



Mapping Teacher Competencies Associated with Teacher Certification: A Systematic Review

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ABSTRACT

This study aims to systematically map teacher competencies related to teacher certification and address fragmented understanding of how certification aligns with contemporary competency requirements. Using the PRISMA approach, 723 articles were identified from the Scopus database, and 16 empirical studies selected following a rigorous screening process. The findings indicate that teacher certification is primarily associated with professional and pedagogical competencies, reflecting its primary function in ensuring the quality of basic instruction. Pedagogical Content Knowledge (PCK) emerges as a key mechanism linking certification to teaching effectiveness. However, competencies that are increasingly critical in modern education such as social, motivational, and digital competencies remain underrepresented in the literature. This imbalance highlights a mismatch between certification systems and the evolving demands of 21st-century education. The findings indicate that the effectiveness of certification varies across educational contexts and is strongly influenced by policy design, institutional capacity, and the integration of continuous professional development. This study contributes by presenting a structured competency mapping and identifying a conceptual shift from certification as a compliance-based mechanism toward a competency development oriented system. The results provide practical implications for policymakers and educational institutions to design certification systems that are more adaptive, integrated, and aligned with future competency demands.

1. Introduction

The quality of education is largely determined by the quality of teachers, who are key actors in the learning process. Recent research confirms that teachers' contributions to student learning outcomes outweigh other school-related factors, particularly when teaching practices align with dynamic and diverse learning needs

(Darling-Hammond et al., 2017; Juniar, 2022; OECD, 2018). In the 21st-century educational landscape, the role of teachers has shifted from that of knowledge transmitters to facilitators of adaptive, collaborative, and technology-based learning. This shift requires mastery of multidimensional competencies, including pedagogical, professional, digital, and communication competencies, as well as socio-emotional skills that support meaningful learning and inclusion (Broos et al., 2020; Caena & Redecker, 2019; Rosyida et al., 2022).

In line with these demands, recent research indicates that the competencies of future teachers are concentrated in four main areas: digital technology skills, communication, lifelong learning, and socio-emotional skills (Ratnasari et al., 2022; Zainor et al., 2025). These domains do not stand alone but are interconnected in shaping effective teaching practices, particularly in the context of technology integration and differentiated instruction (Instefjord & Munthe, 2017; Twining et al., 2017). However, several studies also report a gap between the competencies required and those possessed by teachers, particularly regarding technology integration and adaptive competencies, which limits learning innovation (Broos et al., 2020; De Witte et al., 2015; Lesatri et al., 2022). This gap underscores the urgency of policies and interventions that are not merely administrative but genuinely promote the development of teachers' competencies.

In the policy context, teacher certification has long been used as a tool to ensure standards of professionalism and teacher quality. Certification serves as a mechanism for validating qualifications, ensuring quality, and signaling competence within the education system (Darling-Hammond et al., 2017; Kajsa & Johansson, 2026). Empirically, various studies report that certified teachers tend to show improvements in indicators such as motivation, performance, and professionalism (Bushra et al., 2024; Kamalia et al., 2022). Findings in the context of developing countries, including Indonesia, also indicate a positive relationship between certification, work motivation, and teacher performance, although the magnitude of the effect varies and is influenced by policy design and institutional support (Purwanti & Zarger, 2025; Tjabolo & Herwin, 2020).

Nevertheless, the effectiveness of certification as a driver of teacher quality remains a subject of debate. Several studies indicate that certification is correlated with improvements in teaching practices and student learning outcomes, but other studies have found that certification does not consistently reflect actual improvements in classroom competence (Akuma & Callaghan, 2020; Xuanyun et al., 2024). In fact, a recent research emphasizes that the impact of certification is contingent influenced by the quality of implementation, school leadership, and the continuity of professional development (CPD) (Bushra et al., 2024). In other words, certification does not operate in a vacuum; its effectiveness depends on the accompanying ecosystem of policies and practices (Kraft et al., 2018). Therefore, evaluating the effectiveness of teacher certification requires a more nuanced understanding that considers both its outcomes and the contextual conditions shaping its implementation.

