



ARTICLE INFORMATION

Beliefs and instructional practices of pre-service mathematics teachers: A systematic literature review

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BELIEFS AND INSTRUCTIONAL PRACTICES OF PRE-SERVICE MATHEMATICS TEACHERS: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Pre-service mathematics teachers' beliefs play a crucial role in shaping instructional practices; however, inconsistencies between beliefs and classroom implementation remain a persistent issue. This study aims to systematically review the literature on pre-service mathematics teachers' beliefs and examine how these beliefs influence instructional practices. Specifically, it addresses two research questions: "What beliefs are held by pre-service mathematics teachers?" and "How do these beliefs influence their instructional practices?" A systematic literature review approach was employed to ensure a rigorous and transparent synthesis of existing research. Articles were retrieved from the Scopus database, focusing on peer-reviewed journal publications from 2015 to 2026. Using the keyword "beliefs" and applying predefined inclusion and exclusion criteria, 20 articles were selected for qualitative analysis. Data were extracted using a structured framework covering beliefs, instructional practices, and their relationship. The findings reveal three dominant belief categories: traditional, constructivist, and mixed. Instructional practices were categorized as teacher-centered and student-centered. Notably, the results indicate a recurring misalignment between beliefs and practices: pre-service teachers espouse constructivist beliefs yet continue to implement traditional approaches. This study concludes that beliefs alone are insufficient to drive pedagogical change.

Keywords: Belief–Practice Alignment, Instructional Practices, Pre-Service Mathematics Teachers, Systematic Literature Review, Teacher Beliefs.

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INTRODUCTION

Beliefs play a pivotal role as cognitive filters that could shape how pre-service mathematics teachers interpret, design, and enact instructional practices (Hoth et al., 2022; Purnomo, 2017). Beliefs, in the context of teaching, are broadly understood as psychologically held understandings, assumptions, or propositions about the world that are perceived to be true and that shape individuals' perceptions and actions (Schoen & Lavenia, 2019). Beliefs in the mathematical perspective generally encompass three dimensions: the nature of mathematics, mathematics teaching, and mathematics learning (Tran et al., 2025; Yang et al., 2020). These

perspectives could influence how teachers respond to student thinking and adopt pedagogical innovation (Fukuda et al., 2024). Furthermore, these perspectives could shape instructional orientations classified as traditional, constructivist, and mixed beliefs (Lo, 2023).

A growing body of research has explored the beliefs of pre-service mathematics teachers across various educational contexts (Viquez & Joutsenlahti, 2021). Previous studies have examined beliefs related to constructivist versus traditional orientations, culturally responsive teaching, and inclusive practices for diverse learners (Lo, 2023). These investigations aim to understand how initial teacher education programs influence the development of professional identities. By examining these beliefs, researchers can identify the underlying values that pre-service teachers bring from their own schooling experiences, which often act as a baseline for their future professional growth (Heryatun et al., 2021).

Current literature reveals a diverse landscape of findings regarding these orientations. While some research reports a gradual shift toward student-centered and inquiry-based beliefs (Hatisaru et al., 2025; Mainali, 2022), others reveal the persistence of procedural and teacher-centered perspectives (Manderfeld & Siller, 2019). More importantly, an enduring issue in the literature is the inconsistency between professed beliefs and enacted instructional practices. Pre-service teachers may express progressive beliefs aligned with contemporary educational reforms, yet still implement traditional, teacher-dominated approaches in practice (Wadanambi & Leung, 2019). This misalignment suggests that beliefs do not automatically translate into practice, but rather interact with contextual, experiential, and pedagogical factors (Eckerskorn et al., 2026; Lloyd & Howell, 2019).

The research about beliefs and instructional practices has grown in volume, however the current literature remains fragmented (Hanin & Holm, 2023). Variations in research contexts, theoretical frameworks, and methodological approaches make it difficult to develop a coherent and integrated understanding of how pre-service mathematics teachers' beliefs are conceptualized and how they relate to instructional practices (Lo, 2023; Yang et al., 2020). The existing research has focused on specific belief dimensions independently, without examining their relationship with teaching behavior. Consequently, there is a clear need for a more integrated review to bring these drifting pieces of evidence together.

