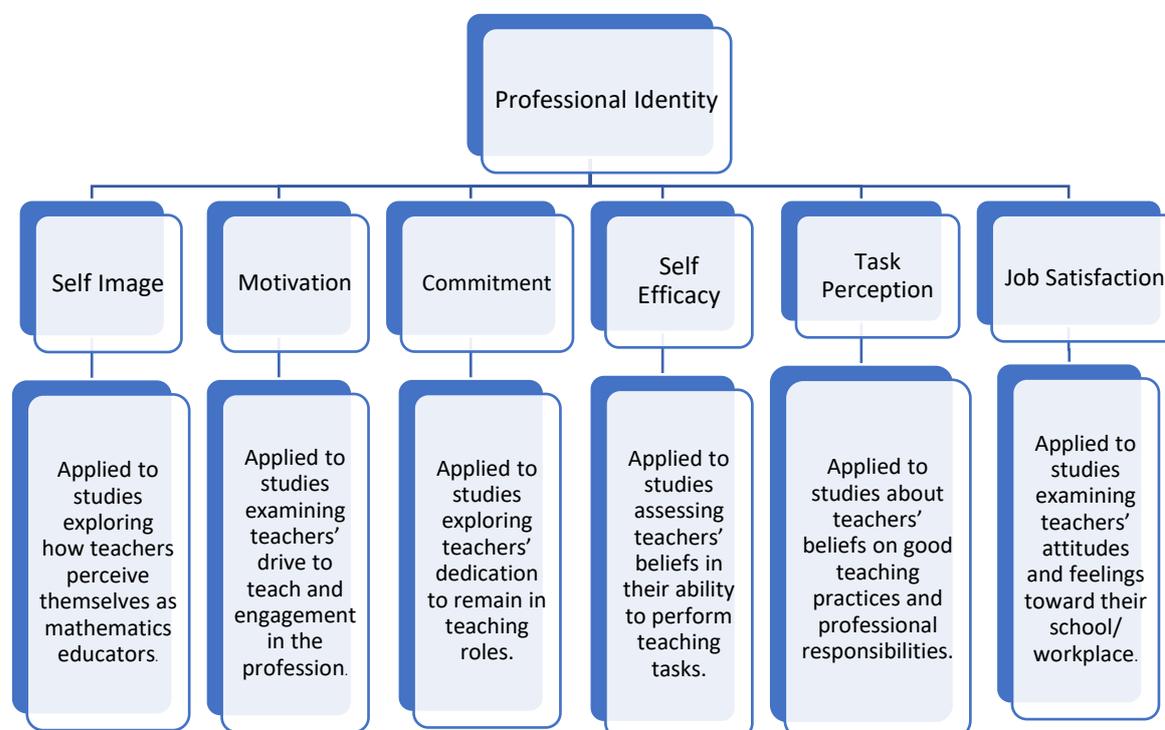


Figure 2. Conceptual framework for secondary mathematics teacher identity.

Data extracted from the 51 studies were also categorised according to each of the two secondary research questions. The initial investigation focused on investigating the characteristics of existing evidence of practices, the career levels of study participants, the domains explored within Hanna et al.'s (2019) research, and the key discoveries. The subsequent phase of the investigation centred on factors such as location, sample size, methodology, methods employed, and theoretical framework.

Although the 51 studies employed diverse methodological approaches, including narrative and ethnographic designs, our synthesis did not treat the studies themselves as uniformly coded units. Instead, the findings and analytic claims reported in each study were coded. This approach is consistent with qualitative synthesis methods that focus on conceptual and thematic convergence across findings, rather than methodological uniformity. By abstracting findings from their original methodological forms, recurring patterns, practices, and conceptual insights can be identified while remaining attentive to contextual variation.

Limitations of the Review

Several limitations should be acknowledged when interpreting the findings of this review. First, although the review synthesised 51 studies, the body of literature is methodologically heterogeneous, with a predominance of narrative, ethnographic, and qualitative designs. This diversity enabled a rich, interpretive synthesis of mathematics teachers' professional identity but it also limited the extent to which findings could be compared or aggregated systematically. The synthesis therefore prioritised conceptual patterns over methodological equivalence, which may have resulted in the underrepresentation of methodological nuances specific to individual study designs. Second, the review relied on reported findings and authors' interpretations rather than re-analysing primary data. As with



all secondary syntheses, this introduces a degree of dependency on the analytical rigor, transparency, and theoretical framing of the original studies. Variations in how professional identity was defined, operationalised, and interpreted across studies may have influenced the synthesis, despite efforts to code findings at the level of meaning units rather than entire studies. Third, although the review sought to identify patterns across diverse contexts, it did not conduct a formal quality appraisal or weighting of studies based on methodological rigor. As a result, all findings included were treated as analytically meaningful, regardless of differences in sample size, duration, or depth of analysis. While this approach aligns with qualitative synthesis traditions (insert citation to support the claim made), it may obscure distinctions among more exploratory studies and those with stronger empirical grounding. Finally, as with all qualitative syntheses, the review is subject to interpretive subjectivity (Broomfield et al., 2024). Although coding and synthesis were conducted systematically, the identification of themes and patterns was inevitably shaped by the researchers' theoretical orientations and interpretive judgments. These limitations suggest that the findings of this review should be interpreted as conceptual and interpretive insights rather than definitive claims about mathematics teachers' professional identity. Acknowledging these constraints underscores the need for more methodologically diverse, longitudinal, and globally inclusive research to advance understanding in mathematics teacher education.