On the other hand, research on teacher competencies is growing rapidly, particularly in identifying competency dimensions relevant to 21st-century learning, such as digital, communication, and socio-emotional competencies (Broos et al., 2020; Caena & Redecker, 2019). However, this mainstream research tends to be separate from the certification literature. While certification studies largely focus on outcomes (performance, motivation, learning outcomes), competency studies place greater emphasis on what competencies matter without explicitly linking them to policy mechanisms such as certification (Zainor et al., 2025). As a result, understanding of which competencies are actually associated with certification remains fragmented. This gap is particularly significant in the context of competency-based education reform. If certification is intended to improve teacher quality, it is important to identify which dimensions of competency consistently emerge in the literature as being related to certification, as well as how contextual factors moderate these relationships. Without systematic mapping, certification risks becoming an administrative procedure that is ineffective in fostering relevant competencies, particularly digital and socio-emotional competencies, which are increasingly essential in contemporary teaching practices (Instefjord & Munthe, 2017; Twining et al., 2017). Accordingly, a systematic mapping of competencies associated with teacher certification is necessary to bridge this gap and provide a more integrated understanding of how certification relates to competency development across different contexts.

Based on these arguments, this study aims to map the competencies associated with teacher certification through a systematic literature review. Specifically, this study identifies (i) the competencies most frequently associated with certification, (ii) the dominant dimensions or typologies of competencies in the literature, and (iii) the contextual factors influencing these associations. By integrating findings across studies, this research contributes to strengthening the evidence base regarding the role of certification in the development of teacher competencies, and provides implications for the design of certification policies that are more aligned with 21st-century competency demands. In line with these objectives, this study addresses three questions: (1) which teacher competencies are associated with teacher certification in the literature; (2) which competency dimensions appear most frequently; and (3) which contextual factors influence the relationship between certification and teacher competencies.

2. Methodology

This study employs a Systematic Literature Review (SLR) approach to systematically identify, evaluate, and synthesize the literature on teacher competencies associated with teacher certification. This approach was chosen because it provides a comprehensive, transparent, and replicable overview of a research topic (Page et al., 2021; Xiao & Watson, 2019). The SLR process in this study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, which include four main stages: identification, screening, eligibility, and inclusion (Page et al., 2021). This approach is widely used in educational research to ensure the validity and reliability of literature synthesis.