The literature search was conducted in the Scopus database, focusing on peer-reviewed journal articles published between 2015 and 2026. To capture a broad scope of relevant studies, the keyword “beliefs” was used as the primary search string. At the same time, specific criteria related to pre-service teachers and mathematics education were applied during the screening stage. This strategy was adopted to avoid overly restrictive search results and to ensure the inclusion of potentially relevant studies. The selection process followed a structured sequence of identification, screening, eligibility, and inclusion, resulting in a refined set of articles for qualitative synthesis. Additional criteria, such as the availability of a DOI, were applied to ensure the traceability, accessibility, and academic integrity of the selected sources.

Therefore, this study aims to systematically review the existing body of research on pre-service mathematics teachers' beliefs and their impact on instructional practices. Specifically, it seeks to answer “What are the dominant beliefs held by pre-service mathematics teachers as reported in the literature?” and “How do pre-service mathematics teachers' beliefs influence their instructional practices?”. By offering a structured and critical synthesis of the literature, this study contributes to advancing a more integrated understanding of belief and practice dynamics in mathematics education.

Beliefs play a pivotal role as cognitive filters that could shape pre-service mathematics teachers' interpretation, design, and enactment of instructional practices (Hoth et al., 2022; Purnomo, 2017). Beliefs, in the context of teaching, are broadly understood as psychologically held understandings, assumptions, or propositions about the world that are perceived as true and shape individuals' perceptions and actions (Schoen & Lavenia, 2019). Beliefs in the

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METHOD

This research uses a systematic literature review as the method (Gough et al., 2017). That is to ensure that the methods used are explicit, rigorous, and accountable. This research identifies, selects, and appends the papers that are found with PRISMA flow (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (Page et al., 2021) to ensure the objectivity of the conclusion. The PRISMA flow was adopted for this review to ensure the systematic review is valuable. It also requires authors to provide a transparent, complete, and accurate account of why the review was conducted, how studies were identified and selected, and what was found (Page et al., 2021)

The literature search was conducted in the Scopus database for the period 2015–2026. To ensure replicability and precision, the search used a specific search string across the Title, Abstract, and Keyword fields. The exact search string used was: TITLE-ABS-KEY ("belief" AND "pre-service teacher" AND "mathematics"). The keyword "beliefs" was central to the search, but it was combined with "pre-service teacher" and "mathematics" to refine the results and ensure relevance to the research objectives. The literature was conducted on April 22, 2026. The search date could explain the inclusion of articles published in the first quarter of 2026. Articles from the year 2026 were included as they were available as 'online-first' or 'early access' publications at the time of data collection. These articles have undergone peer review and are assigned to upcoming volumes, ensuring their inclusion contributes to the most current state of the art in the field.

Firstly, 100 articles have been collected with the following search strings. However, not all of those articles were included in this study, as we applied the PRISMA flow to conduct the inclusion and exclusion process. The complete selection process is illustrated in Figure 1. From the selection process, 20 articles were included for the synthesis process.

To ensure transparency in the selection process, the 56 articles excluded during the eligibility stage were categorized by specific reasons. The articles were selected for this paper are based on the inclusion and exclusion criteria that outlined in table 1 below.

Table 1. Exclusion and Inclusion Criteria

Criteria	Inclusion	Exclusion
Document Type	Peer-reviewed journal articles	Theses, book chapters, conference proceedings
Technical Access	Articles have a valid DOI Articles have a full-text access available	Articles without DOI Articles does not have a full-text access available
Focus Area	Beliefs and mathematics education	Non-math fields (science, english, pre-school, general) No related to beliefs
Subject	Pre-service mathematics teachers	School students , inservice teachers, teacher educators, researchers
Focus Area	Beliefs and mathematics education	Non-math fields (science, english, pre-school, general) No related to beliefs