Results and Discussion

Secondary Question 1: What are the characteristics of practices aimed at developing the professional identity of mathematics teachers?

In 26 out of 51 studies (51%), no additional training, coursework, or community practices were implemented to enhance teacher professional identity development. Instead, participants in these studies relied on routine, day-to-day activities that secondary mathematics teachers engage in such as classroom teaching, teacher meetings, and parent-teacher conferences to sharpen their professional identities. In contrast, the remaining 25 out of 51 (49%) studies incorporated targeted interventions. In this context, imposed practices were considered interventions, including professional development programs, mentoring initiatives, initial teacher education (ITE) programs, training, coursework, or other activities that have been introduced into teachers' routine work to support their professional identity development. It is noteworthy that studies without intervention assessed professional identity in both in-service ($n = 16$; 31%) and pre-service ($n = 9$; 18%) teachers. Among these, five studies (10%) specified early-career teachers (Arslan, 2023; Arslan et al., 2021; Nichols et al., 2017; Ntow & Adler, 2019; Olitsky, 2021), one (2%) focused on experienced teachers (Williams, 2011), two (4%) encompassed both in-service and pre-service teachers (Losano et al., 2018; Willis et al., 2021), while the remaining one (2%) did not specify any career level (Willis et al., 2021), indicating a broader applicability across different stages of professional development (see Appendix 1). Please note that some articles fall under multiple classifications, while others could not be categorised using Hanna et al.'s (2019) domains.

Studies were classified as either "with intervention" or "without intervention" based on whether the study introduced a deliberate program or activity specifically designed to influence teachers' professional identity or solely observed the development across time without a specific intervention. This operational distinction ensured that the classification reflected the intentionality and design of the activity in influencing identity, rather than simply the context in which teachers work. Studies involving pre-service teachers were only classified as "intervention" if they included a program that impacted on identity and was evaluated over time; otherwise, the studies were considered "without intervention".

With intervention

These studies implement a structured program or activity explicitly intended to support or accelerate professional identity development. Examples include professional development programs, mentoring initiatives, initial teacher education (ITE) programs, coursework, or other targeted training activities. Studies were classified as "intervention" if they measured identity longitudinally, such as before and after an ITE program or a professional development initiative.



Without intervention

These studies examine identity development in the context of teachers' routine professional activities, without introducing additional programs. Examples include classroom teaching, teacher meetings, parent-teacher conferences, or other day to day professional tasks. These studies focus on naturally occurring changes in identity rather than evaluating the impact of a structured intervention.

Studies which implemented a professional development program as a form of intervention prioritised the use of resources such as explanations, examples, and tasks (Heyd-Metzuyanim, 2019; Kumar & Subramaniam, 2015). They also emphasised learning through observation, reflection, and the analysis of classroom activities. Some professional development programs focused solely on enhancing mathematics content knowledge and pedagogy (Ntow & Adler, 2019). In examining the impact of coursework on professional development, three studies were identified (Crisan & Rodd, 2017; Hossain et al., 2013; Molfino & Ochoviet, 2019). These courses encompassed various elements, including training, enhancement of mathematics content knowledge, and practicum experiences. Additionally, a few studies employed communities of practice as an intervention, involving activities such as regular meetings with a community of teachers, resource analysis, lesson plan development, lesson observation, and subsequent reflection and revision (Cyrino, 2016; Goos & Bennison, 2008; Lieberman, 2009). Six of the studies exclusively assessed the impact of Initial Teacher Education (ITE) programs on the development of professional identity among secondary mathematics teachers (Coddington & Swanson, 2019; de Freitas, 2008; Dunleavy et al., 2021; Friedrichsen et al., 2008; Goos & Bennison, 2008; Marschall, 2022). Within the ITE programs, three studies adopted unique approaches to support teachers in identity development, which involved identity-based activities, fieldwork, and professional development practices (Coddington & Swanson, 2019; Dunleavy et al., 2021; Goos & Bennison, 2008). Other interventions included subject knowledge enhancement programs, curriculum changes, class observations, and mentoring (Çelikdemir & Haser, 2024; Mosvold & Bjuland, 2016; Nichols et al., 2017; Olitsky, 2021; Woolhouse & Cochrane, 2015).

