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School Mathematics as Institutionalized Knowledge: A Critical Analysis of Instructional Practices

Risza Presty Rumani✉
Universitas Ahmad Dahlan

e-mail: riszarumani59@gmail.com

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ABSTRACT

School mathematics is increasingly recognized as an institutionalized form of knowledge shaped by policy discourse, teacher beliefs, cultural traditions, and classroom practices rather than a neutral body of content. This study aims to critically examine how instructional practices reproduce or challenge the dominant institutional structure of school mathematics and to explore pathways for transformative reform. Employing a qualitative systematic literature review design, this research analyzed 30 peer-reviewed studies published between 2020 and 2025. Data were collected through structured document analysis and synthesized using thematic content analysis. The findings reveal that prevailing instructional models continue to privilege procedural efficiency, examination performance, and rigid curricular sequencing, often marginalizing critical reasoning, creativity, and contextual relevance. However, cognitively activating instruction, problem-based learning, ethnomathematical integration, and critical pedagogical approaches demonstrate strong potential to enhance student agency, conceptual understanding, and social relevance. The study concludes that sustainable transformation of school mathematics requires systemic alignment among educational policy, teacher professional development, instructional practice, and cultural context.

INTRODUCTION

Contemporary research increasingly challenges the assumption that school mathematics represents neutral and objective knowledge. Instead, it is recognized as a socially constructed and institutionally regulated body of knowledge shaped by educational policy, assessment regimes, teacher beliefs, and classroom traditions (Nguyen, 2024). Empirical evidence indicates that mathematics instruction worldwide remains heavily dominated by procedural drills, routine exercises, and standardized assessments that privilege efficiency and accuracy over reasoning and meaning-making (Mailizar & Fan, 2020; Osborne, 2021). These conditions raise fundamental concerns regarding the relevance, equity, and intellectual depth of school mathematics learning.

Policy discourses play a decisive role in defining what counts as legitimate mathematics in schools. Nguyen (2024) identifies five dominant discourses: mathematics as a core subject, as sequential and hierarchical, as well-defined and

stable, as contested between conceptual and procedural approaches, and as a field where equity is narrowly interpreted as access and achievement. These discourses are embedded in curriculum standards, assessment systems, intervention programs, and tracking mechanisms, shaping everyday classroom practices and reinforcing a procedural and examination-oriented culture.

At the instructional level, teachers serve as key mediators of this institutionalized knowledge. Longitudinal studies demonstrate that teachers' knowledge of students' mathematical thinking significantly predicts instructional quality when school contexts support learner-centered visions (Lee & Santagata, 2020). Teachers' instructional visions are further shaped by professional networks and collegial interactions that stabilize shared norms of "good teaching" (Munter & Wilhelm, 2020). Importantly, advanced academic mathematics training can shift classroom practices toward greater emphasis on explanation, definition, and proof, aligning school mathematics more closely with formal deductive structures (Even & Mytlis, 2024). Moreover, meta-analytic evidence confirms that professional development interventions which transform teacher knowledge and practice are strongly associated with improvements in student achievement (Lynch et al., 2025).

Despite extensive research on instructional reform, a significant research gap remains in understanding how institutional forces, teacher visions, and classroom practices interact to reproduce or transform the dominant form of school mathematics. While individual studies document the benefits of cognitively activating instruction, problem-based learning, and critical contextual approaches (Cheng et al., 2023; Hackenberg et al., 2020; De Alkimim & De Macêdo, 2025), fewer studies integrate these findings into a comprehensive institutional analysis.

Therefore, this study aims to critically analyze school mathematics as institutionalized knowledge by examining the relationships between policy discourse, teacher knowledge, and instructional practices. The novelty of this research lies in its integrative framework that connects institutional theory with empirical evidence on instructional practice, offering a systemic explanation of how school mathematics can be transformed toward more meaningful, equitable, and socially responsive learning.

METHODOLOGY

Research Design

This study employed a qualitative systematic literature review design to investigate how school mathematics operates as institutionalized knowledge and how instructional practices reproduce or challenge its dominant form. This design was selected because the research objective was not to measure causal relationships statistically but to synthesize conceptual patterns, empirical findings, and theoretical perspectives from contemporary research in mathematics education. The systematic approach ensured rigor, transparency, and replicability in the selection and analysis of sources.