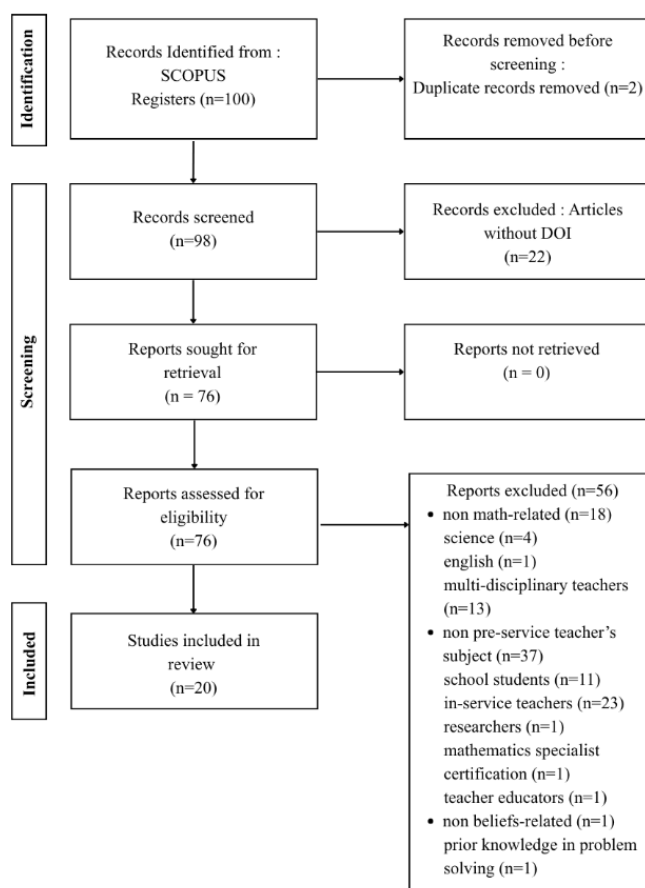


Figure 1. PRISMA Flow Diagram Tailored to The SLR

We established strict inclusion and exclusion criteria to maintain the quality and focus of research. We gathered 100 articles use the keywords that already mention before. However, we were not include all of those articles for this research. All of those 100 articles that we found are peer-reviewed journal articles, none of which are theses, book, chapters, or proceedings. At the first step, we exclude 2 from those 100 articles because its duplicated files. After that exclusion, we included 98 articles to be screened further. To ensure the technical quality of the data, we excluded 22 articles that did not have a valid DOI. From that exclusion stage, we got 76 articles that already eligible for the assessment. At this stage, we conducted a deep review by reading the full text of all 76 reports. This step was crucial to make sure each article truly focused on our core topic. We ended up excluding 56 articles because they did not meet our specific focus area or subject. Specifically, many of these articles involved in-service teachers and school students, or discussed non-math subjects like science and English. We also excluded articles that were not related to the "beliefs" construct. After do the screening, we found 20 articles eligible for final synthesis to ensure that the results are accurate and relevant to pre-service mathematics teacher's beliefs.

RESULT

To systematically address the research questions, a structured data extraction process was employed to organize and synthesize relevant information from the selected studies. This review is guided by two primary Research Questions (RQ): first, identifying the types of pre-service mathematics teachers' beliefs (RQ1), and second, examining how these beliefs influence their instructional practices (RQ2). The extraction framework was specifically designed to capture key aspects related to pre-service mathematics teachers' beliefs (RQ1) and

their influence on instructional practices (RQ2). Each study was analyzed based on its contextual background, methodological characteristics, and primary focus, followed by a detailed identification of the types of beliefs reported and how these beliefs were reflected in instructional practices. In addition, the relationship between beliefs and practices was categorized to determine whether they were aligned, misaligned, or partially aligned. However, we sorted the articles into two main groups. The first group shown in Table 2 are consists of studies that explore both the instructional practices and beliefs of pre-service mathematics teachers. Meanwhile, the second group in Table 3 focuses on their beliefs as a standalone concept, without linking them directly to classroom teaching practices. This structured approach enables a consistent and transparent comparison across studies, fcilitating the identification of patterns, themes, and gaps within the existing literature. The result of the articles that focused on beliefs are presented in Table 2.

Table 2. Studies of Pre-service Mathematics Teachers' Beliefs and Their Instructional Practices (Part 1)

No	Author(s) & Year	Country	Beliefs Identified	Type	Instructional Practices	Relationship
1	(Manderfeld & Siller, 2019)	Germany	Mathematics didactic as a design of lessons and transfer of knowledge. Teachers focus on teaching techniques.	Traditional	Teacher-centered (transfer of knowledge)	Aligned
2	(Wadanambi & Leung, 2019)	Sri Lanka	Mathematics is about solving problems and teacher is the facilitator	Mix	Teacher-centered	Misaligned
3	(Min et al., 2023)	United States	Student with language struggle could study maths better with scaffolding	Constructivist	Student-centered	Aligned
4	(Letwinsky et al., 2018)	United States	Teachers should give opportunities for students to share their thinking and make learning math fun.	Mix	Student-centered	Aligned
5	(Mainali, 2022)	USA	Shift from "math is boring/procedural" to "math is creative and problem-solving based."	Mix	Student-centered (Simulated: Used concept maps and manipulatives during the methods course).	Aligned