As detailed in Appendix 1, 10 studies (20%) with interventions focused on in-service teachers (including two studies focusing on early career teachers, while the rest did not specify experience levels), 12 studies (24%) focused on pre-service teachers, and two studies (4%) included both pre-service and in-service teachers. The duration of these interventions varied significantly, ranging from 20-40 days (Crisan & Rodd, 2017) to 5 years (Lieberman, 2009). Only two interventions (4%) were conducted for less than a month (Mosvold & Bjuland, 2016; Nichols et al., 2017). While in some cases, it was challenging to ascertain the exact duration of the intervention, eight interventions (16%) were explicitly described as lasting at least 1 year (Andersson, 2011; Arslan et al., 2021; Friedrichsen et al., 2008; Goos, 2005; Goos & Bennison, 2008; Hanley & Darby, 2006; Marschall, 2022; Olitsky, 2021), with one intervention extending for a 5-year duration (Lieberman, 2009).

Across the majority of studies, the development of self-image, a pivotal aspect within Hanna et al.'s (2019) first domain, took centre stage in discussions on teachers' professional identity. These studies inquired into participants' perceptions and emotions as teachers, elucidating how they define and identify themselves, particularly in terms of their self-perception as educators. The studies primarily focusing on self-image also explored the impact of interactions with others, especially with other teachers, parents, mentors, and stakeholders along the journey of becoming a mathematics teacher. Following closely, task perception emerged as the second most emphasised aspect of professional development, which was subsequently trailed by self-efficacy, commitment, and motivation. Notably, the discussion on job satisfaction was absent across all studies, suggesting a lack of attention to how teachers perceive their schools or institutions. The studies overlooked the assessment of teachers' emotional and professional well-being within their teaching environments, neglecting to explore whether teachers experience emotional strain in their work or find a sense of emotional and professional fulfillment in their roles.

It is worth noting that approximately 22 (43%) studies were solely focused on one aspect of identity development, predominantly on self-image and task perception, while the remainder explored multiple domains of professional development. In the 19 (37%) studies with no intervention, participants



generally reported positive growth in their self-image. Likewise, 15 (29%) studies revealed that participants experienced a positive development in their self-image after undergoing an intervention. Conversely, nine studies (17%) with intervention indicated that participants made notable strides in their task perception. Additionally, in nine studies (17%), participants' task perception underwent positive changes that influenced their professional identity in the absence of intervention. Whether with or without intervention, however, attention to self-efficacy, commitment, and motivation appeared relatively less prominent.

The studies that could not be categorised within Hanna et al.'s (2019) domains are listed below (Table 4). A brief overview of their findings revealed that these interventions primarily concentrated on enhancing teachers' proficiency in various facets, including fostering cultural mathematical thinking (Owens, 2014), utilising technology (Chronaki & Matos, 2014; Goos, 2005), fostering active learning (Goos, 2013), and encouraging critical thinking (Hanley & Darby, 2006). The studies encompassed both in-service and pre-service teachers, embracing those in the early stages of their careers as well as those with extensive experience.

Table 4
Studies Not Categorised Within Hanna's Teacher Identity Domains

Study	Type of Interventions	Career level	Key findings
Owens (2014)	Self-reflective report	Pre-service and in-service	Reflecting on one's culture in relation to mathematics aided in identity development.
Chronaki and Matos (2014)	Technology-based mathematics teaching training (3 months)	In-service	Learning to incorporate technology in mathematics teaching was found to develop teacher identity.
Goos (2005)	Initial teacher education course (4 years)	Pre-service	Learning to incorporate technology in mathematics teaching was found to develop teacher identity.
Hanley and Darby (2006)	Curriculum innovation (1 year)	In-service (experienced and early career)	Curriculum innovation does not change previously held views but allows teachers to critically analyse their views.
Essien (2014)	No intervention	Pre-service	It was found that pre-service teachers were being taught to become learners of mathematics content rather than teachers of mathematics content.
Goos (2013)	Promoting change in their teaching style	In-service	It was found that tensions between teachers' beliefs, contexts, and goals were a trigger for learning and development.
Ntow and Adler (2019)	Professional development (10 months)	Early career	Professional development resources influenced teachers' development of practice-linked mathematics teacher identities.
Pipere and Mičule (2014)	No intervention	In-service	The study identified major features of teachers' mathematics identity.
Rodrigues et al. (2022)	Supervised Curricular Teaching Practice (2 years)	Pre-service	Experiences of vulnerability were found to trigger pre-service teachers to exercise their sense of agency and therefore trigger professional identity development.



Secondary Question 2: What methods and instruments are used to measure the effectiveness of practices that have an impact on mathematics teachers' professional identity?

