Journal for Research in MATHEMATICS LEARNING

Juring (Journal for Research in Mathematics Learning)
p-ISSN: 2621-7430 |e-ISSN: 2621-7422
Volume 8, Issue 4, December 2025, 365 – 380
DOI: http://dx.doi.org/10.24014/juring.v8i4.38506

Reconstruction of the Epistemology of Mathematics Education: Integration of the Rationality of the Philosophy of Science and the Emotional Psychology of Students

Aisyah Nursyam[1*], Abdullah Sinring[2], Syamsu Kamaruddin[3] and Muhammad Rizal Usman[4]

[1] *Mathematics Education, Makassar State University, Makassar, Indonesia*
[2,3] *Guidance and Counseling, Makassar State University, Makassar, Indonesia*
[4] *Mathematics Education, Muhammadiyah University of Makassar, Makassar, Indonesia*
[*]*E-mail: aisyah.nursyam@student.unm.ac.id*

Abstract. This study aims to reconstruct the epistemology of mathematics education by integrating the philosophy of science and students' emotional psychology. The epistemological crisis in mathematics learning is characterized by the dominance of rationalistic approaches that tend to ignore students' affective and reflective dimensions. Empirical evidence indicates a high level of mathematics anxiety and low emotional engagement, both of which affect students' motivation and academic performance. This research employs a Systematic Literature Review (SLR) method based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol by analyzing 45 national and international articles published between 2012 and 2025. Data were analyzed thematically through three stages: conceptual coding, thematic classification, and interpretative synthesis. The review identifies four main themes: (1) epistemology of mathematics education and the philosophy of science, (2) emotional intelligence and self-reflection, (3) mathematics anxiety and affective resilience, and (4) learning motivation and academic achievement. The integration of the philosophy of science reorganizes rationality in mathematics education to be more reflective and humanistic, while emotional psychology balances cognition and affection. The conceptual model positions the epistemology of mathematics education as the core, interacting dynamically with emotional intelligence, mathematics anxiety, and learning motivation that together influence students' academic performance. The findings emphasize the need to reconstruct the epistemology of mathematics education toward a balance between rationality and emotional awareness. Accordingly, mathematics learning should be developed through reflective, humanistic, and experience-based approaches to foster students as epistemic subjects who think rationally and mature emotionally.

Keywords: emotional intelligence; epistemology of education; learning motivation; mathematics anxiety; philosophy of science

Abstrak. Penelitian ini bertujuan merekonstruksi epistemologi pendidikan matematika melalui integrasi filsafat ilmu dan psikologi emosional mahasiswa. Krisis epistemologis dalam pembelajaran matematika ditandai oleh dominasi pendekatan rasionalistik yang mengabaikan aspek afektif dan reflektif mahasiswa. Fenomena empiris menunjukkan tingginya kecemasan matematika (mathematics anxiety) dan rendahnya keterlibatan emosional yang berdampak pada motivasi serta prestasi belajar. Penelitian ini menggunakan metode Systematic Literature Review (SLR) berbasis protokol PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) dengan menganalisis 45 artikel nasional dan internasional terbitan 2013–2025. Analisis dilakukan secara tematik melalui tiga tahap, yaitu koding konseptual, klasifikasi tematik, dan sintesis interpretatif. Hasil kajian menghasilkan empat tema utama: (1) epistemologi pendidikan matematika dan filsafat ilmu, (2) kecerdasan emosional dan refleksi diri, (3) kecemasan matematika dan ketahanan afektif, serta (4) motivasi belajar dan prestasi akademik. Integrasi filsafat ilmu menata ulang rasionalitas pembelajaran menjadi lebih reflektif dan humanistik, sedangkan psikologi emosional membantu menyeimbangkan kognisi dan afeksi. Model konseptual yang dihasilkan menempatkan epistemologi pendidikan matematika sebagai inti yang berinteraksi dengan kecerdasan emosional, kecemasan

matematika, dan motivasi belajar yang secara sinergis memengaruhi prestasi akademik mahasiswa. Hasil penelitian menegaskan pentingnya rekonstruksi epistemologi pendidikan matematika yang berorientasi pada keseimbangan antara rasionalitas dan kesadaran emosional. Implikasinya, pembelajaran matematika perlu dikembangkan secara reflektif, humanistik, dan berbasis pengalaman agar mahasiswa mampu menjadi subjek epistemik yang berpikir rasional sekaligus matang secara emosional.

Kata kunci: epistemologi pendidikan; filsafat ilmu; kecerdasan emosional; kecemasan matematika; motivasi belajar

INTRODUCTION

Mathematics education is philosophically rooted in debates about how mathematical knowledge is constructed, validated, and transferred to students. The classical epistemological view of mathematics holds that it is rational knowledge that is a priori, deductive, and detached from the human emotional dimension (Daulay et al., 2022). This results in a learning approach that overemphasizes logical rationality while neglecting students' affective and psychological aspects as epistemic subjects. Consequently, mathematics learning loses its humanistic meaning and tends to form cognitive routines devoid of reflection and emotional engagement. In other words, rational epistemological issues are inseparable from students' emotional states, which directly influence how they understand and interpret knowledge.

This crisis of meaning in mathematics education is reflected in the learning orientation that still positions students as passive recipients of knowledge, characterized by low cognitive and emotional engagement, limited ability to relate mathematical concepts to real contexts, and limited independent learning initiatives, indicating a lack of personal meaning in the material being studied. The philosophy of science highlights this problem through the study of educational epistemology that demands a balance between the rational and emotional dimensions. Ernest et al. (2016) emphasizes that the philosophy of mathematics education has a responsibility to analyze the structure of knowledge as well as the social and affective values inherent in teaching and learning practices. This view is reinforced by Sukarma (2013) and Zalukhu et al. (2023), who emphasize that educational epistemology must be oriented towards the construction of meaning and reflective experience, not merely formal reasoning. Thus, the relationship between epistemology and emotion is not two separate domains, but two complementary dimensions in the process of mathematical meaning formation.