Table 3. (Continued) Studies of Pre-service Mathematics Teachers' Beliefs and Their Instructional Practices (Part 2)

No	Author(s) & Year	Country	Beliefs Identified	Type	Instructional Practices	Relationship
6	(Jacobson, 2017)	USA	Mathematics as a Process (belief views mathematics learning as an active process of construction rather than a passive reception of facts.) VS Mathematics as a Product (This belief views mathematics as a finished set of rules and procedures)	Mix	Student-centered (Implemented during Field Experience)	Aligned
7	(Hatisaru et al., 2025)	Australia	Secondary pre-service teachers reflected process-related orientation and application-related orientation.	Mix (dominantly Constructivist)	Student-centered (Exploratory learning, problem-solving tasks, real-world context, teacher as facilitator)	Aligned
8	(Kim, 2018)	USA	Mathematics as an exploration tool vs. a set of rules. Technology: The role of technology (GeoGebra) for visualization and concept discovery.	Mix	Student-Centered (Dynamic geometry exploration)	Aligned
9	(Haavold et al., 2024)	Norway	Beliefs about the function of proofs (verification vs. logical explanation) and the relative difficulty between direct and indirect proofs.	Mix	Student-Centered (Explorative discussions on the validity of arguments and proof logic)	Aligned

Table 4. (Continued) Studies of Pre-service Mathematics Teachers' Beliefs and Their Instructional Practices (Part 3)

No	Author(s) & Year	Country	Beliefs Identified	Type	Instructional Practices	Relationship
10	(Lloyd & Howell, 2019)	USA	Mathematics teaching and learning (MTL) beliefs are positioned along a traditional–reform continuum, including beliefs about computation, expository teaching, student ideas, justification, inquiry, productive struggle, and relevance.	Mix	Mixed (Reported encouraging justification and inquiry; also reported expository teaching and emphasis on correct answers).	Partially Aligned
11	(Apkarian et al., 2023)	USA	Mathematics learning is an active process of meaning-making through reasoning, collaboration, and discussion.	Constructivist	Student-centered	Aligned
12	(Scherer & Bertram, 2024)	Germany	Beliefs about fixed vs. developable mathematical ability; inclusive education beliefs; self-efficacy	Mix	Student - centered	Aligned

The previous table highlighted the connection between pre-service mathematics teacher beliefs and their practices. However, we identified some articles did not have focus on the practices. We made it to be a separate group of studies. These articles provide insight into theoretical perspectives or psychological factors, without observing the implementation. The result of that articles group shown at Table 3 below.

Table 5. Studies Investigating Pre-service Teachers' Beliefs Without Direct Instructional Observation (Part 1)

No	Author(s) & Year	Country	Beliefs Identified	Type	Focus
1	(Novikasari & Dede, 2021)	Turkey	Learning multiplication isn't just memorizing, it should involve thinking-process and concept connection	Constructivist	Beliefs about the nature of multiplication learning, encompassing remote beliefs, dynamic beliefs, self-efficacy beliefs in multiplication problems, and beliefs about multiplication as presented in textbooks.
2	(Yang et al., 2026)	China	Transmissive beliefs have a negative correlation with noticing. Constructivist beliefs have a positive correlation with noticing.	Mix	Focused on video noticing, not implementation. Beliefs about pedagogical orientations, distinguishing between transmissive beliefs-negatively associated with teacher noticing-and constructivist beliefs-positively associated with teacher noticing-and their mediating role between teacher knowledge and professional noticing.
3	(Eckerskorn et al., 2026)	Germany	Higher mathematics self-concept was associated with more pleasant and fewer unpleasant emotions. Subjects with lower self-concept show stress.	Mix	Focused on emotions and self-concept. Beliefs about mathematics self-concept, specifically how pre-service teachers' confidence in their own mathematical ability shapes their emotional and physiological responses when engaging with mathematics tasks
4	(Wellberg, 2025)	International (6 countries)	Subject that see "math as a rules-based" beliefs, use traditional assessment. Subject that sees "math as inquiry" beliefs, do discussion of students' false.	Mix	Focused on preferred assessment. Beliefs about the nature of mathematics and students' mathematical ability, and how these beliefs shape pre-service teachers' opinions on error correction approaches and assessment preferences.