Methodologically, the studies reviewed relied predominantly on narrative, ethnographic, and cross-sectional qualitative research designs ($n = 46$, 90%, including 12 longitudinal studies). Qualitative methods, in particular, provide rich, contextualised insights into the processes, experiences, and meanings that underpin teachers' professional identity development (Lutovac & Kaasila, 2019). This methodological emphasis aligns with theoretical understandings of professional identity as a dynamic, relational, and socially situated construct that is continuously shaped through experience, reflection, and interaction within specific contexts (Beauchamp & Thomas, 2009). From this perspective, identity is not a fixed or stable variable but a process of meaning-making, often expressed through narratives that capture how teachers interpret and negotiate their professional roles over time (Sfard & Prusak, 2005). These approaches allow researchers to capture the complexity, nuance, and individuality of teachers' experiences in ways that quantitative measures alone may not achieve. While quantitative approaches can identify patterns, trends, or associations related to identity, they are less able to access these interpretive, contextual, and narrative dimensions of identity construction, which are central to understanding professional identity development (Creswell, 1998; Denzin, 2001). Although these approaches provide valuable insights into teachers' lived experiences, there remains a notable lack of longitudinal and mixed-methods research capable of tracing how professional identity develops, stabilises, or shifts over time in response to changing professional contexts, interventions, and career stages. Only two (4%) mixed-methods studies (Matthews, 2020; Woolhouse & Cochrane, 2015) and three (6%) quantitative studies (Polizzi et al., 2021; Willis et al., 2021; Yeigh et al., 2023) were identified during the review. Quantitative designs, including quasi-experiments with control groups, can suggest trends or associations and provide some insight into causal relationships (Gopalan et al., 2020; Randler & Bogner, 2008), but are limited by confounding factors, self-report biases, and constraints on generalisability. Therefore, both qualitative and quantitative data are valuable and complementary, with qualitative approaches being particularly essential for understanding the depth and richness of identity development.

The studies reviewed utilised a diverse array of instruments and methods to assess mathematics teachers' professional identity, including surveys, interviews, observations, focus group discussions, work samples, and written reflections (see Appendix 2). This diversity in approaches reflects the complex, multifaceted nature of professional identity, which is influenced by numerous contextual, social, and personal factors. Consequently, comparing results across studies was challenging, particularly given differences in theoretical frameworks and methods of data analysis, some of which relied on subjective interpretation (van den Hurk et al., 2019). For example, while multiple theoretical frameworks were employed, there was limited cumulative theoretical development. Many studies adopted identity as a descriptive construct rather than advancing or critically interrogating theoretical models of professional identity specific to mathematics teacher education. Greater theoretical integration and dialogue across studies would strengthen conceptual coherence in the field.

Geographically, the literature is unevenly distributed, with a concentration of studies conducted in specific regions and educational systems. The majority of studies were conducted in the United States (14, 27%), followed by England (9, 17%), Australia (7, 13%), Turkey (4, 8%), and South Africa (3, 6%). Countries like Brazil, Greece, Sweden, India, Norway, Latvia, Denmark, Finland, Papua New Guinea, and Uruguay have also contributed to research on the professional identity of secondary mathematics teachers, although each of these nations produced only one (2%) dedicated study. This imbalance limits the field's capacity to make broader claims about mathematics teacher identity across diverse cultural, policy, and institutional contexts. Comparative and cross-cultural studies remain underrepresented and would offer important insights into both shared patterns and context-specific challenges and influences.

The number of participants also varied considerably, ranging from one to 612. The majority (33, 65%) of studies had fewer than 10 participants, which may limit the generalisability of findings. Small samples can lead to higher variability and make it difficult to draw strong conclusions or detect



meaningful patterns (insert citation). The wide range in sample sizes (from 1 to 612) may impact the comparability of results across studies. Only 14% (7) of studies had more than 100 participants, indicating that large-scale, generalisable research is limited in this area (see Appendix 2). Larger samples tend to produce more reliable and replicable findings (insert citation), so the lack of such studies about teacher identity could be a gap in the research field. The review further revealed insufficient attention to intersectional factors in terms of teacher subgroups, such as gender, ethnicity, socio-economic background, career stage, and employment status. Early-career teachers, teachers working in marginalised or under-resourced contexts, and those experiencing professional vulnerability (e.g., low self-efficacy or role conflict) remain particularly under-studied in terms of teacher identity.

Primary Research Question: What evidence of practices exists to advance mathematics teachers' professional identity?

Synthesising and identifying commonalities across the diverse body of studies proved challenging. This difficulty stemmed largely from the widespread use of qualitative data, which resulted in a lack of standardised measures for examining consistently the evolution of teachers' professional identities. The multifaceted nature of professional identity further ensures that its evolution remains a dynamic and deeply personalised journey for every mathematics educator. While several studies reported positive developments in teachers' professional identity (e.g., Çelikdemir & Haser, 2024; Cyrino, 2016; de Freitas, 2008), including shifts in self-image (e.g., Horn et al., 2008; Kumar & Subramaniam, 2015), task perception (e.g., Coddington & Swanson, 2019; Molfino & Ochoviet, 2019), and self-efficacy (e.g., Olitsky, 2021; Yeigh et al., 2023), both with and without targeted interventions, the specific evidence of practices behind these initiatives remain insufficiently understood.