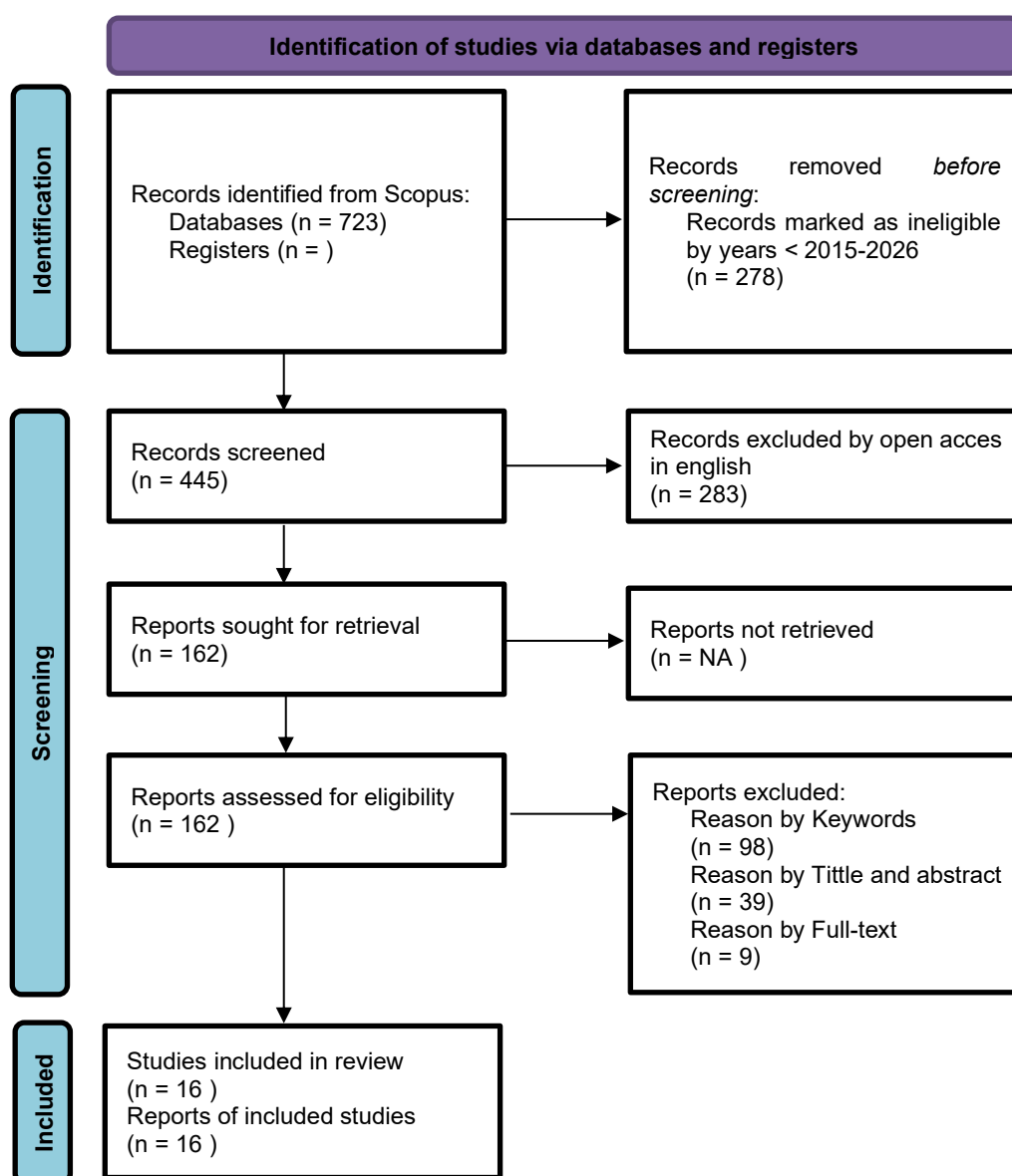


Figure 1. Prisma Flow Diagram

Research Questions Framework

This study uses the PICO (Population, Interest, Context) approach to formulate the research question:

1. Population (P) : Teachers
2. Interest (I) : Teacher competencies
3. Context (Co) : Teacher certification

The PICO approach was used because it is suitable for qualitative and exploratory research in SLR (Lockwood et al., 2015).

Search Strategy

Literature was retrieved from the Scopus database using the following search string, as shown in the table 1.

Table 1. Search String

Search String	Documents obtained
("teacher certification" OR "teacher licensure" OR "teacher licensing") AND ("teacher competence" OR "teacher competency" OR "teacher skills" OR "teacher professionalism") AND ("education" OR "teaching")	723

A total of 723 articles were collected through Scopus and then analyzed using a prism diagram in Figure 1 with three phases: Identification, Screening, and Inclusion. In the initial identification stage, 278 articles were removed from the 723 articles based on journal publication year <2015-2026, leaving 445 articles. In the first screening stage, articles were filtered based on open access in english, and 283 articles were excluded, leaving 162 articles. Next, articles were filtered based on document keywords (98), Tittle and abstract (39), and full-text reading to filter articles that were relevant to the research focus (9 articles), resulting in a final total of 16 articles included for analysis in the study.

3. Results and Discussion

Teacher Competency Mapping

A total of 16 empirical articles were analyzed in this study, using quantitative, qualitative, and mixed-methods approaches. Most of the studies were conducted in developing countries, particularly Indonesia, with a focus on the relationship between teacher certification and various aspects of teacher competence and performance, as shown in the table 2.

Table 2. Mapping Competencies Based on Articles

No	Studies	Competencies
1.	(Kajsa & Johansson, 2026)	Pedagogical, PCK
2.	(Rasmitadila et al., 2025)	Pedagogical, Professional, Social
3.	(Yadav et al., 2017)	Digital
4.	(Maujud & Syaharuddin, 2025)	Pedagogical, Professional, Social
5.	(Olvido et al., 2024)	Professional
6.	(Sumaryanta et al., 2019)	Pedagogical, Professional, Motivation
7.	(Mohamadi & Malekshahi, 2018)	Professional, Social
8.	(Kyi et al., 2023)	Digital, Pedagogical
9.	(Siebenhütter, 2023)	Motivation
10.	(Torbeys et al., 2020)	PCK
11.	(Revina et al., 2023)	Professional
12.	(Johansson & Myrberg, 2019)	Professional
13.	(Tjabolo & Herwin, 2020)	Professional

14.	(Kusumaningtyas et al., 2020)	Pedagogical, Professional
15.	(Bushra et al., 2024)	Professional, Motivation
16.	(Zainor et al., 2025)	Digital, Social

The results of the thematic analysis identified five key competency dimensions related to teacher certification, as shown in the table 3.