Table 6. (Continued) Studies Investigating Pre-service Teachers' Beliefs Without Direct Instructional Observation (Part 2)

No	Author(s) & Year	Country	Beliefs Identified	Type	Focus
5	(Segarra & Julià, 2022)		Self-efficacy: Confidence in teaching ability and the belief that teacher's instruction directly impacts student learning outcomes.	Constructivist	Focused on correlation of MTEBI and academic achievement. Beliefs about mathematics teaching efficacy, specifically personal mathematics teaching efficacy and general teaching outcome expectancy, and their relationship with pre-service teachers' attitudes toward mathematics and academic achievement.
6	(Tran et al., 2025)	Australia	Inquiry-oriented beliefs, active student learning, low support for teacher-directed learning, non-fixed ability beliefs.	Mixed (dominantly Constructivist)	Beliefs on preference toward inquiry-based learning, student engagement, and less support for explicit teacher-centered learning.
7	(Woltron, 2026)	Australia	Mathematical world views (dynamic/process vs. static/product). Goals: Beliefs about teaching goals (practical application vs. formal schemes).	Mixed	Focused on analyzing correlations between mathematical world views and learning goal orientations via survey. Beliefs about the nature of mathematics and mathematics learning, distinguishing between inquiry-based orientations-viewing mathematics as a process of inquiry-and transmission-based orientations-viewing mathematics as a collection of facts and rules-alongside beliefs about the active versus passive role of students in learning.

Table 7. (Continued) Studies Investigating Pre-service Teachers' Beliefs Without Direct Instructional Observation (Part 3)

No	Author(s) & Year	Count ry	Beliefs Identified	Type	Focus
8	(Dunekacke et al., 2025)	Germany	Application-related beliefs; process-related beliefs; static orientation beliefs	Mix	Focus on beliefs, emotions, and knowledge rather than teaching practices. Beliefs about the nature of mathematics, encompassing application-related beliefs, process-related beliefs, and static orientation beliefs, and their relationships with pre-service teachers' emotions and knowledge within the framework of control-value theory.

The first theme examines the types of beliefs held by pre-service teachers, ranging from traditional-transmissive to constructivist-reform orientations. The second theme explores the alignment between beliefs and instructional practices, identifying where these views translate into classroom action or where discrepancies exist. Finally, the third theme identifies psychological and contextual factors, such as: self-efficacy and emotions, that shape these belief systems. A detailed synthesis of these themes is discussed in the following sections.

Type of Beliefs Held by Pre-Service Mathematics Teachers

The articles showed that there are diverse landscape of beliefs orientation of pre-service mathematics teachers. This beliefs orientation could be grouped by traditional, constructivist, and mixed-beliefs systems. From those articles, only one that we found as a traditional beliefs. The traditional beliefs' article documenting about dominating teacher-centered orientation that see mathematics as a body of knowledge to be transmitted through structured lesson design (Manderfeld & Siller, 2019). The constructivist beliefs is the opposite from traditional beliefs, constructivist beliefs characterized by subjects' views of mathematics as an active and meaning-making process. The constructivist belief evidenced in several studies. Pre-service teachers in the United States expressed beliefs that students with language difficulties could benefit from scaffolding and collaborative engagement in math class (Min et al., 2023), while others emphasized the importance of reasoning, discussion, and mathematical exploration as central to learning (Apkarian et al., 2023). In addition, there is studies about self-efficacy beliefs. Those studies showing that confidence in teaching ability and preceptions of one's own mathematical competence could shaped teachers' disposition towards instruction (Eckerskorn et al., 2026; Segarra & Julià, 2022).

The majority of studies reported mixed belief orientations. The mixed beliefs orientation reflecting coexistence of traditional and constructivist perspectives within individual pre-service teachers. This mixed beliefs showed at multiples dimensions such as: beliefs about the nature of mathematics as process versus product, beliefs about the role of the teacher as transmitter versus facilitator, and beliefs about student learning as passive reception versus active construction (Jacobson, 2017; Lloyd & Howell, 2019; Woltron, 2026). Furthermore, we identified beliefs related to inclusive education, specifically regarding

whether mathematical ability is fixed or developable (Scherer & Bertram, 2024). Additionally, we found about the beliefs of the role of technology in learning mathematics that identified about pre-service teachers' perspectives about tools like geogebra as the facilitators of conceptual discovery rather than computational aids (Kim, 2018). Another studies identified beliefs of pre-service teachers about mathematical proof (Haavold et al., 2024). Overall, these findings suggest that prospective mathematics teachers' belief systems are multidimensional, context-sensitive, and rarely have a completely uniform orientation.