Empirical studies have shown that this epistemological crisis directly affects students' psychological well-being. Epistemological obstacles in learning mathematics are often accompanied by anxiety, conceptual confusion, and low motivation to learn (Koly et al., 2023; Rahmah & Maarif, 2021). The phenomenon of mathematics anxiety (MA) is increasing among mathematics education students and negatively affects conceptual understanding abilities (Handayani, 2019). Disai, Dariyo, and Basaria (2017) found that mathematics anxiety is negatively correlated with academic self-efficacy, while high self-confidence is positively correlated with learning readiness. These empirical findings indicate that students' epistemological processes are driven not only by reasoning structures but also by emotional stability, which shapes their mental readiness to understand mathematical concepts.

In contrast to anxiety, various recent studies have shown that emotional intelligence (EQ) plays a crucial role in shaping academic resilience and success in mathematics learning. A meta-analysis by Naufal Aljura, Retnawati, and Bondan Widjajanti (2024) revealed that emotional intelligence significantly impacts learning outcomes, with a combined effect size of 0.662. This finding is consistent with Asare's (2025) research, which suggests that metacognitive awareness acts as a significant mediator between EQ and mathematics achievement. Meanwhile, Schukajlow, Rakoczy, and Pekrun (2023) observed in their research that positive emotions, such as curiosity and enjoyment in learning, contribute to increased students' motivation and academic engagement.

On the other hand, research by Ambarwati, Nurwahidin dan Sudjarwo (2022) and Dela Citra Sabrina and Kusuma (2025) confirms that mathematics learning based on the philosophy of science, particularly through the Realistic Mathematics Education (RME) approach and reflective constructivism, has the potential to foster students' creativity and epistemic awareness. However, most existing theories of mathematics learning remain dominated by cognitive and constructivist paradigms, which tend to ignore students' affective-emotional aspects. This disconnect creates a significant theoretical gap between the epistemology of mathematics education and emotional psychology (Suratiningsih & Prasetyo, 2024). Therefore, integrating the philosophy of science and emotional psychology is an epistemological and pedagogical necessity that must be addressed immediately in mathematics education theory.

This gap indicates the need to reconstruct the epistemology of mathematics education so that it is not only based on logical rationality but also on students' emotional awareness and self-reflection. This approach aligns with the ideas of Tarigan et al. (2022) and Purnomo & Mansur (2024), who emphasize the importance of integrating ontological, epistemological, and axiological dimensions in education. This epistemological reconstruction, grounded in the philosophy of science and emotional psychology, is expected to present a new paradigm for holistic mathematics learning that combines rational and emotional intelligence in constructing meaningful learning.

Based on this framework, this study attempts to reconstruct the theory of mathematics education by reviewing the philosophy of science and students' emotional psychology. Specifically, this study answers two main questions: (1) how previous research results reconstruct the theory of mathematics education from the psychological aspects of students, and (2) how the philosophy of science can be used as a basis for the epistemological reconstruction of the theory of mathematics learning. This study systematically analyzes 45 international and national articles published between 2013 and 2025 using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach.

Structurally, this article is organized into five sections. The first section presents the philosophical and empirical background as the epistemological context of the study. The second section explains the PRISMA-based SLR method used to explore and categorize the literature. The third section presents the main findings regarding the relationship between the epistemology of mathematics education and students' emotional psychology. The fourth section discusses the reconstruction model of the epistemology of mathematics education based on a synthesis of the philosophy of science and emotional psychology. The final section presents conclusions and conceptual implications for the theory and practice of mathematics learning in higher education.

METHOD

This study uses a Systematic Literature Review (SLR) approach with qualitative analysis, following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. In addition, each article included through the selection process also undergoes a systematic quality assessment, including evaluation of the relevance of the substance, clarity of research objectives, the appropriateness of the methodological design, data collection and analysis procedures, and the strength of the evidence generated, so that only studies that meet scientific standards are used in the final synthesis. This method was chosen because it provides a systematic, transparent, and replicable procedure for searching, selecting, and synthesizing research results relevant to the study's focus on the reconstruction of the epistemology of mathematics education from the perspectives of the philosophy of science and students' emotional psychology. The SLR-PRISMA approach enables researchers to integrate previous research findings from diverse paradigms and methodological approaches into a coherent, theoretically grounded conceptual framework.

This study began by identifying scientific articles through searches across various reputable academic databases, namely Scopus, ERIC, DOAJ, Google Scholar, and SINTA. The search was

conducted using a combination of keywords, including epistemology of mathematics education, philosophy of mathematics education, emotional intelligence, mathematics anxiety, student motivation, and reflective learning.

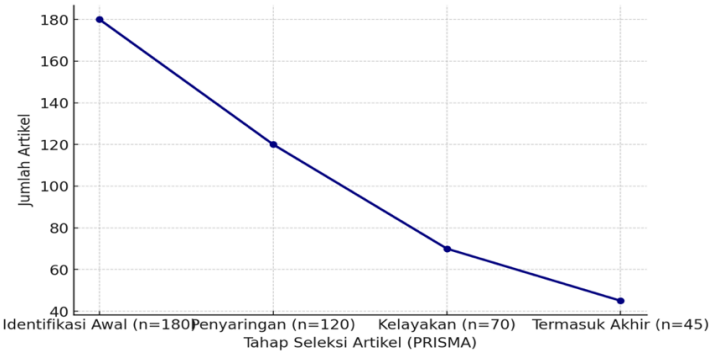

Figure 1: Integration Prism Diagram of Educational Epistemology-EQ-MA-Motivation-Achievement

The initial search yielded 180 articles generally relevant to the philosophy of mathematics education and the psychology of learning. Titles and abstracts were then screened to ensure their relevance to the research theme, yielding 120 articles that met the initial criteria. A feasibility study was then conducted, with an in-depth review of the articles' content to assess their relevance to the epistemology of mathematics education and the psychological aspects of students. In the final, or inclusion, stage, only 45 articles met all criteria and were used as primary sources in this analysis.

The inclusion criteria for this study were strictly defined to ensure theoretical and empirical relevance. Articles must have been published between 2013 and 2025, be from reputable national or international journals, and explicitly address topics in the philosophy of science, educational epistemology, mathematics learning, or student emotional psychology. Articles that were purely conceptual in nature without empirical relevance to mathematics education, or conversely, empirical research without an epistemological foundation, were excluded from the analysis. This approach ensures that the reviewed literature truly contributes to the reconstruction of the epistemology of mathematics education, balancing the rational and emotional dimensions.