Some practices were less formally structured, instead relying on sustained engagement with routine teaching experiences (e.g., Dalby & Noyes, 2022; Hobbs, 2012; Olitsky, 2021), such as engagement in communities of practice (e.g., Dalby & Noyes, 2022). This spontaneous approach gradually nurtured the development of professional identity among secondary mathematics educators, emphasising the significance of hands-on, practical involvement in real classroom contexts. The details and nuances of professional identity were clearly apparent in these practices, including teachers' self-image (e.g., Heyd-Metzuyanim, 2019; Kumar & Subramaniam, 2015), motivation (Willis et al., 2021; Yeigh et al., 2023), professional commitment (e.g., Hobbs, 2012, 2013), beliefs about their teaching capabilities (e.g., Johnson, 2020; Kumar & Subramaniam, 2015), and perception about mathematics teaching (e.g., Arslan, 2023; Arslan et al., 2021). Other practices ranged from specialised courses tailored to specific subject matters (e.g., Crisan & Rodd, 2017; Molfino & Ochoviet, 2019; Ponte et al., 2002), to comprehensive training programs (e.g., Chronaki & Matos, 2014) and interactive community practices (e.g., Cyrino, 2016). The various studies represent the diversity of approaches that enhance the professional identity of both pre-service and in-service mathematics teachers.

These findings suggest that future research on mathematics teachers' professional identity would benefit from greater methodological coherence, particularly through clearer articulation of the practices that underpin identity change. While qualitative approaches remain essential for capturing the personalised and dynamic nature of professional identity, greater attention is needed to explicitly document and theorise how everyday (routine) teaching practices and formal interventions contribute to shifts in identity development. The prominence of informal, practice-based learning highlights the importance of sustained engagement in routine teaching experiences, alongside structured professional learning opportunities. In line with previous research, our results reinforce the widely recognised view that professional identity development is continuous, situated, and shaped through teachers' ongoing experiences, rather than produced through lone professional development initiatives (Ivanova & Skara-Mincline, 2016; Mackay, 2017; Suarez & McGrath, 2022).



Conclusions

The findings of this review have several important implications for mathematics teacher education practice and policy. Existing literature on the vital importance of professional identity formation, Initial Teacher Education (ITE) programs and ongoing professional development should intentionally create spaces for identity exploration, reflection, and negotiation, enabling teachers to examine how their beliefs about mathematics, teaching, and learners evolve over time. For this reason, it could be valuable for mathematics ITE programs to show pre-service teachers how to utilise structured reflective practices, such as reflective journals, mentoring conversations, and collaborative inquiry, to support them in articulating and critically examining their professional identities from the early stages of their career (de Freitas, 2008). These practices can help teachers make sense of tensions between personal beliefs, institutional expectations, curriculum demands, and accountability pressures that often shape mathematics teaching. The findings of this research suggest that positive shifts in self-image, task perception, and self-efficacy highlight the importance of sustained professional learning opportunities, rather than isolated program or training. Therefore, policy frameworks should prioritise long-term, school-embedded professional development, including mentoring, coaching, and professional learning communities, that support ongoing identity development across career stages.

In terms of research gaps, this literature review has found very limited attention being placed to address the challenges of under-represented teacher subgroups. This highlights the importance of this type of research being undertaken, and perhaps a need to explore equity-oriented policies in mathematics teacher education. Indeed, ITE programs and government policies may explicitly address the needs of early-career teachers, teachers working in disadvantaged or marginalised contexts, and those experiencing low self-efficacy. Integrating intersectional perspectives into teacher education curricula has the potential to better prepare teachers to navigate identity-related challenges linked to gender, ethnicity, and socio-economic background. Furthermore, the lack of longitudinal research evidence suggests a need for policy support for long-term evaluation and research-informed practice in mathematics teacher education. Funding and institutional policies that enable longitudinal tracking of teacher development would provide opportunities to gather valuable insights into how identity formation relates to teacher retention, instructional quality, and student outcomes over time.