Population and Sample

The population of this study consisted of peer-reviewed research articles published in international journals focusing on mathematics education, instructional practices, educational policy, and teacher development. Using purposive sampling, twenty (20) journal articles published between 2020–2025 were selected as the research sample. The selection criteria included:

(1) Relevance to School Mathematics or Instructional Practice,

(2) Empirical or Theoretical Rigor,

(3) Publication in Reputable Indexed Journals, and

(4) Direct Contribution to Understanding Institutional Influences in Mathematics Instruction.

Data Collection Techniques

Data were collected through systematic document analysis. The researchers conducted database searches in Scopus, Web of Science, ERIC, and Google Scholar using keywords such as school mathematics, instructional practices, institutional knowledge, teacher knowledge, and mathematics education reform. Each article was reviewed using a structured extraction form capturing research context, methods, key findings, and theoretical implications.

Data Analysis Techniques

Data analysis followed thematic content analysis. First, open coding was applied to identify key concepts related to institutional discourse, teacher vision, instructional practice, and student learning outcomes. Second, axial coding grouped these concepts into major analytical categories. Finally, selective coding integrated the categories into an explanatory framework of how school mathematics is constructed and transformed through instructional practice.

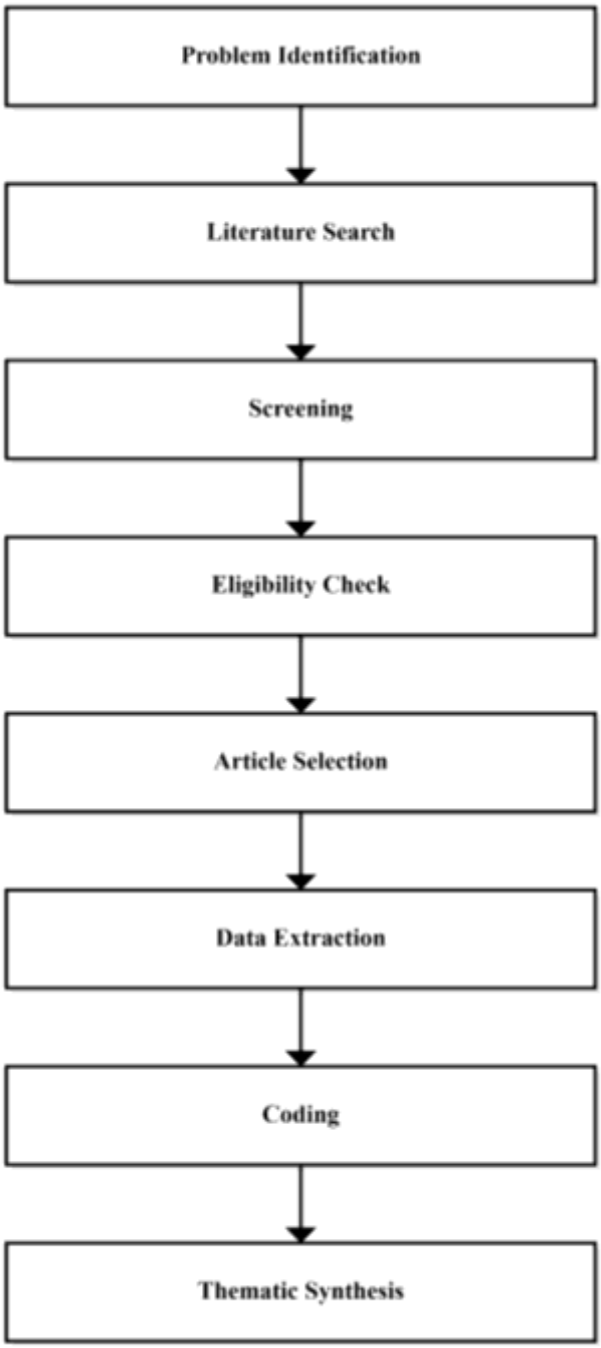

Figure 1. Stages of the Research Process

RESULTS AND DISCUSSION

This section presents the main findings of the study and critically discusses how school mathematics is constructed as institutionalized knowledge through policy discourse, teacher vision, and instructional practice. The analysis produced four dominant thematic categories:

1) Policy discourse and institutional framing,
2) Teacher knowledge and instructional vision,

3) Dominant and alternative instructional practices, and
4) Critical and contextual approaches to mathematics education.

