Психологическая наука и образование
2026. *31*(4), 166–177.
https://doi.org/10.17759/pse.2026310412
ISSN: 1814-2052
ISSN: 2311-7273 (online)

Psychological Science and Education
2026. *31*(4), 166–177.
https://doi.org/10.17759/pse.2026310412
ISSN: 1814-2052
ISSN: 2311-7273 (online)

Научная статья | Original paper

Constructivist or instrumentalist? Exploring how pre-service teachers' beliefs shape the integration of mathematical values and SDGs

I. Novikasari[1] ✉, **M.H. Muflihin**[1], **F. Fauzi**[1], **L. Rahmawati**[2], **R. Rohmad**[1]
[1] UIN Prof. K.H. Saifuddin Zuhri, Indonesia
[2] Ahmad Dahlan University, Indonesia
✉ ifa_da@uinsaizu.ac.id

Abstract

Context and relevance. As global challenges intensify, mathematics education faces growing demands to cultivate both abstract reasoning and value orientations aligned with the Sustainable Development Goals (SDGs). Pre-service teachers' epistemological beliefs play a critical role in shaping how these elements are incorporated into instructional materials. **Objective.** This study examines how Indonesian pre-service mathematics teachers' belief orientations — constructivist, Platonist, or instrumentalist — influence their integration of mathematical values (usefulness, creativity, transformation) and SDG themes in teaching resources. **Methods and materials.** A qualitative design engaged 37 final-year pre-service teachers (15 male, 22 female; aged 20–24) from an Indonesian state university. Data from written reflections and semi-structured interviews were analyzed through theory-driven descriptive coding, with rigor ensured via triangulation, member checking, and audit trails. **Results.** Analysis revealed distinct pedagogical patterns: constructivist-oriented teachers developed materials emphasizing creativity and contextual SDG integration, while Platonist approaches prioritized conceptual rigor and instrumentalist designs focused on procedural applications — both showing comparatively limited depth in value integration. **Conclusions.** The findings demonstrate how epistemological beliefs shape SDG implementation, suggesting teacher education programs would benefit from systematically addressing belief systems to prepare educators for creating mathematics instruction that balances conceptual mastery, creative reasoning, and global citizenship.

Keywords: mathematical beliefs, pre-service teachers, teaching materials, Sustainable Development Goals (SDGs), value

For citation: Novikasari, I., Muflihin, M.H., Fauzi, F., Rahmawati, L., Rohmad, R. (2026). Constructivist or instrumentalist? Exploring how pre-service teachers' beliefs shape the integration of mathematical values and SDGs. *Psychological Science and Education, 31*(4), 166–177. (In Russ.). https://doi.org/10.17759/pse.2026310412

Конструктивизм или инструментализм? Как убеждения будущих учителей влияют на интеграцию математических ценностей и целей устойчивого развития

И. Новикасари[1] ✉, **М.Х. Муфлихин**[1], **Ф. Фаузи**[1], **Л. Рахмавати**[2], **Р. Рохмад**[1]
[1] Государственный исламский университет имени проф. К.Х. Саифуддина Зухри, Пурвокерто, Индонезия
[2] Университет Ахмад Дахлан, Джокьякарта, Индонезия
✉ ifa_da@uinsaizu.ac.id

Резюме

Контекст и актуальность. В условиях усиления глобальных проблем математическое образование сталкивается с растущей необходимостью развивать у учащихся как абстрактное мышление, так и ценностные установки, соответствующие целям устойчивого развития (ЦУР). Убеждения будущих учителей о природе знания (эпистемологические убеждения) во многом определяют то, как эти аспекты включаются в учебные материалы. **Цель.** Изучить, как убеждения индонезийских будущих учителей математики (конструктивистские, платонистские или инструменталистские) влияют на то, как они интегрируют математические ценности (полезность, креативность, трансформацию) и темы целей устойчивого развития в учебные материалы. **Методы и материалы.** В качественном исследовании участвовали 37 студентов выпускного курса (15 юношей и 22 девушки в возрасте 20–24 лет) одного из государственных университетов Индонезии. Для анализа данных письменных рефлексивных отчетов и полуструктурированных интервью применялось теоретически обоснованное дескриптивное кодирование; надежность результатов обеспечивалась за счет метода триангуляции, проверки участниками и ведения аудиторского следа. **Результаты.** В результате анализа были выявлены четкие педагогические закономерности: учителя с конструктивистскими убеждениями создавали учебные материалы, в которых акцент делался на креативность и контекстуальное включение тем ЦУР; платонистский подход отдавал приоритет концептуальной строгости, а инструменталистский — процедурным применениям. При этом оба последних подхода демонстрировали сравнительно меньшую глубину интеграции ценностей. **Выводы.** Результаты показывают, как эпистемологические убеждения влияют на внедрение ЦУР, и позволяют предположить, что было бы полезно систематически анализировать эти убеждения в рамках педагогических программ, чтобы готовить учителей к планированию уроков математики, в которых сочетаются концептуальное освоение материала, творческое мышление и воспитание в них идей мирового гражданства.