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Competing interests

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Appendix 1

Summary of Characteristics of the Studies Reviewed

Study	Intervention Duration	Career Level	Focus of the Study	Key Findings
Arslan (2023)	No intervention	Early career	Task perception	Negative emotional experiences were found to limit beginning teachers' identity development.
Arslan et al. (2021)	Challenging beliefs (1 year)	Early career	Task perception	A teaching environment that challenges one's beliefs may shape teacher identity development.
Cyrino (2016)	Community of Practice (10 months)	In-service and pre-service	Task perception	Eight elements that promoted professional identity development were identified.
Ponte et al., (2002)	ICT course (1 semester)	Pre-service	Task perception	Pre-service teachers developed new perspectives and values around the use of ICT in teaching.
(Kim, 2018)	No intervention	In-service	Task perception	Factors that shape teacher identity were identified, such as beliefs around practice and challenges in developing practice.
Nichols et al. (2016)	No intervention	Early career	Task perception	Emotional classroom experiences were identified as identity development work.
Çelikdemir and Haser (2024)	Observing experienced teachers (1 semester)	Pre-service	Task perception	Participants showed increased self-awareness and understanding of the complexity of teaching math.
Boylan and Woolsey (2014)	No intervention	Early career	Task perception	A teacher's relationship with social justice was recognised as a factor in shaping teacher identity.
Heyd-Metzuyanım (2019)	Professional development (1 year)	In-service	Task perception Self-image	The PD program caused a shift in identity, but the teacher's self-described identity was misaligned with their teaching practices.
Kumar and Subramaniam (2015)	Professional development (5 months)	In-service	Task perception Self-efficacy Self-image	The PD program altered how teachers perceive themselves and the role of textbooks in their teaching.
De Freitas (2008)	Course-based research project (duration not stated)	Pre-service	Task perception Self-image	Pre-service teachers developed critical awareness.
Horn et al. (2008)	No intervention	Pre-service	Self-image Task perception	Identity development was shaped by learning and early teaching experiences.
Portaankorva-Koivisto and Grevholm (2019)	No intervention	Pre-service	Self-image Task perception	Student teachers were found to view their teacher identity as incomplete.
Matthews (2020)	No intervention	In-service	Self-image Task perception	Two categories of teachers' formative experiences were identified: personal initiative (lower student outcomes) and people support (higher student outcomes).



Study	Intervention Duration	Career Level	Focus of the Study	Key Findings
Molfino and Ochoviet (2019)	Postgraduate training course (length not stated)	In-service	Self-image Task perception	A strong intent to change teaching practices led to a change in identity.
Coddington and Swanson (2019)	Fieldwork and professional development (over 100 hrs PD and 60 hrs fieldwork)	Pre-service	Self-image Task perception Commitment	Structured opportunities to reflect on visions of oneself as a future teacher may lead to early development of identity.
Johnson (2020)	No intervention	Pre-service	Self-image Task perception Self-efficacy	The case study was found to see his teacher identity as 'teacher as advocate'.
Skott (2019)	No intervention	Early career	Self-image	The teacher transitioned from identifying primarily as a maths teacher to a schoolteacher.
Adams (2017)	No intervention	In-service	Self-image	Experience with professional learning helps situate oneself within the maths teaching community.
Akkoç et al. (2014)	No intervention	Pre-service	Self-image	Kegan's theory was found to work as an operational tool to analyse identity.
Andersson (2011)	No intervention	In-service	Self-image	The findings describe a teacher's identity development as she attempts to change her teaching style.
Crisan and Rodd (2017)	Retraining course (20-40 days)	In-service, out-of-field teachers	Self-image Motivation	A new framework for maths teacher identity was developed.
Williams (2011)	No intervention	In-service (experienced)	Self-image	Presents the narratives and identities of two teachers in the context of figured worlds theory.
Dunleavy et al. (2021)	Identity-based activities (1 year)	Pre-service	Self-image	Pre-service maths teachers incorporate their identities into their maths teaching.
Friedrichsen et al. (2008)	Alternative certification program (15 months)	Pre-service	Self-image	Three degrees of teacher identity were identified.
Goos and Bennison (2007)	Online community of practice (16 months)	Pre-service/early career	Self-image	The online community of practice for pre-service mathematics teachers contributed to the teachers' defining their own professional goals and values.
Hossain et al. (2013)	Mathematics Enhancement Course (6 months)	Pre-service (non-mathematics graduates)	Self-image	The findings describe the identity development work of two prospective mathematics teachers.
Kasten et al. (2014)	No intervention	Pre-service	Self-image	Three primary contexts for understanding teacher identities were identified.
Lieberman (2009)	Lesson study (5 years)	In-service	Self-image	A learning community was found to contribute to professional identity development.