Policy Discourse and the Institutional Framing of School Mathematics

The findings show that policy discourse strongly shapes the institutional form of school mathematics. Nguyen (2024) identifies five dominant discourses: mathematics as a core subject, as sequential and hierarchical, as well-defined and stable, as contested between conceptual and procedural approaches, and as a domain where equity is narrowly reduced to access and achievement. These discourses are embedded in curriculum documents, assessment frameworks, and intervention policies, which in turn regulate classroom practice and define what counts as "normal" and legitimate mathematics learning.

As a result, mathematics instruction is often oriented toward coverage of content and performance on standardized assessments, reinforcing procedural routines and limiting opportunities for deep reasoning. This institutional framing aligns with global patterns reported by Mailizar and Fan (2020) and Osborne (2021), who found that secondary mathematics classrooms remain dominated by drill-based instruction and routine problem solving.

Table 1. Policy Discourses and Their Instructional Implications

Policy Discourse	Institutional Effect	Classroom Implication	Key Sources
Mathematics as core subject	Prioritized over other subjects	High-stakes testing focus	Nguyen, 2024
Sequential & hierarchical	Rigid curriculum sequencing	Limited flexibility	Nguyen, 2024
Well-defined & stable	Fixed body of knowledge	Procedural dominance	Nguyen, 2024
Conceptual vs procedural tension	Pedagogical polarization	Inconsistent instruction	Nguyen, 2024; Osborne, 2021
Equity as access & achievement	Narrow equity framing	Persistent learning gaps	Nguyen, 2024

Source: Author's Synthesis (2025)

Table 1 illustrates the relationship between types of mathematics instructional practices, their institutional roles, and their transformative potential. Procedural drill–based instruction reinforces the dominant institutional image of mathematics as a fixed set of rules and techniques, thereby sustaining a system that prioritizes efficiency and correctness over conceptual understanding. Empirical studies by Mailizar and Fan (2020) and Osborne (2021) indicate that such practices limit conceptual exploration and inhibit the development of higher-order thinking skills.

In contrast, cognitively activating instruction shifts the focus from merely obtaining correct answers toward reasoning, explanation, and mathematical discourse.

Cheng et al. (2023) demonstrate that this form of instruction strongly predicts student achievement by promoting deeper intellectual engagement and conceptual coherence.

Problem-based and inquiry-based learning models further enhance this transformation by positioning students as active constructors of knowledge. However, their effectiveness is highly dependent on teacher expertise, school support systems, and the surrounding learning culture (Hackenberg et al., 2020; Ssali et al., 2025). Consequently, this table underscores that instructional change is not solely a technical adjustment but an institutional and contextual transformation.

Teacher Knowledge and Instructional Vision

Teachers play a central role in maintaining or transforming institutionalized school mathematics. Lee and Santagata (2020) demonstrate that teachers' knowledge of students' mathematical thinking is strongly associated with higher-quality instruction, particularly when school environments support student-centered pedagogy. Similarly, Munter and Wilhelm (2020) show that teachers' instructional visions are shaped through professional networks that stabilize shared beliefs about effective teaching.

University-level mathematics training also influences classroom practice. Even and Mytlis (2024) found that advanced academic mathematics courses encourage teachers to emphasize explanation, definition, and proof, shifting instruction closer to formal deductive structures. Moreover, Lynch et al. (2025) provide meta-analytic evidence that professional development interventions targeting teacher knowledge and instructional practice significantly improve student achievement.

Table 2. Teacher Knowledge, Vision, and Instructional Outcomes

Teacher Factor	Influence on Instruction	Impact on Learning	Key Sources
Knowledge of student thinking	Improves instructional responsiveness	Higher achievement	Lee & Santagata, 2020
Professional networks	Stabilize instructional vision	Coherent teaching practices	Munter & Wilhelm, 2020
University mathematics training	Increases emphasis on proof & explanation	Deeper conceptual learning	Even & Mytlis, 2024
Professional development	Transforms knowledge & practice	Improved student outcomes	Lynch et al., 2025

Source: Author's Synthesis (2025)

Table 2 demonstrates that the quality of mathematics instruction is fundamentally shaped by teacher knowledge, instructional vision, and professional ecosystems. Teachers who possess deep knowledge of students' mathematical thinking are better equipped to design adaptive and responsive instruction, which directly contributes to improved student learning outcomes (Lee & Santagata, 2020).