The analysis was conducted thematically in three stages: conceptual coding, thematic classification, and interpretive synthesis. Conceptual coding was used to identify main themes such as the epistemology of mathematics education, emotional intelligence, mathematics anxiety, learning motivation, and self-reflection to be used to identify main themes such as the epistemology of mathematics education, emotional intelligence, mathematics anxiety, learning motivation, and self-reflection, by Reading each article in depth, marking sections containing core concepts, then grouping these pieces of information into similar meaning categories. The coding process was carried out iteratively through manual recording and digital tagging, so that each recurring concept could be confirmed, compared, and synthesized into a stable theme construction. These themes were then categorized into four large clusters, namely (1) the epistemology of mathematics education, (2) emotional intelligence and self-reflection, (3) mathematics anxiety and negative affective factors, and (4) learning motivation and academic achievement. Interpretive synthesis is used to examine the relationships among themes and to build a conceptual model for reconstructing the epistemology of integrative mathematics education.

RESULT AND DISSCUSSION

The results of a systematic analysis using the PRISMA method of 45 articles show that the reconstruction of the epistemology of mathematics education can be understood through four main themes, namely: (1) epistemology of mathematics education and philosophy of science, (2) emotional intelligence (EQ) and student self-reflection, (3) mathematics anxiety (MA) and affective resilience, and (4) learning motivation and its implications for academic achievement.

Table 1. Article Synthesis Matrix (PRISMA Method)

No	Author (Year)	Title (summary)	Main findings	Implications for student psychology
1.	(Daulay et al., 2022)	A study of the epistemology of mathematics and science	Emphasizes mathematics as a priori (deductive) knowledge and its methodological differences from the natural sciences.	Emphasizes the need to build students' cognitive confidence in deductive reasoning; has implications for learning strategies that strengthen logical justification (reducing cognitive anxiety related to abstraction).
2.	(Rahmah & Maarif, 2021)	Epistemological analysis of obstacles for grade VII junior high school students with statistical material (data presentation)	There are conceptual, procedural, and operational technical barriers; for example, calculation errors and conceptual misconceptions account for 100% of the total.	Shows that conceptual misconceptions trigger academic uncertainty → cause performance anxiety and reduce self-efficacy; recommends pedagogical interventions that target cognitive and emotional aspects.
3.	(Koly et al., 2023)	Analysis of learning obstacles from the epistemological aspect in problem solving	Errors were found in determining formulas, calculations, and solution steps; only 1 in 3 understood ≥2 indicators.	Confirming the relationship between teaching strategies (contextual practice) and students' psychological conditions: the habit of routine questions reduces cognitive resilience when faced with non-routine questions → reduces motivation and increases frustration.
4.	(Sukarma, 2013)	Epistemology, constructivism, and discovery learning mathematics	Obstacles arise due to limited familiarity with non-routine questions and low interest; students tend to write answers directly without any procedure.	Demonstrates the role of interest (motivation) and pedagogical habits on students' psychological state (interest, attention, and self-regulation)—recommendations: variety of questions & strengthening metacognition to increase cognitive self-confidence.
5.	(Andriani, 2023)	Construction and implementation of philosophy of science (mathematics & mathematics education)	Presenting ontological/epistemological views and linking them to learning approaches (constructivism, open-ended).	Recommending learning approaches that foster students' epistemic dispositions (reflection, argumentation), is important for building cognitive resilience and reducing anxiety related to abstract tasks..
6.	(Wijayanto, 2023)	Construction and implementation of the philosophy of educational science	Explains various views (absolutism, relativism, fallibilism) and pedagogical implications (open-ended, constructivism).	Emphasizes the need to develop epistemic dispositions and teaching strategies that also consider students' affective aspects (epistemic security, interest, self-efficacy).
7.	(Zalukhu et al., 2023)	The position and role of philosophy in mathematics learning	Presents the scope of the philosophy of mathematics (epistemology, ontology, methodology, logic) and its relationship to learning	Suggesting the use of the Socratic method and reflective dialogue to improve epistemic dispositions that have a positive impact on students' cognitive maturity and

No	Author (Year)	Title (summary)	Main findings	Implications for student psychology
			practices and the Socratic method.	reduce academic anxiety when dealing with abstract concepts.
8.	(Rifai et al., 2025)	SLR on integration of epistemological theories in educational management	Epistemology (constructivism, empiricism, rationalism, pragmatism) influences planning, evaluation, and governance; challenge: low epistemic literacy among decision-makers.	Relevance**:** At the institutional level, a lack of epistemic literacy affects curriculum design and learning environments, thereby impacting students' psychological well-being (e.g., isolation, self-confidence)—recommendations: epistemic training for teachers and curricula that integrate affective aspects.
9.	(Ernest et al., 2016)	An Overview of the Philosophy of Mathematics Education	The philosophy of mathematics education analyzes and critiques claims about the practice of mathematics education.	Emphasizes the need for learning interventions that consider the emotional aspects of students who miss conceptual reinforcement before procedural manipulation to reduce anxiety and increase cognitive resilience.
10.	(Indah & Kadarisma, 2023)	Epistemological analysis of obstacles faced by vocational school students in the material of composition functions	Individuals actively construct knowledge; cognitive conflict drives the formation of new concepts.	Encourage students' learning independence and self-efficacy in understanding mathematical concepts.
11.	(Munawwaroh et al., 2025)	Epistemological Obstacles in the Process of Learning Mathematical Abstraction: SLR	55% dominant epistemological barriers; difficulties in representation & reflection of concepts	Epistemic barriers reduce self-efficacy; recommendations for reflective approaches & scaffolding for emotion regulation.
12.	(Tarigan et al., 2022)	Direction and Orientation of Philosophy of Science in Indonesia	The philosophy of science in Indonesia is still Western-oriented; it needs to be integrated with Islamic and local paradigms.	Building critical awareness and epistemic identity of students through paradigm reflection
13.	(Eka et al., 2025)	The Influence of Epistemological Beliefs on Learning Outcomes of Sequences and Series	Epistemological beliefs significantly influence mathematics learning outcomes.	Epistemological beliefs contribute to intrinsic motivation and academic self-confidence.
14.	(Ambarwati et al., 2022)	Educational Philosophical Study of PMRI's Approach	RME emphasizes progressive mathematization and interactivity	This approach increases students' creativity and self-confidence through contextual learning.
15.	(Suratiningsih & Prasetyo, 2024)	Learning Geometry from an Epistemological	Integration of epistemological philosophy	Cultivating reflective awareness and intellectual curiosity in prospective teacher students