Table 3. Competency Distribution

No	Competencies	Number of studies	Characteristics
1.	Professional	10	Dominant
2.	Pedagogical & PCK	7	Core competencies
3.	Social	4	Mediating factors
4.	Motivation	3	Limited
5.	Digital	3	Limited

Professional Competence

Professional competence is the most frequently cited dimension in the literature. This competence encompasses subject matter mastery, teaching performance and professional standards for teachers. Several studies indicate that certified teachers perform better than those who are not certified (Tjabolo & Herwin, 2020). Furthermore, other research findings suggest that certification and licensing systems contribute to improving the initial quality of teachers' teaching practices (Olvido et al., 2024). The predominance of professional competencies suggests that teacher certification still serves primarily as a mechanism for ensuring minimum quality standards, rather than as a tool for comprehensive competency development. In other words, certification measures "eligibility" more than "potential for growth."

Pedagogical Competence and Content Knowledge

Pedagogical competencies are also a primary focus in many studies, particularly regarding instructional strategies, classroom management and learning assessment. In addition, it was found that Pedagogical Content Knowledge (PCK) plays a crucial role in improving the quality of learning (Kajsa & Johansson, 2026; Torbeyns et al., 2020). These findings indicate that the relationship between certification and the quality of learning is not direct but is mediated by teachers' ability to integrate content knowledge and pedagogy (PCK). In other words, PCK serves as a bridge between certification and teaching effectiveness.

Social Competence

Social competence was addressed in only 4 of the 16 studies, covering communication skills, empathy, and the quality of teacher-student relationships. Although its frequency was relatively low, several studies emphasized that this dimension is an integral part of overall teacher competence (Maujud & Syaharuddin, 2025). The low representation of social competencies does not imply that they are less important; rather, it indicates an epistemological bias in the certification literature. Certification systems and much of the research tend to

prioritize competencies that are easily measurable (performance, evaluation scores) and standardizable. In contrast, social competencies are contextual, relational, and difficult to measure quantitatively. Consequently, this dimension is often acknowledged normatively but neglected empirically. Furthermore, the position of social competence in these findings highlights its role as an enabling competence not a standalone core competency, but one that moderates the effectiveness of other competencies. Teachers with good pedagogy are not necessarily effective without the ability to build positive relationships with students. Thus, social competence functions as a “catalyst” that determines whether pedagogical competence truly impacts learning. The implication is that a lack of attention to social competence in certification has the potential to produce teachers who are technically competent but relationally ineffective.

Motivational Competence

Motivational competence was identified in only three studies, covering work motivation, professional commitment, and job satisfaction. Several studies indicate that certification and professional development programs can enhance teacher motivation, which in turn leads to improved performance (Rasmitadila et al., 2025). Although the frequency is low, these findings indicate that motivation plays a more significant role than merely serving as an additional variable. Motivation functions as an indirect mechanism in the relationship between certification and teacher performance.

Meaning:

Certification → indirectly enhances competence

Certification → enhances motivation

Motivation → drives improved performance

Thus, the relationship between certification and competence is actually non-linear and mediated, not a simple direct relationship. The scarcity of studies in this area suggests that the literature still tends to adopt a linear input–output approach, in which certification is viewed as directly leading to improved quality. This approach overlooks the psychological dynamics that are, in fact, key to changing teachers’ professional behavior. A significant implication is that certification policies that focus solely on administrative evaluation are likely to fail without an increase in intrinsic motivation; such certification merely fosters compliance, not commitment.