Professional networks function as institutional mechanisms that stabilize instructional norms. Munter and Wilhelm (2020) show that strong professional

communities reinforce shared visions of effective teaching, thereby strengthening instructional coherence within schools. Moreover, teachers' academic training in advanced mathematics encourages greater emphasis on explanation, proof, and formal reasoning, moving classroom practice closer to authentic mathematical thinking (Even & Mytlis, 2024).

The meta-analysis by Lynch et al. (2025) further confirms that sustained professional development significantly enhances teacher competence and leads to measurable gains in student achievement. Thus, this table emphasizes that transforming school mathematics depends critically on systematic investment in teacher capacity building.

Dominant and Alternative Instructional Practices

The findings reveal a strong contrast between dominant and alternative instructional practices. Dominant practices, including procedural drills and routine exercises, tend to reinforce mathematics as fixed procedures and underutilize technological opportunities (Mailizar & Fan, 2020; Osborne, 2021). In contrast, cognitively activating instruction and classroom discourse challenge the notion of a single correct method and significantly predict student achievement (Cheng et al., 2023).

Problem-based learning, inquiry-based learning, games, and cooperative learning further shift instruction toward active knowledge construction, although their effectiveness depends heavily on teacher expertise and school context (Hackenberg et al., 2020; Bognar et al., 2025; Ssali et al., 2025).

Table 3. Instructional Practices and Transformative Potential

Instructional Focus	Institutional Role	Transformative Potential	Key Sources
Procedural drills	Reinforces procedural mathematics	Low	Mailizar & Fan, 2020; Osborne, 2021
Cognitive activation	Promotes reasoning & discourse	High	Cheng et al., 2023
PBL / IBL / Games	Supports active learning	High (context-dependent)	Hackenberg et al., 2020; Bognar et al., 2025; Ssali et al., 2025

Source: Author's Synthesis (2025)

Table 3 highlights the contributions of critical and contextual approaches in challenging the abstract and ahistorical nature of institutionalized school mathematics. Critical financial education and critical mathematics education expand the function of mathematics beyond cognitive skills, fostering social awareness and critical agency among students (De Alkimim & De Macêdo, 2025; Steflitsch & Kollosche, 2025).

Translanguaging practices in EMI classrooms and instructional models in indigenous schools illustrate how cultural and linguistic contexts can bridge everyday knowledge with academic mathematics (Tai & Wei, 2020; Hatton & Jajalla, 2025). These approaches directly challenge institutional boundaries that traditionally separate school mathematics from students' lived experiences.

Overall, the table demonstrates that integrating cultural context, language diversity, and social realities strengthens the relevance of mathematics learning, enhances student engagement, and supports the development of more equitable and meaningful mathematics education.

Critical and Contextual Approaches to Mathematics

Critical and contextual approaches challenge the abstraction of institutionalized mathematics by embedding learning in social and cultural realities. Critical mathematics education and financial literacy approaches foster students' critical agency, although many learners still perceive them as "non-mathematical" due to their departure from routine computation (De Alkimim & De Macêdo, 2025; Steflitsch & Kollosche, 2025). Studies in indigenous schooling and EMI classrooms demonstrate how translanguaging and local cultural contexts connect everyday knowledge with academic mathematics, disrupting institutional boundaries between school mathematics and lived experience (Tai & Wei, 2020; Hatton & Jajalla, 2025).