No	Author (Year)	Title (summary)	Main findings	Implications for student psychology
		Philosophical Perspective	encourages students' critical and reflective thinking.	
16.	(Sabrina & Kusuma, 2025)	Integration of Epistemological and Ontological Dimensions in Mathematics Learning	The integration of epistemology and ontology strengthens conceptual and reflective understanding.	Developing students' philosophical thinking disposition and cognitive regulation in interpreting concepts
17.	(Tarigan et al., 2022)	Epistemology as the Foundation of Education	Epistemology determines the direction of knowledge and educational methods.	Increase students' awareness of the sources and validity of mathematical knowledge.
18.	(Fairus et al., 2022)	The Relationship between Mathematical Philosophy and IT-Based Learning Models	Mathematical philosophy influences constructivism-based and IT-based learning design; IT integration improves students' mathematical motivation and abilities.	The integration of philosophy and IT in learning fosters students' curiosity, intrinsic motivation, and self-confidence in the mathematics learning process.
19.	(Purnomo & Mansur, 2024)	Study of Ontology, Epistemology, and Axiology in the World of Education	Education is the practical application of philosophy; the aspects of ontology, epistemology, and axiology form the basis of scientific thinking.	Cultivating students' philosophical reflection to understand the nature of knowledge and increasing reflective learning awareness (metacognitive awareness)
20.	(Rani, 2023)	Implementation of Project-Based Learning from the Perspective of Ontology and Epistemology of the Philosophy of Mathematics Education	The PjBL model, based on constructivist philosophy, is effective in developing conceptual knowledge and social skills.	Students experience increased responsibility, collaboration, and self-efficacy through epistemic reflection in learning projects.
21.	(Luthfiyah & Khobir, 2023)	Study of Ontology, Epistemology, and Axiology in Islamic Education in Indonesia	Three dimensions of philosophy (ontology, epistemology, axiology) form the foundation of humanistic Islamic education.	Encourage students to think critically and reflectively about human values and spirituality in mathematics learning.
22.	(Amini et al., 2025)	Effective Strategies for Overcoming Math Anxiety Through Learning Approaches	Effective strategies: Emotional Freedom Technique (EFT), ethnomathematics, peer tutoring, RME, STEM, scientific, and brain-based learning	Affective and context-based strategies reduce anxiety and increase mathematical self-confidence.
23.	(Asare & Larbi, 2025)	Nexus Between Emotional Intelligence and Mathematics Performance: The Role of	EI and metacognitive awareness have a positive effect on mathematics performance; metacognitive awareness mediates and	Shows that emotion regulation and metacognitive reflection are important for reducing academic stress and increasing self-efficacy.

No	Author (Year)	Title (summary)	Main findings	Implications for student psychology
		Metacognitive Awareness	moderates the EI-achievement relationship.	
24.	(Disai et al., 2017)	The Relationship between Mathematics Anxiety and Self-Efficacy with High School Students' Mathematics Learning Outcomes	Mathematics anxiety is negatively related to learning outcomes ($r = -0.196$), whereas self-efficacy is positively related ($r = 0.210$).	High self-efficacy reduces anxiety and increases cognitive readiness in facing math exams.
25.	(Aljura et al., 2024)	A Meta-Analysis: The Effect of Emotional Intelligence on Students' Mathematics Learning Outcomes	The combined effect of EI on learning outcomes = 0.662 (moderate effect); highest in junior high schools and the Kalimantan–NTT–Maluku region	Strengthening the role of EI in mathematics achievement; recommending EI training in instruction and curriculum
26.	(Anino & Ubalde, 2025)	Socio-Emotional Learning Skills in Mathematics: A Systematic Literature Review	SEL (self-awareness, regulation, empathy, motivation) competencies increase academic resilience and student engagement.	Strengthening SEL skills affects students' emotional regulation and persistence in problem-solving.
27.	(Cintami et al., 2022)	The Influence of Emotional Intelligence on Mathematical Problem-Solving Ability	There is a significant influence ($t = 6.696$; $F = 44.842$; $p < 0.05$) between EI and problem solving abilities	EI helps students manage emotions and focus on logical thinking, relevant for student teachers in reflective learning.
28.	(Lei et al., 2025)	Mathematics Anxiety, Trait Emotional Intelligence, and Self-Concept: Pathways to Academic Achievement	Math anxiety lowers performance through self-concept; EI acts as a psychological protector	EI strengthens emotional resilience and positive self-concept against math anxiety
29.	(Defi et al., 2021)	Junior High School Students' Mastery of Mathematical Concepts Reviewed from Epistemological Beliefs About Mathematics and Emotional Intelligence	There is a significant relationship between epistemological beliefs about mathematics and students' mastery of mathematical concepts.	Students with high affective regulation showed decreased anxiety and increased reflective focus.
30.	(Auliya, 2016)	Mathematics anxiety and mathematical understanding	Dominant factors: negative experiences, authoritarian methods, and low self-confidence	A humanistic and dialogical approach is recommended to increase students' sense of affective safety.