Study	Intervention Duration	Career Level	Focus of the Study	Key Findings
Losano et al. (2017)	No intervention	Pre-service/early career	Self-image	The findings describe the development of one teacher's professional identity during the first year of teaching.
Mandt and Afdal (2022)	No intervention	Pre-service	Self-image	Ethics and values were found to play a major role in professional identity development.
Woolhouse and Cochrane (2015)	Subject Knowledge Enhancement program (1 year)	Pre-service	Self-image	Pre-service teachers began to identify themselves as part of a community of practice rather than a newcomer or apprentice.
Mosvold and Bjuland (2016)	Mentoring (length not stated)	Pre-service	Self-image	The findings illustrate how pre-service teachers identify themselves compared with how their mentors describe them.
Dalby and Noyes (2022)	No intervention	In-service	Self-image	The findings suggest professional learning may be improved by the development of more effective communities of practice.
Willis et al. (2021)	No intervention	Did not specify career levels	Self-image Self-efficacy Motivation	The study developed a measure of mathematics teacher identity development.
Olitsky (2019)	No intervention	Early career	Self-image Self-efficacy	Self-talk was found to be an effective strategy for teachers to foster a positive professional identity when faced with challenges.
Polizzi et al. (2021)	No intervention	In-service	Self-image Self-efficacy	Mathematics teachers report smaller communities of practice, a lower sense of identity, and lower self-efficacy than other teachers.
Yeigh et al. (2023)	No intervention	In-service	Self-image Self-efficacy Motivation	The study found a positive correlation between results on the Teacher of Mathematics Identity scale and wellbeing.
van Putten et al., (2014)	No intervention	Pre-service	Self-efficacy Self-image	An incongruence between teachers' perceptions of their identity and the manifestation of their identity in the classroom was identified.
Marschall (2021)	ITE program (1 year)	Pre-service	Self-efficacy Self-image	Identity development was found to directly affect self-efficacy appraisal.
Hobbs (2013)	No intervention	In-service	Self-image Commitment Self-efficacy	The study developed the Boundary Between Fields model.
Hobbs (2012)	No intervention	In-service	Commitment Self-image	Teachers' appreciation for their subjects was found to be related to their identity.



Appendix 2

Methods and Instruments Used to Measure the Effectiveness of Practices



Study	Location	Sample Size	Methodology and Methods	Theoretical Framework
Arslan (2023)	Turkey	7	Qualitative (written diaries)	The OCC theory.
Arslan et al. (2021)	Turkey	2	Longitudinal qualitative (interviews, observations)	Wenger's (1998) Social Theory of Learning.
Cyrino (2016)	Brazil	7	Qualitative (work samples, field notes, audio recordings of sessions)	Communities of Practice.
Ponte et al. (2002)	Portugal	94	Qualitative (observations, discussions, reflections, questionnaire)	Institutional worlds (Berger & Luckman, 1966) and social identities (Dubar, 1997).
Kim (2018)	United States	4	Qualitative (observations, surveys, interviews)	Post-structural and dialogical approaches to identity.
Nichols et al. (2017)	United States	8	Qualitative (interviews)	Emotions and identity
Çelikdemir and Haser (2024)	Turkey	12	Qualitative (semi-structured interviews)	Beijaard et al. (2000) teacher identity model
Boylan and Woolsey (2015)	England	18	Qualitative (survey, interviews)	Social justice teacher identity, determinate identity, sociocultural view of identity.
Heyd-Metzuyanım (2019)	United States	1	Longitudinal qualitative (observations, interviews)	Exploration and acquisition pedagogical discourses (EPD and APD). Commognitive framework.
Kumar and Subramaniam (2015)	India	4	Qualitative (reported classroom experiences, classroom observations)	Relation between the perceived role of the teacher, the textbook, and teachers' professional identity.
De Freitas (2008)	United States	12	Qualitative (classroom observations, assignments)	Walshaw's (2004) concept of mathematics teacher identity development.
Horn et al. (2008)	United States	8	Longitudinal qualitative (observations and interviews)	Holland et al.'s (1998) concept of figured worlds and Lave et al.'s (1984) concept of arenas and settings as contexts for learning.
Portaankorva-Koivisto and Grevholm (2019)	Finland	188	Qualitative (written metaphor)	Beijaard et al.'s (2000) tripartition of teachers as subject matter experts, didactical experts, and pedagogical experts, expanded with two additional categories, self-referential and contextual.
Matthews (2020)	United States	15 teachers and 329 students	Mixed methods (semi-structured interviews, classroom observations, questionnaires, student maths achievement)	The Dynamic Systems Model of Role Identity (Kaplan & Garner, 2017).
Molfino and Ochoviet (2019)	Uruguay	9	Qualitative (written logs, reflective narratives, classroom observations)	Sfard and Prusak's (2005) definition of identity. Bjuland et al.'s (2012) four indicators of professional identity.