Table 4. Critical and Contextual Approaches in Mathematics Education

Approach	Key Features	Educational Contribution	Key Sources
Critical financial education	Uses social-economic issues	Builds critical agency	De Alkimim & De Macêdo, 2025
Critical mathematics education	Questions power & inequality	Promotes social justice	Steflitsch & Kollosche, 2025
Translanguaging (EMI)	Integrates linguistic resources	Connects school & lived knowledge	Tai & Wei, 2020
Indigenous schooling	Contextualized mathematics	Preserves cultural relevance	Hatton & Jajalla, 2025

Source: Author's Synthesis (2025)

Cultural, Philosophical, and Socio-Moral Dimensions of Institutionalized School Mathematics

The findings further reveal that school mathematics is deeply embedded in cultural, philosophical, and socio-moral structures, reinforcing its status as institutionalized knowledge. Danoebroto (2020) demonstrates that ethnomathematics and school mathematics are conceptually interrelated; school mathematics should serve as a bridge that transforms local cultural mathematical practices into formal academic structures. When this cultural dimension is neglected, students tend to perceive mathematics as abstract and detached from their lived realities, thereby weakening engagement and relevance.

Historical perspectives strengthen this interpretation. Mendes (2020) shows that the mobilization of mathematical knowledge for schooling must account for the historical evolution of concepts, enabling learners to recognize mathematics as a socially constructed intellectual product rather than a fixed body of truths. This historical framing contributes to students' reflective awareness of the role of mathematics in human civilization and social development.

From a philosophical standpoint, mathematics instruction is expected to cultivate critical and creative thinking. Darmayanti and Widodo (2024), as well as Marsigit and Rahmadhani, argue that dominant procedural teaching traditions suppress students' reasoning, imagination, and intellectual autonomy. They propose that the ideology of mathematics education must reposition mathematics as a medium for forming rational, reflective, and innovative individuals. This aligns with earlier findings in this study that cognitively activating instruction and dialogic practices challenge the procedural dominance of institutionalized mathematics.

Empirical evidence from Indonesian educational reforms further exposes institutional tensions. Nurulaeni and Rahma (2022) report persistent obstacles in the implementation of *Merdeka Belajar* in mathematics, particularly teacher readiness, limited understanding of differentiated learning, and the endurance of exam-oriented paradigms. Consequently, the transformative goals of autonomy, creativity, and student agency remain underachieved within existing institutional frameworks.

Concerns regarding the relevance of school mathematics are reinforced by Hamin et al. (2025), who identify a substantial gap between academic mathematical demands and the competencies required in everyday life and the workplace. This misalignment contributes to declining student motivation and a weakened perception of the usefulness of mathematics, thereby sustaining institutional rigidity rather than adaptive transformation.

At the professional level, Rustiyana (2023) demonstrates that peer-coaching within teacher learning communities significantly improves mathematics teachers' formative assessment competence. This finding supports the argument that institutional transformation depends heavily on collaborative professional development rather than individual instructional change alone.

Beyond cognition, mathematics education intersects with broader socio-moral challenges. Ismail et al. (2025) and Kholidi and Faradina (2025) emphasize that education plays a crucial role in addressing Indonesia's identity crisis and moral degradation. Mathematics instruction, therefore, should not be isolated from character formation, ethical development, and cultural responsibility. This socio-moral function reinforces the view that institutionalized school mathematics is not merely epistemic but ideological and ethical in nature.

Finally, Delgado-Rebolledo and Zakaryan (2020) confirm that effective mathematics instruction emerges from the integration of mathematical practice knowledge and pedagogical content knowledge (PCK). Teachers who successfully align conceptual understanding with pedagogical strategies produce learning that is both rigorous and meaningful, enabling gradual transformation of institutionalized instructional norms.

CONCLUSION

This study confirms that school mathematics is not merely a collection of neutral concepts but a deeply institutionalized form of knowledge shaped by policy discourses, teacher beliefs, instructional traditions, and cultural ideologies. The persistence of procedural and examination-oriented practices reflects the power of institutional structures in regulating classroom behavior and defining what counts as legitimate mathematical learning. At the same time, the findings demonstrate that cognitively activating instruction, problem-based learning, and critical–contextual approaches offer powerful alternatives for cultivating student agency, conceptual understanding, and social relevance. Meaningful and sustainable reform, therefore, cannot rely on isolated classroom innovations but must be grounded in systemic coherence among curriculum policy, assessment systems, teacher professional development, instructional design, and cultural integration. Future research should investigate concrete institutional redesign strategies that enable schools to sustain equitable, meaningful, and contextually responsive mathematics education in diverse learning environments.

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