No	Author (Year)	Title (summary)	Main findings	Implications for student psychology
31.	(Asare, 2025)	Epistemological belief, reflective thinking and mathematics interest as a predictor of students' mathematics performance: mediation analysis via structural equation modeling (SEM)	The combined contribution of EI + metacognitive is significant to achievement ($\beta = 0.74$, $p < 0.05$)	Learning that integrates EI and metacognitive reflection reduces academic stress and increases intrinsic motivation.
32.	(Maharani, 2024)	Analysis of Socio-emotional Development in Mathematics Learning Through Multi-representative Based Test Instruments	Emotions play a role in motivation and persistence in learning mathematics.	Provides an understanding that good emotional management increases self-confidence, reduces academic stress, and encourages positive attitudes towards mathematics.
33.	(Astuti et al., 2024)	Analysis of Students' Emotional Intelligence in Mathematics Learning	Low EQ especially in the aspects of motivation and initiative	This shows that low EQ has an impact on decreasing intrinsic motivation and student learning initiative, so that learning interventions based on reflection and affection are needed.
34.	(Anggraini et al., 2022)	The Influence of Emotional Intelligence and Learning Motivation on Students' Mathematics Learning Outcomes	EQ → learning outcomes (68.6%), motivation → learning outcomes (30.9%)	This illustrates that students with high EQ are better able to manage learning stress, maintain focus, and maintain academic tenacity.
35.	(Handayani, 2019)	The Influence of Mathematics Anxiety on Understanding of Mathematical Concepts	Anxiety negatively affects conceptual understanding	It shows that excessive anxiety inhibits students' logical thinking processes and reduces their ability to understand mathematical concepts in depth.
36.	(Prasetyo & Dasari, 2023)	Identification of Anxiety and Learning Motivation on Mathematics Learning Outcomes	Anxiety reduces performance, motivation	This illustrates that students who have high motivation are able to suppress academic anxiety and increase confidence in solving mathematical problems.
37.	(Schukajlow et al., 2023)	Emotions and Motivation in Mathematics Education	Emotions and motivation influence each other in learning	Shows that happiness, curiosity, and interest play an important role in creating emotional resilience and students' focus on learning mathematics.

No	Author (Year)	Title (summary)	Main findings	Implications for student psychology
38.	(Panduwinata et al., 2023)	The Influence of Emotional Intelligence on Students' Understanding of Mathematical Concepts	It turns out that emotional intelligence has a big influence on understanding concepts.	Shows that students with high emotional intelligence are calmer, more focused, and more confident when facing complex mathematical tasks.
39.	(Khatimah et al., 2025)	The Influence of Basic Mathematical Knowledge on Students' Epistemological Beliefs and Interest in Learning Mathematics	EQ influences learning strategies	Shows that students who are able to recognize and regulate emotions tend to use reflective and independent learning strategies.
40.	(Lyany et al., 2024)	Analysis of High School Students' Mathematical Anxiety Levels from a Neuroscience and Epistemology Perspective	One student experienced high levels of math anxiety, while 13 others experienced moderate levels. The most common cognitive math anxiety was 37.1%. Common symptoms included forgetting formulas and feeling overwhelmed when working on math assignments requiring higher-order thinking.	Demonstrates the importance of psychological support for students in overcoming academic anxiety so that they are able to develop adaptive and resilient learning patterns.
41.	(Gómez-Chacón & Marbán, 2024)	Epistemic emotions and pre-service mathematics teachers' knowledge for teaching	Positive emotions increase learning engagement	It confirms that students with positive emotions are more active, persistent, and show emotional resilience to the academic pressures of mathematics.
42.	(Ghufron & Suminta, 2017)	The relationship between epistemological beliefs and self-regulation in learning in students	There is a significant negative relationship between epistemological beliefs and self-regulated learning. Students with flexible and reflective epistemological beliefs have higher self-regulation than those with rigid views.	Students with open epistemological beliefs are better able to regulate their emotions, think reflectively, and develop intrinsic motivation in learning. These findings underscore the importance of learning that fosters epistemic awareness and a balance between rationality and emotional regulation.

After synthesizing 45 articles that met the inclusion criteria, a set of main themes emerged, conceptually interconnected. These findings were then analyzed in depth to identify patterns of interrelationships among variables that shape the epistemology of mathematics education from the perspective of students' emotional psychology. The relationships between these variables include the role of Educational Epistemology as a conceptual foundation, Emotional Intelligence (EQ) as an affective reinforcer, Mathematics Anxiety (MA) as an inhibiting factor, Learning Motivation as an epistemic driver, and Academic Achievement as the final learning outcome. To clarify the interactions between these components, the following figure displays a Thematic Network that

visualizes the epistemological and emotional relationships in the reconstruction of mathematics education.

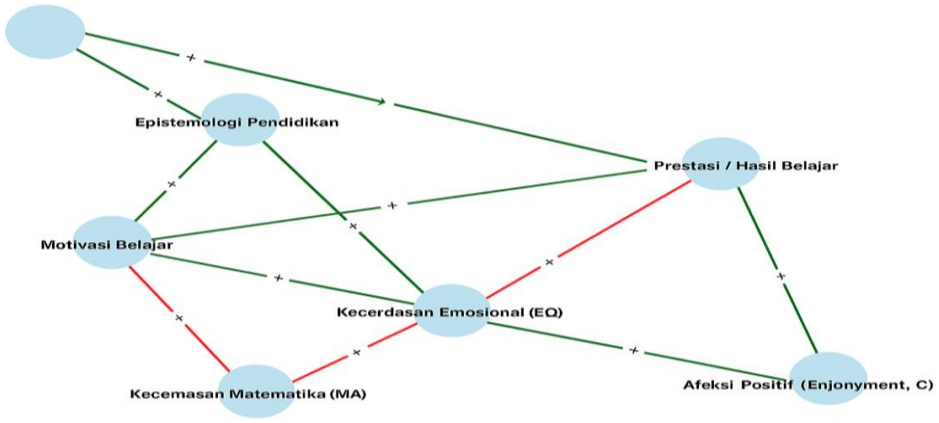

Figure 2. Relationship between Education Epistemology-EQ-MA-Achievement Motivation

Philosophically, the epistemology of mathematics education remains dominated by rationalistic and constructivist paradigms that position knowledge as the product of logical reasoning and cognitive experience alone (Daulay et al., 2022; Ernest et al., 2016). This paradigm ignores the role of emotional, social, and reflective dimensions in mathematics learning, leading students to experience epistemic alienation in the thinking process (Sukarma, 2013). Reconstruction of epistemology needs to be directed towards a more humanistic approach, where rationality is combined with emotional awareness (Tarigan et al., 2022; Zalukhu et al., 2023).