Forms of Instructional Practices Associated with Beliefs

In this second section, we examine about the various forms of instructional practices reported in the literature. Based on the selected studies, these instructional practices are not uniform but vary significantly depending on the teacher's pedagogical orientation, ranging from rigid teacher-centered methods to flexible student-centered explorations. Student-centered approaches were the predominant among the studies that directly observed or reported on classroom or field-based practices. Pre-service teachers who held constructivist or mixed beliefs tended to implement practices that emphasized problem-solving, exploratory learning, real-world applications, and opportunities for student discussion and collaborative meaning-making (Apkarian et al., 2023; Hatisaru et al., 2025; Kim, 2018). Pre-service teachers who held traditional beliefs orientation, tended to implement teacher-centered practices, primarily focusing on direct instruction and the structured transfer of mathematical knowledge (Manderfeld & Siller, 2019).

However, not all of the studies at this review documented an actual instructional practices. Most of the studies included in this review focus on planned, preferred, or simulated practices rather than actual teaching behavior in a real classroom setting. Some studies captured pre-service teachers' preferred instructional approaches through surveys or reflective instruments (Tran et al., 2025; Wellberg, 2025). Other studies examined practices within the context of teacher education coursework rather than real classroom settings (Jacobson, 2017; Mainali, 2022). Several studies focused on video noticing activities in which pre-service teachers analyzed teaching episodes as a proxy for understanding their pedagogical orientations, without direct observation of their own teaching (Yang et al., 2026). Additionally, there is studies documented about the assesment preferences. Pre-services teachers held inquiry orientation beliefs tending to choose discussion-based and formative assessment approaches instead of sumative assessment rule-based (Wellberg, 2025). These distinctitions are suggest that the nature of practice as operationalized across studies is far from uniform. Its ranging from actual classroom implementation to hypothetical or simulated instructional decisions.

Patterns of Belief and Practice Relationships

In this third section, we explore about the relationship between pre-service teachers' beliefs and their actual or intended instructional practices which not simple one-to-one correspondence. We found three distinc patterns such as alignment, misalignment, and partial alignment. Alignment pattern is the most common pattern reported from the studies. The alignment means pre-service teachers' beliefs corresponded with their observed or reported instructional behaviors. Studies from diverse national contexts including the United States, Australia, Germany, and Norway; consistently documented this pattern, particularly among pre-service teachers holding constructivist or mixed beliefs who implemented student-centered approaches (Haavold et al., 2024; Hatisaru et al., 2025; Min et al., 2023; Scherer & Bertram, 2024). The example of alignment pattern such as: pre-service teachers who believe that mathematics should be explored, adopt exploratory teaching methods for their classes (Hatisaru et al., 2025). Another study found that the pre-services teacher who value the importance of scaffolding are implement scaffolding structures for their students (Min et al., 2023).

Furthermore, pre-service teachers who view mathematical proof as a collaborative process facilitate active classroom discussions to reflect those beliefs (Haavold et al., 2024).

Misalignment pattern found in one study of pre-service teachers at Sri Lanka context. This study reported that pre-services teacher beliefs about teacher being a problem-solve facilitator at class, but in the reality, they were still teaching with teacher-centered style (Wadanambi & Leung, 2019). This suggests that belief-practice congruence cannot be assumed, and that contextual, institutional, and cultural factors may constrain the translation of beliefs into practice. Furthermore, there is a partial alignment pattern identified in one study. Pre-service teachers reported encouraging justification and inquiry in principle while simultaneously endorsing expository teaching and an emphasis on correct answers in practice (Lloyd & Howell, 2019). This partial alignment indicates that belief systems are not always internally consistent, and that different belief dimensions may align differentially with various aspects of instructional practice. However, studies that utilized only belief questionnaires without classroom observation data were excluded from this section, as they provided insufficient evidence to assess the actual relationship between beliefs and practices.