Study	Location	Sample Size	Methodology and Methods	Theoretical Framework
Coddington and Swanson (2019)	United States	16	Qualitative (written reflections, semi-structured interviews)	Wenger's (1998) communities of practice and Cobb et al.'s (2009) conceptualisation of normative and personal identity.
Johnson (2020)	United States	1	Qualitative (narrative inquiry interviews)	The National Research Council's (2001) conception of mathematical proficiency and Martin's (2007) definition of mathematics identity.
Skott (2019)	Denmark	1	Longitudinal qualitative (observations, semi-structured interviews)	Patterns of Participation.
Adams (2017)	England	1	Qualitative (semi-structured interviews)	Theories of teacher professional learning and identity
Akkoç et al. (2014)	Turkey	1	Qualitative (semi-structured interview)	Kegan's (1982) constructive-development theory.
Andersson (2011)	Sweden	1	Longitudinal qualitative (interviews, informal communication)	Socio-cultural-political perspective.
Crisan and Rodd (2017)	England	47	Qualitative (questionnaires, mathematical work samples, written reflections, interviews, class observations)	"Modes of Belonging" Mathematics Teacher Identity framework, adapted from Wenger's (1998) social ecology of identity.
Williams (2011)	England	2	Qualitative (interviews)	Holland et al.'s (1998) figured worlds.
Dunleavy et al. (2021)	United States	3 teacher educators and their students	Qualitative (work samples)	Black feminist thought (Collins, 2002). Multi-dimensional reflexive framework.
Friedrichsen, et al. (2008)	United States	19	Longitudinal qualitative (semi-structured interview, course application materials, course artifacts).	Wenger's (1998) social theory of learning.
Goos and Bennison (2007)	Australia	19	Longitudinal qualitative (unstructured online communications, semi-structured group interview)	Wenger's (1998) community of practice theory.
Hossain et al. (2013)	England	2	Qualitative (semi-structured interviews)	Post-structural approach to "understanding mathematics in-depth" (UMiD; Davies & Harre, 1990)
Kasten et al. (2014)	United States	68	Qualitative (questionnaire)	Context specific identities. Sfard and Prusak's (2005) notion that identity can be thought of as "collections of stories about persons."



Study	Location	Sample Size	Methodology and Methods	Theoretical Framework
Lieberman (2009)	United States	7	Qualitative (observations of lesson study planning meetings, interviews, work samples)	Learning communities.
Losano et al. (2017)	Argentina	1	Longitudinal qualitative (written narratives, semi-structured interviews)	Holland et al.'s (1998) concept of figured worlds.
Mandt and Afdal (2022)	Norway	10	Qualitative (narrative inquiry interviews)	Ricoeur's (1992) theory of identity and Schatzki's (2010) theory of timespace of human activity.
Woolhouse and Cochrane (2015)	England	159	Mixed methods (surveys, focus group discussions)	Lave and Wenger's (1991) concept of participation in communities of practice.
Mosvold and Bjuland (2016)	Norway	2	Qualitative (interviews, observations)	Sfard and Prusak's (2005) narrative approach to identity and Davies and Harré's (1990) positioning theory.
Dalby & Noyes (2022)	England	32	Qualitative (interviews, focus groups, survey)	Wenger's (1999) communities of practice.
Willis et al. (2021)	Australia	612	Cross-sectional quantitative (survey)	Teacher of Mathematics Identity (ToMI) scale
Olitsky (2019)	United States	2	Longitudinal qualitative (semi-structured interviews, observations, reflection journals, surveys)	Identity & community. Professional community & interaction ritual. Structure, agency, and self-talk.
Polizzi et al. (2021)	United States	165	Cross-sectional quantitative (survey)	Communities of Practice.
Yeigh et al. (2023)	Australia	402	Cross-sectional quantitative (survey)	ToMI and Identity-based Motivation (IBM) theory.
van Putten et al. (2014)	South Africa	6	Qualitative (semi-structured interviews, classroom observations)	Beijaard et al.'s (2000) model of teacher identity.
Marschall (2022)	England	1	Longitudinal qualitative (written reflections, lesson observations, interviews,	Bandura's (2007) definition of self-efficacy and a socio-psychological perspective on identity as a dynamic narrative (Sfard & Prusak, 2005).
Hobbs (2013)	Australia	23	Qualitative (interviews)	Teaching out-of-field as a boundary-crossing event.
Hobbs (2012)	Australia	3	Longitudinal qualitative (observations, interviews, focus group discussions)	Aesthetic understanding inspired by Dewey, 1934/1980.
Owens (2014)	Papua New Guinea	239	Qualitative (document analysis)	Framework for developing identity as a mathematical thinker (Owens, 2007/2008).
Chronaki and Matos (2014)	Greece	7	Qualitative (observations, semi-structured interviews)	Discourse theory



Study	Location	Sample Size	Methodology and Methods	Theoretical Framework
Essien (2014)	South Africa	4	Qualitative (observations)	Wenger's (1998) notion of identity in practice.
Goos (2005)	Australia	4	Qualitative (classroom observations, interviews, work samples)	Valsiner's (1997) zone theory.
Goos (2013)	Australia	3	Longitudinal mixed methods (semi-structured interviews, questionnaire, lesson observations)	Valsiner's (1997) zone theory.
Hanley and Darby (2006)	England	4	Qualitative (interviews)	Post-structuralist framework, contemporary socio-cultural theory
Ntow and Adler (2019)	South Africa	2	Qualitative (observations, semi-structured interviews)	Nasir and Cooks' (2009) constructs of ideational, material, and relational identity resources.
Pipere and Mičule (2014)	Latvia	3	Qualitative (semi-structured interviews)	Mathematical identity from different identity positions in the context of the dialogical self (Ligorio & Cesar, 2021).
Rodrigues et al. (2022)	Brazil	10	Qualitative (lesson plans, teaching observations, discussions)	Movement of construction of maths teachers' professional identity, experiences of vulnerability in teaching.