Empirical findings demonstrate that emotional intelligence (EQ) plays a significant role in improving students' understanding and resilience in learning. A meta-analysis (Aljura et al., 2024) demonstrated a positive association between EQ and mathematics achievement, while Asare and Larbi (2025) confirmed that metacognitive awareness is a significant mediator of the relationship between EQ and academic performance. The integration of self-reflection and emotional regulation has been shown to foster students' self-efficacy and intrinsic motivation (Dzulfikar, 2016).

Conversely, mathematics anxiety (MA) negatively impacts conceptual ability and learning resilience. Research (Disai et al., 2017) and (Handayani, 2019) show a strong negative correlation between anxiety and academic achievement. Affect-based approaches such as emotional freedom technique (EFT), peer tutoring, and ethnomathematics are effective in reducing anxiety and increasing self-confidence (Amini et al., 2025; Laily & Lestari, 2024). This suggests that emotional balance is a prerequisite for the formation of meaningful mathematical knowledge.

Furthermore, learning motivation emerged as a connecting variable between EQ, MA, and academic achievement. Studies by Anggraini et al. (2022) and Prasetyo and Dasari (2023) showed that intrinsic motivation helps reduce anxiety and strengthen students' self-confidence. Positive emotions such as curiosity and enjoyment of learning (Schukajlow et al., 2023) contribute to academic resilience and active engagement in learning. Thus, motivation is not only psychological but also epistemic—as it influences how students interpret and construct mathematical knowledge.

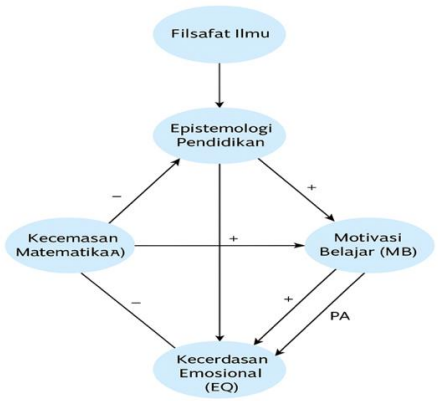

Figure 3. Conceptual Model of Reconstruction of Epistemology of Mathematics Education

The synthesis of these four themes yields a conceptual model for reconstructing the epistemology of mathematics education, oriented toward integrating the philosophy of science and students' emotional psychology. This model positions the Epistemology of Mathematics Education as a foundation that dynamically interacts with EQ, MA, and Motivation, which collectively influence Academic Achievement. This model demonstrates that the philosophy of science serves as a reflective foundation that guides students in understanding the nature of knowledge. At the same time, emotional psychology maintains affective stability, enabling the mathematical thinking process to take place adaptively and meaningfully.

The results of this study confirm that the reconstruction of the epistemology of mathematics education must be directed at a balance between rationality and emotionality, between cognition and affect. The philosophy of science provides a theoretical basis for restructuring thinking paradigms, while emotional psychology offers an empirical mechanism for developing students' affective resilience. The integration of the two creates a more reflective, humanistic, and relevant epistemology of mathematics education to meet the needs of modern learning.

CONCLUSION

A systematic review of 45 articles, conducted according to the PRISMA method, indicates that the reconstruction of the epistemology of mathematics education should focus on integrating the philosophy of science and students' emotional psychology. Philosophically, the paradigm of mathematics education, which is too rationalistic and constructivist, does not fully reflect the nature of human learning, which is also influenced by the affective dimension. The philosophy of science serves as a conceptual foundation for restructuring epistemology to be more reflective and humanistic. At the same time, emotional psychology provides a basis for pedagogical practice that balances students' rationality and affect in their understanding of mathematical knowledge.

Empirically, emotional intelligence, learning motivation, and self-reflection have been shown to positively influence academic achievement, while math anxiety is a major inhibiting factor that reduces understanding and learning resilience. Therefore, meaningful mathematics learning must combine logical rationality with emotional awareness through a reflective, humanistic, and experience-based approach. The results of this study imply the need to develop a mathematics learning model and curriculum that balances logic and empathy, so that students not only understand concepts intellectually but also internalize them emotionally and reflectively.

However, this study has limitations in its data sources, namely that it covers only articles indexed in Scopus, DOAJ, Google Scholar, and SINTA databases between 2013 and 2025. These limitations in the period and accessibility of the databases have the potential to create publication bias and do not fully reflect the latest research from non-English-language journals or relevant local studies. Therefore, further research is recommended to expand data sources and deepen empirical

analysis through experimental or mixed-method studies so that the reconstruction of the epistemology of mathematics education can be tested more comprehensively.

REFERENCES

Aljura, A. N., Retnawati, H., & Widjajanti, D. B. (2024). A Meta-Analysis : The Effect of Emotional Intelligence on Students ' Mathematics Learning Outcomes in Indonesia. *Jurnal Riset Pendidikan Matematika*, *11*(2), 77–89. https://doi.org/http://dx.doi.org/10.21831/jrpm.v11i2.71116

Ambarwati, S., Nurwahidin, M., & Sudjarwo. (2022). Kajian filosofis edukatif pendekatan pembelajaran RME (Realistic Mathematics Education) di Indonesia. *Journal of Innovation Research and Knowledge*, *2*(7), 2703–2712. https://doi.org/https://doi.org/10.53625/jirk.v2i7.4189

Amini, A., Fuat, Supriyo, & Ariyanto, E. A. (2025). Systematic Literature Review : Strategi Efektif Cara Mengatasi Kecemasan Matematika Pada Peserta Didik melalui Pendekatan Pembelajaran. *Sindoro : Cendikia Pendidikan*, *15*(12), 41–50. https://doi.org/https://doi.org/10.99534/p5rtpa29

Andriani, N. (2023). *Konstruksi Dan Implementasi Filsafat Ilmu: Matematika Dan Pendidikan Matematika*. https://doi.org/https://id.scribd.com/document/690949219/Konstruksi-Dan-Implementasi-Filsafat-Ilmu-Matematika-Dan-Pendidikan-Matematika