Digital Competence

Digital competence was also identified in only three studies, covering technology use, ICT integration, and digital pedagogy. Several studies indicate that teachers’ technological competence has not yet reached its full potential, particularly regarding the integration of technology into teaching practices (Kyi et al., 2023; Zainor et al., 2025). The low representation of digital competencies is not merely a gap in the literature, but reflects a structural disconnect between certification policies and educational transformation. There are two main indicators: first, the “Lagging Policy Effect,” where the certification system has evolved from an old

paradigm (the pre-digital era), resulting in indicators that remain traditional and have not yet systematically incorporated digital competencies. Second, “Fragmented Integration” Although technology has been introduced into teacher education, its integration remains partial, unstandardized, and not a core component of certification evaluation. Consequently, a phenomenon arises where teachers are certified but may not necessarily be digitally competent. In fact, in the context of modern education, digital competencies are no longer merely supplementary but a prerequisite for effective learning and the foundation of pedagogical innovation. These findings indicate a misalignment between the certification system and the needs of 21st-century education, where policies are not evolving as quickly as the changing learning environment.

Contextual Variation Across Educational Systems

The findings of this review indicate that the relationship between teacher certification and teacher competence is not uniform but varies significantly across different educational contexts. The included studies reveal that differences in policy design, institutional capacity, and teacher development systems influence how certification contributes to the development of competence. In the context of developing countries, particularly Indonesia, teacher certification is often closely linked to improvements in professional competence and teacher performance. Empirical studies show that certification programs are frequently associated with improvements in teaching performance, motivation, and professional standards, largely driven by policy incentives and formal recognition mechanisms (Tjabolo & Herwin, 2020).

Similarly, professional development initiatives integrated with certification programs have proven effective in enhancing pedagogical and professional competencies, especially when supported by structured training and institutional programs (Rasmitadila et al., 2025). However, other studies suggest that the impact of certification in such contexts often depends on the quality of its implementation as well as the availability of a system for continuous professional development (Revina et al., 2023). In contrast, studies of more structured education systems emphasize the role of teacher education and specialization in developing competencies that go beyond mere certification. For example, research on teacher specialization shows that subject-specific expertise and teaching quality are more closely linked to long-term student learning outcomes than certification status itself (Johansson & Myrberg, 2019).

Similarly, various studies on Pedagogical Content Knowledge (PCK) highlight that learning opportunities during teacher education programs play a crucial role in the development of teaching competencies (Torbeys et al., 2020). These findings suggest that, in this context, certification serves as part of a broader professional preparation system, rather than as a standalone determinant of competence. Furthermore, cross-context evidence indicates that the development of digital competencies remains inconsistent across different education systems. Although some studies highlight efforts to integrate technology knowledge into teacher education, implementation is often only partial and lacks systematic alignment with

certification frameworks (Kyi et al., 2023). This inconsistency reflects broader structural differences in how education systems respond to digital transformation.

Overall, these findings suggest that teacher certification is implemented differently across various contexts. In systems with strong policy incentives but limited institutional support, certification tends to reinforce basic professional competencies. Conversely, in systems with well established teacher education structures and ongoing professional development, certification is integrated into a broader ecosystem that supports the development of more in depth competencies. These differences highlight the importance of considering contextual factors when interpreting the effectiveness of teacher certification.

Discussion

The results of this study indicate that teacher certification remains dominated by the reinforcement of professional and pedagogical competencies, which underscores the certification system's focus on standardizing basic teacher quality. Certification primarily functions as a mechanism for professional legitimacy, ensuring that teachers meet minimum standards in subject matter mastery and teaching practices. This finding is consistent with empirical evidence showing that certification correlates with improved teacher performance and professionalism (Tjabolo & Herwin, 2020). However, this dominance also indicates that certification remains focused on competencies that are easily measured and standardized, potentially overlooking more complex dimensions of competence.

One of the key findings of this study is the role of pedagogical competence and Pedagogical Content Knowledge (PCK) as core mechanisms linking certification to the quality of learning. Certification does not directly improve learning outcomes, but rather through enhancing teachers' ability to effectively integrate content and pedagogy. This aligns with the finding that PCK is the primary determinant of instructional quality in the classroom (Torbeyns et al., 2020). Thus, the effectiveness of certification depends heavily on the extent to which teachers are able to internalize these competencies in actual practice, rather than merely fulfilling administrative requirements.