DISCUSSION

The Complexity of Belief–Practice Relationships in Mathematics Teaching

The persistent gap between pre-service teachers' constructivist beliefs and their enacted instructional practices demands theoretical explanation beyond mere description of findings (Nguyen & Le, 2024). The findings of this review confirm that beliefs alone are insufficient predictors of instructional behavior, as teaching is fundamentally mediated by a constellation of individual, contextual, and institutional factors (Emery et al., 2021). Pre-service teachers may genuinely hold student-centered beliefs yet find themselves unable or unwilling to enact them in practice due to constraints operating at multiple levels simultaneously, including policy demands, curriculum and assessment structures, cultural expectations, and school-level conditions (Abedi, 2024; Ayalew, 2025; Nguyen & Le, 2024). Understanding this complexity requires moving beyond a simplistic belief-causes-practice model toward a more nuanced view of teaching as a socially embedded and contextually negotiated activity. in line with recent complex, ecological, and contextualized framings of teacher learning and practice (Blundell, 2025; Coles, 2023; Daly & Langdon, 2020; Ehrenfeld & Brady, 2025).

Knowledge, Skills, and Confidence as Mediators of Practice

The main factor of pre-service teachers misalignment about their beliefs is the gap between belief and possessing the competence to act on it. Many pre-service mathematics teachers strongly agree that students should be active in class that indicate constructivist beliefs, but they did not have a technical skills to create that kind of class (Fukaya et al., 2024; Muhtarom et al., 2019; Pagiling & Taufik, 2022). Teaching with a modern way is difficult because teacher should have knowledge and ability to build discussion environment and being flexible for responding students' questions that can not be developed through beliefs endorsement alone (Sunzuma & Luneta, 2023; Yang et al., 2020).

The student-centered learning is more complex than teacher-centered, it could make the pre-service teachers with a low confidence feel stressed. So, they will be back to the rigid way or teacher-centered learning cause it easier to manage, even if it is misalignment with the principal they beliefs. Furthermore, this gap is often widened by a lack of professional confidence and classroom authority. Pre-service teachers frequently report a lack of confidence in their ability to manage student-centered classrooms, particularly during early field placements where they are still developing their professional identity (Jacobson, 2017; Mainali, 2022). Without a firm belief in their own ability to manage a decentralized classroom, pre-

service teachers are unlikely to take the instructional risks necessary for reform-oriented teaching (Lloyd & Howell, 2019).

Contextual and Institutional Constraints on Instructional Practice

Before being a pre-service mathematics teachers, they were a students that observed their teachers' method for teaching such a traditional orientation for years. This experience could shape a teaching method in their minds deeply (Mainali, 2022). Even pre-service teachers who intellectually endorse reform-oriented approaches tend to revert to familiar, procedural practices when placed in real classroom contexts, suggesting that belief transformation requires sustained experiential learning and structured reflective practice rather than conceptual knowledge alone (Apkarian et al., 2023; Jacobson, 2017).

Mentor teacher influence represents another powerful contextual constraint. During teaching practices, pre-service teachers are typically supervised by cooperating or mentor teachers whose own instructional practices may be predominantly traditional. In such settings, pre-service teachers frequently feel pressured to conform to the pedagogical norms modeled by their mentors, suppressing their own reform-oriented beliefs in favor of practices that are contextually sanctioned and institutionally expected (Hatisaru et al., 2025; Wadanambi & Leung, 2019). This dynamic highlights the critical role of practicum quality and mentor teacher orientation in either facilitating or impeding belief-practice alignment.

Students centered methods such a disscussion or inquiry learning are good, but its need more time than the traditional method. However, schools have their own curriculum demands. Pre-service teachers operating within such systems may perceive constructivist approaches as incompatible with curriculum demands, even when they personally endorse them (Dunekacke et al., 2025; Woltron, 2026). Those are similar with the assessment systems that prioritize procedural performance on standardized tests create additional pressure to adopt efficient, teacher-directed instruction over more exploratory, process-oriented approaches (Wellberg, 2025). These systemic pressures collectively constitute a structural barrier to belief enactment that operates independently of individual belief strength or pedagogical competence.

Positioning the Findings within the Broader Literature

The findings of this review are broadly consistent with and extend insights from recent theoretical works in mathematics teacher education. The research of (Skott, 2015) challenged the assumption that beliefs directly drive practice, proposing instead that beliefs are dynamically negotiated within social and institutional contexts—a perspective that helps explain why pre-service teachers in this review enacted teacher-centered practices even when holding reform-oriented beliefs. This suggests that the mixed belief orientations identified in this synthesis reflect a negotiation of identity as pre-service teachers transition from the idealistic environment of university training to the pragmatic realities of school culture.