Anggraini, T. P., Abbas, N., Oroh, F. A., & Pauweni, K. A. Y. P. (2022). Pengaruh Kecerdasan Emosional dan Motivasi Belajar Terhadap Hasil Belajar Matematika Siswa. *Jambura Journal of Mathematics Education*, *3*(1), 1–9. https://doi.org/https://doi.org/10.34312/jmathedu.v3i1.11807

Anino, M. P., & Ubalde, M. V. (2025). Socio-Emotional Learning Skills in Mathematics : A Systematic Literature Review. *Journal of Innovations in Teaching and Learning*, *5*(1), 44–48. https://doi.org/10.12691/jitl-5-1-7

Asare, B. (2025). Epistemological belief , reflective thinking and mathematics interest as a predictor of students ' mathematics performance : mediation analysis via structural equation modeling (SEM). *Cogent Education*, *12*(1). https://doi.org/10.1080/2331186X.2025.2542437

Asare, B., & Larbi, E. (2025). Nexus between emotional intelligence and mathematics performance : the role of metacognitive awareness. *Cogent Education*, *12*(1). https://doi.org/10.1080/2331186X.2025.2450117

Astuti, I., Rahmi, D., Yuniati, S., & Kurniati, A. (2024). Analisis kecerdasan emosional siswa pada pembelajaran matematika 1,2,3,4. *Jurnal Penelitian Pembelajaran Matematika Sekolah (JP2MS)*, *8*(1), 34–45. https://doi.org/https://doi.org/10.33369/jp2ms.8.1.34-45

Auliya, R. N. (2016). Kecemasan Matematika dan Pemahaman Matematis. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *6*(1), 12–22. https://doi.org/10.30998/formatif.v6i1.748

Cintami, F. A., Cahyadi, F., & Budiman, M. A. (2022). Pengaruh Tingkat Kecerdasan Emosional Terhadap Kemampuan Pemecahan Masalah Matematika Siswa Kelas V. *DIKDAS MATAPPA: Jurnal Ilmu Pendidikan Dasar*, *1*(20), 70–78. https://doi.org/https://doi.org/10.31100/dikdas.v5i1.1491

Daulay, L. S., Salminawati, Elmi, N., & Parapat, I. K. (2022). Epistemologi Filsafat dan Sains Perspektif Barat dan Islam dalam Dunia Pendidikan. *Scaffolding: Jurnal Pendidikan Islam Dan Multikulturalisme*, *4*(3), 408–421. https://doi.org/https://doi.org/10.37680/scaffolding.v4i3.2122

Defi, S. L., Parta, I. N., & Permadi, H. (2021). Penguasaan Konsep Matematika Siswa SMP Ditinjau dari Keyakinan Epistemologis tentang Matematika dan Kecerdasan Emosional.

AKSIOMA: Jurnal Program Studi Pendidikan Matematika, *10*(3), 1963–1972. https://doi.org/https://doi.org/10.24127/ajpm.v10i3.3690

Disai, W. I., Dariyo, A., & Basaria, D. (2017). Hubungan antara Kecemasan Matematika dan Self-Efficacy dengan Hasil Belajar Matematika Siswa SMA X Kota Palangka Raya. *Jurnal Muara Ilmu Sosial, Humaniora, Dan Seni*, *1*(2), 556–568. https://doi.org/https://doi.org/10.24912/jmishumsen.v1i2.799

Dzulfikar, A. (2016). Kecemasan matematika pada mahasiswa calon guru matematika. *Jurnal Matematika Dan Pendidikan Matematika*, *I*(1), 34–44. https://doi.org/https://doi.org/10.26594/jmpm.v1i1.508

Eka, F., Yani, A., Siregar, N., & Meldi, N. F. (2025). Analisis Hambatan Epistemologi dikaji dari Kemampuan Menyelesaikan Masalah Kontekstual Barisan dan Deret Geometri. *JP2M (Jurnal Pendidikan Dan Pembelajaran Matematika)*, *11*(1), 474–484. https://doi.org/https://doi.org/10.29100/jp2m.v11i1.6732

Ernest, P., Skovsmose, O., Bendegem, J. P. V., Bicudo, M., Miarka, R., Kvasz, L., & Moeller, R. (2016). *The Philosophy of Mathematics Education : An overview of the philosophy of mathematics education*. Springer Open.

Fairus, Dewi, I., & Simamora, E. (2022). Keterkaitan Filsafat Matematika dengan Model Pembelajaran Berbasis IT. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *07*(1), 538–549. https://doi.org/https://doi.org/10.31004/cendekia.v7i1.1921

Ghufron, M. N., & Suminta, R. R. (2017). Hubungan antara kepercayaan epistemologis dengan belajar berdasar regulasi diri. *Jurnal Psikologi Insight*, *1*(1), 40–54. https://doi.org/https://doi.org/10.17509/insight.v1i1.8443

Gómez-Chacón, I. M., & Marbán, J. M. (2024). Epistemic emotions and pre - service mathematics teachers ' knowledge for teaching. *ZDM – Mathematics Education*, *56*(6), 1223–1237. https://doi.org/10.1007/s11858-024-01624-5

Handayani, S. D. (2019). Pengaruh Kecemasan Matematika terhadap Pemahaman Konsep Matematika. *SAP (Susunan Artikel Pendidikan)*, *4*(1), 59–65. https://doi.org/http://dx.doi.org/10.30998/sap.v4i1.3708

Indah, J. P., & Kadarisma, G. (2023). Analisis Epistimologi Obstacle Siswa SMK pada Materi Fungsi Komposisi. *Jurnal Pembelajaran Matematika Inovatif*, *6*(5), 2045–2052. https://doi.org/https://doi.org/10.22460/jpmi.v6i5.18547

Khatimah, U. K., Sangila, M. S., Agus, I., & Riansyah, F. (2025). Pengaruh Pengetahuan Dasar Matematika Terhadap Keyakinan Epistemologis Dan Minat Belajar Matematika Siswa. *Literasi: Jurnal Pendidikan Guru Indonesia*, *4*(1), 26–35. https://doi.org/https://doi.org/10.58218/literasi.v4i1.1268

Koly, A., Leton, S. I., Gawa, M. G. M., Fernandez, A. J., Lakapu, M., & Dosinaeng, W. B. N. (2023). *Analisis Learning Obstacle Siswa dari Aspek Epistimologi pada Pemecahan Masalah Matematis*. *4*(2), 153–166. https://doi.org/https://doi.org/10.30822/asimtot.v4i2.2342