Furthermore, the results of this study indicate that social competencies play an enabling or moderating role in teaching effectiveness. Although not a dominant focus in the literature, social competencies such as communication and teacher-student relationships determine the extent to which pedagogical competencies can be translated into meaningful learning experiences. However, the lack of attention to this dimension indicates a bias in the certification system that emphasizes technical aspects over relational ones (Maujud & Syaharuddin, 2025). Consequently, certified teachers may not necessarily possess adequate interpersonal skills to support inclusive and participatory learning. In addition, this study identifies motivation as a crucial mediating variable. Certification does not automatically improve competence, but rather works by enhancing teachers' motivation and professional commitment.

Empirical evidence shows that professional development programs can boost motivation, which in turn impacts teacher performance (Rasmitadila et al., 2025). These findings challenge the linear assumption that certification directly improves quality, and demonstrate that the relationship is indirect and dependent on psychological factors. In other words, without strong motivation, certification risks yielding only administrative compliance rather than substantive quality improvement.

On the other hand, the low representation of digital competencies indicates a structural gap between the certification system and the educational needs of the 21st century. Although technology has become an integral part of modern learning, digital competencies have not yet been systematically integrated into the teacher certification framework. This is reinforced by the finding that the integration of technology in teacher education remains partial and suboptimal (Kyi et al., 2023). This situation indicates a policy lag, where certification policies are falling behind advancements in educational technology.

An additional insight emerging from this study is that the effectiveness of teacher certification depends heavily on the educational context. Findings in the Results section indicate that the relationship between certification and teacher competence varies across different systems, particularly between educational contexts in developing countries and more structured ones. In developing countries, certification is often closely linked to improvements in teacher performance and motivation, driven largely by policy incentives and formal recognition mechanisms (Tjabolo & Herwin, 2020). However, its impact tends to be limited if not supported by continuous professional development and institutional capacity (Revina et al., 2023). Conversely, research conducted within more structured systems indicates that competence is influenced more by teacher education, specialization, and learning opportunities than by certification alone (Johansson & Myrberg, 2019).

This is particularly evident in the role of pedagogical content knowledge, which develops through systematic training and practice, rather than through certification status itself (Torbeyns et al., 2020). These differences indicate that certification does not function as a universal mechanism for competency development, but rather as a context-dependent instrument, where its effectiveness is influenced by the broader institutional environment and policies. In summary, the findings of this study indicate that the current teacher certification system remains focused on visible and measurable competencies (professional, pedagogical) but pays insufficient attention to latent, contextual, and future-oriented competencies (social, motivational, digital). Current teacher certification is more effective in ensuring baseline quality, but it is not yet optimal in fostering adaptive transformations in teachers' competencies to address changes in education. Thus, a paradigm shift is needed from certification as a compliance mechanism toward certification as a dynamic competency development system. This change requires stronger integration between certification, continuous professional development, and future competency needs.

4. Conclusion

This study aims to systematically map the competencies of teachers related to teacher certification and to examine the extent to which such certification aligns with current educational demands. The findings indicate that teacher certification is primarily linked to professional and pedagogical competencies, underscoring its central role in ensuring the quality of basic instruction. Furthermore, pedagogical content knowledge (PCK) emerges as a key mechanism through which certification contributes to learning effectiveness. However, this study also reveals that other critical competencies particularly social, motivational, and digital competencies remain underrepresented. These competencies play a critical role as driving and mediating factors that influence how effectively teachers apply their knowledge in practice. Their limited presence suggests that the current certification system remains largely oriented toward measurable and standardized competencies, rather than more complex, contextual, and future oriented dimensions of teaching.

Overall, this study confirms that while teacher certification effectively establishes minimum professional standards, it remains insufficient for developing comprehensive competencies required in modern education. This highlights a misalignment between current certification systems and the evolving demands of 21st-century learning. From a practical perspective, certification should be repositioned as part of a continuous competency development system rather than a one-time validation process. This requires stronger integration with ongoing professional development, particularly in enhancing pedagogical content knowledge as well as digital and socio-emotional competencies. In addition, aligning certification policies with institutional capacity through structured training, mentoring, and sustained support is essential to ensure meaningful impact. Without such alignment, certification risks becoming a procedural requirement rather than a transformative tool for improving teacher competence and instructional quality. Future research should examine how certification frameworks can be redesigned to incorporate emerging competencies and how contextual and institutional factors shape their effectiveness across diverse educational settings.

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