Recent work has shown that the relationship between mathematical beliefs, professional knowledge, and instructional practice is mediated by teachers' competence and situation-specific skills, meaning that belief–practice alignment is as much a competence issue as it is a dispositional one (Depaepe et al., 2020; Yang et al., 2020). More recently, (Lee & Vongkulluksn, 2022) emphasized that teacher education programs must explicitly target the interplay between beliefs, knowledge, and practice if meaningful pedagogical transformation is to occur. Taken together, these works position the current findings within a broader scholarly consensus: belief-practice dynamics are shaped not only by individual belief systems but by the complex interaction of professional knowledge, situational skills, and institutional structures.

Methodological Limitations and Directions for Future Research

A significant methodological limitation of this systematic review lies in how instructional practices were captured in the analyzed studies. The findings indicate that much of the existing literature relies on planned practices, simulations, or reflective tasks (such as video noticing) rather than direct, real-time observations of classroom teaching. Relying on these proxy measures may not fully capture the messy, dynamic realities and immediate pressures pre-service mathematics teachers face when they step into a real classroom. Consequently, the conclusions regarding the link between beliefs and practices are largely based on hypothetical intentions or instructional decisions rather than empirical evidence of actual pedagogical actions within complex school environments. Furthermore, the scope of this synthesis was somewhat constrained by the use of a single database (Scopus) and a broad primary keyword.

Although a growing body of research has examined pre-services mathematics teachers' beliefs and their relationship with instructional practices but the existing literature remains largely dominated by studies conducted in Western and other outside Southeast Asian Contexts (Afrillia & Purnomo, 2025; Viquez & Joutsenlahti, 2021; Yang et al., 2020). As a result, current understandings of belief and practice alignment are primarily shaped by educational systems, pedagogical traditions and cultural assumptions that may not fully reflect the realities of Southeast Asian classrooms.

In particular, Malaysia and Indonesia have their own unique educational contexts which is shaped by exam-oriented systems, more structured teacher and student relationships and strong socio-cultural and religious influences on teaching and learning. These elements can influence not only what pre-services teachers believe about teaching mathematics but also how confident they are to put those beliefs into practice in real classrooms (Muhtarom et al., 2019; Purnomo et al., 2016). Initial studies in the Southeast Asian context have begun to explore this by documenting how pre-service teachers' mindsets influence their interactional patterns and error-handling strategies during mathematics instruction (Putri et al., 2026). However, research from these contexts is still quite limited and is often underrepresented in large reviews (Gao, 2025; Purnomo et al., 2016). As the result, there is still a lack of deeper and context sensitive understanding of how the relationship between beliefs and instructional practices actually plays out in this region.

CONCLUSION AND SUGGESTIONS

This systematic literature review examined the dominant beliefs held by pre-service mathematics teachers and their relationship with instructional practices across twenty studies. The findings reveal that mixed belief orientations were most prevalent, with pre-service teachers simultaneously holding constructivist and traditional perspectives across multiple dimensions including the nature of mathematics, teaching, and learning. While alignment between beliefs and practices was the most commonly reported pattern, cases of misalignment and partial alignment demonstrate that constructivist beliefs do not automatically translate into student-centered instruction. This gap is mediated by a complex interplay of individual factors including underdeveloped pedagogical content knowledge, limited confidence, and insufficient classroom authority and contextual factors such as entrenched school norms, mentor teacher influence, curriculum demands, assessment pressures, and institutional culture. These findings collectively position belief-practice dynamics as a structural and socially embedded phenomenon rather than a purely dispositional one, and underscore the need for teacher education programs to adopt more integrated, experientially grounded approaches to belief transformation.

To address the identified belief-practice gap, teacher education programs are recommended to implement structured interventions including reflective teaching journals,

microteaching sessions, lesson study, video-based reflection, and supervised practicum with systematic feedback mechanisms, as these experiential approaches provide pre-service teachers with the practical competence and pedagogical confidence necessary to enact reform-oriented beliefs in real classroom contexts. For future research, longitudinal and observational studies are strongly recommended over reliance on self-report instruments alone, as triangulating questionnaire data with classroom observations, video analysis, and structured interviews would yield more ecologically valid evidence of how beliefs manifest in actual instructional practice. Additionally, future studies should prioritize underrepresented cultural and geographic contexts particularly in Southeast Asia and other non-Western settings to develop a more globally inclusive understanding of belief-practice dynamics in mathematics teacher education.

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