Laily, N., & Lestari, A. S. B. (2024). Studi literatur: Analisis Kecemasan Siswa Pada Pembelajaran Matematika. *Ar-Riyadhiyyat: Jurnal Pendidikan Matematika*, *4*(2), 81–89. https://doi.org/10.47766/arriyadhiyyat.v4i2.2221

Lei, Q., Liu, D., Chen, X., Hirni, M., Wang, J., Abdelnaby, H., & Wei, S. (2025). *Mathematics anxiety , trait emotional intelligence , and self- - concept : Pathways to mathematics performance in students with and without mathematics learning difficulties*. *25*(4), 945–957. https://doi.org/10.1111/1471-3802.70020

Luthfiyah, & Khobir, A. (2023). Ontologi , Epistimologi dan Aksiologi Filsafat Pendidikan. *Jurnal Basicedu*, *7*(5), 3249–3254. https://doi.org/https://doi.org/10.31004/basicedu.v7i5.6150

Lyany, E. G., Tapo, M. M., Turnip, G., & Rudhito, M. A. (2024). Analisis Tingkat Kecemasan Matematis Siswa Sma Ditinjau Dari Sudut Pandang Neurosains. *Fraktal: Jurnal Matematika Dan Pendidikan Matematika*, *5*(2), 75–84. https://doi.org/https://doi.org/10.35508/fractal.v5i2.19599

Maharani, N. I. (2024). Analysis of Socio-emotional Development in Mathematics Learning Through Multi-representative Based Test Instruments. *Jurnal RisetPendidikan Matematika Jakarta*, *6*(1), 9–16. https://doi.org/https://doi.org/10.21009/jrpmj.v6i1.43816

Munawwaroh, A. G., Pramudya, I., & Nurhasanah, F. (2025). Epistemological Obstacles in the Process of Learning Mathematical Abstraction : A Systematic Literature Review. *KnE Social Sciences*, *10*(11), 272–294. https://doi.org/10.18502/kss.v10i11.18749

Panduwinata, B., Zamzaili, & Haji, S. (2023). Pengaruh Kecerdasan Emosional Terhadap Pemahaman Konsep Matematika Peserta Didik. *Jurnal Didactical Mathematics*, *5*(April), 38–45. https://doi.org/https://doi.org/10.31949/dm.v5i1.4291

Prasetyo, F., & Dasari, D. (2023). Studi Literatur : Identifikasi Kecemasan Matematika dan Motivasi Belajar Terhadap Hasil Belajar Matematika Siswa. *RANGE : Jurnal Pendidikan Matematika*, *4*(2), 240–253. https://doi.org/10.32938/jpm.v4i2.3649

Purnomo, D., & Mansur, A. (2024). Studi Ontologi, Epistemologi dan Aksiologi dalam Dunia Pendidikan. *Jurnal Jendela Pendidikan*, *4*(04), 398–406. https://doi.org/https://doi.org/10.57008/jjp.v4i04.1028

Rahmah, B. N., & Maarif, S. (2021). Analisis Epistimologi Obstacles terhadap Siswa SMP Kelas VII dengan Materi Statistika (Penyajian Data). *Jurnal Matematika UNAND*, *10*(4), 510–518. https://doi.org/https://doi.org/10.25077/jmu.10.4.510-518.2021

Rani, T. P. (2023). Penerapan Model Project Based Leanrning dalam Perspektif Ontologi dan Epistemologi Filsafat Pendidikan Matematika. *STRATEGY : Jurnal Inovasi Strategi Dan Model Pembelajaran*, *3*(1), 1–8. https://doi.org/https://doi.org/10.51878/strategi.v3i1.1956

Rifai, A., Watson, Wachidi, Taqiyyuddin, Y. M., & Haqiqi, M. A. (2025). A Systematic Literature Review on the Integration of Epistemological Theories in Educational Management Practices. *Multicultural Islamic Education Review*, *3*(1), 99–110. https://doi.org/10.23917/mier.v3i1.10210

Sabrina, D. C., & Kusuma, A. B. (2025). Integrasi Dimensi Epistemologis dan Ontologis dalam Pembelajaran Matematika : Kajian Literatur Sistematis. *Proximal: Jurnal Penelitian Matematika Dan Pendidikan Matematika*, *8*(3), 866–874. https://doi.org/https://doi.org/10.30605/proximal.v8i3.6392

Schukajlow, S., Rakoczy, K., & Pekrun, R. (2023). Emotions and motivation in mathematics education : Where we are today and where we need to go. *ZDM – Mathematics Education*, *55*, 249–267. https://doi.org/10.1007/s11858-022-01463-2

Sukarma, I. K. (2013). Epistemology, constructivism, and discovery learning in mathematics. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *1*, 104–116. https://doi.org/https://doi.org/10.33394/j-ps.v1i1.523

Suratiningsih, & Prasetyo, S. (2024). Belajar geometri dari sudut pandang filosofi epistimologi bagi siswa SD/MI. *MIDA: Jurnal Pendidikan Dasar Islam*, *7*(2), 271–286. https://doi.org/https://doi.org/10.52166/mida.v7i2.6789

Tarigan, M., Gustiana, D., & Lestari, T. D. (2022). Arah dan Orientasi Filsafat Ilmu di Indonesia. *Mahaguru: Jurnal Pendidikan Guru Sekolah Dasar*, *3*(1), 159–168. https://doi.org/https://doi.org/10.33487/MGR.V3I1.3977

Wijayanto, Y. I. (2023). *Konstruksi dan Implementasi Filsafat Ilmu : Matematika dan Pendidikan Matematika* [Universitas Negeri Yogyakarta]. http://repository/unpublished

Zalukhu, A., Herman, Hulu, D. B. T., Zebua, N. S. A., Naibaho, T., & Simanjuntak, R. (2023). Kedudukan dan Peran Filsafat dalam Pembelajaran Matematika. *Journal on Education*, *05*(03), 6054–6062. https://doi.org/https://doi.org/10.31004/joe.v5i3.1371