Ключевые слова: математические убеждения, будущие учителя, учебные материалы, цели устойчивого развития (ЦУР), ценность

Для цитирования: Новикасари, И., Муфлихин, М.Х., Фаузи, Ф., Рахмавати, Л., Рохмад, Р. (2026). Конструктивизм или инструментализм? Как убеждения будущих учителей влияют на интеграцию математических ценностей и целей устойчивого развития. *Psychological Science and Education, 31*(4), 166–177. (In Russ.). https://doi.org/10.17759/pse.2026310412

Introduction

Mathematics education in the era of globalization plays a crucial role in equipping young learners to engage with complex global challenges (Chronaki, Yolcu, 2021). Advances in technology and information have shifted educational goals from mere knowledge transmission to applying mathematical concepts to real-world problems, including integrating Sustainable Development Goals (SDGs) into curricula (McDiarmid, Zhao, 2023). The 2030 Agenda for Sustainable Development emphasizes issues like poverty, gender equity, and climate change, and embedding SDGs in math education fosters critical thinking and problem-solving within authentic contexts (Persaud, Dagher, 2021). However, research remains scarce on how pre-service teachers' motivations and beliefs influence the design of SDG-focused teaching materials despite evidence linking such curricula to enhanced student engagement with global issues (Alsina, Vásquez, 2024; Li et al., 2024).

Existing studies have explored SDG integration across educational levels and regions, revealing mixed findings regarding teachers' knowledge and practices. For example, Tesfamicael and Enge (2024) found active engagement with sustainable development in Norway's primary to secondary curricula, whereas Altıntaş et al. (2024) reported limited awareness among math teachers about sustainability concepts. Calls for reform in mathematics education emphasize moving beyond exam preparation towards fostering sustainability literacy and active participation (Shimizu, Vithal, 2023). Central to these efforts is the recognition that teachers' mathematical beliefs — defined as personal and contextual views on the nature of mathematics and its teaching (Novikasari, Dede, 2021) — profoundly shape instructional choices and resource development (Novikasari et al., 2024). However, how these beliefs intersect with SDG integration in teaching materials remains underexplored.

Mathematical values — usefulness, creativity, and transformation — mediate how pre-service teachers design instructional tools, shaping their pedagogical orientations (Novikasari et al., 2024). Grounded in Ernest et al. (2016) typology of mathematical beliefs (constructivism, Platonism, instrumentalism), this study examines how these belief systems influence pre-service teachers' integration of SDGs and mathematical values into their materials. Usefulness, reflecting the pragmatic dimension of mathematics, emphasizes real-world problem-solving (e.g., applying linear equations to household budgets), aligning with Skovsmose's (2023) "mathematics-as-action". Creativity fosters innovative approaches through open-ended tasks (e.g., modeling climate change geometrically), resonating with (Haim, Aschauer, 2024) "divergent mathematical practices". Transformation extends further, using mathematics to critique societal issues (e.g., visualizing income inequality) via Freirean critical pedagogy (Thanheiser, Mamolo, 2024). By revealing how epistemological beliefs shape value-driven SDG integration, the findings aim to advance teacher education and policy for globally responsive mathematics instruction.

Mathematical beliefs in education

Mathematical beliefs refer to teachers' views about the nature of mathematics, how it should be taught, and its purpose, which significantly shape instructional practices (Ernest et al., 2016; Philipp, 2007). These beliefs are commonly grouped into three main perspectives: constructivist, platonist, and instrumentalist. The constructivist approach emphasizes that students actively construct mathematical knowledge by engaging in their environment and reflecting on their experiences (Novikasari, Dede, 2021). Teachers with this belief encourage learners to independently explore concepts, solve real-world problems, and develop meaningful solutions. In contrast, Platonism regards mathematics as an abstract, non-physical entity accessible through logic and deductive reasoning, with teachers focusing on teaching core principles logically and sequentially (Goldin et al., 2016).

The instrumentalist perspective, meanwhile, sees mathematics primarily as a practical tool for problem-solving. Teachers who adopt this view prioritize efficient techniques and methods

that efficiently produce useful results (Thompson, 1992). Research shows that these differing beliefs influence teaching approaches and students' ability to understand and apply mathematics in real-life contexts (Hidayat, Novikasari, 2023; Krasilo, Repesciuc, 2025). Recognizing these belief systems helps explain why some educators emphasize creativity and exploration while others focus more on logic or practical skills. Ultimately, these philosophical orientations shape how mathematics is taught and learned in classrooms.

Integrating SDGs and mathematical values in mathematics education

The integration of Sustainable Development Goals (SDGs) into mathematics education is increasingly important for fostering responsible, real-world learning that addresses global challenges (Persaud, Dagher, 2021). The SDGs, especially those related to quality education, economic growth, and sustainability, align closely with key mathematical skills such as problem-solving and critical thinking. Embedding these goals in math teaching helps students connect concepts to societal issues, making learning more relevant and impactful (Filho et al., 2024).

Teaching materials are central to this integration, reflecting content and pedagogical values (Potari, 2018). Constructivist-based materials promote creativity, utility, and transformation by contextualizing math in real-life situations, while Platonist and Instrumentalist approaches focus more on logical structures or efficient problem-solving (Thompson, 1992). This study explores how pre-service teachers' mathematical beliefs influence the incorporation of SDGs and mathematical values in junior high school teaching materials. It examines three key aspects: the identification of teachers' mathematical beliefs, the extent of SDG integration, and the reflection of mathematical values in the materials they develop.

Materials and methods

Participants

This qualitative study involved 37 pre-service teachers (M = 22,1 years; SD = 1,3) enrolled in a teacher education program at a state university in Indonesia. The participants, consisting of 15 males and 22 females aged between 20 and 24, were selected through purposive sampling based on their active engagement in coursework related to mathematics pedagogy. Inclusion criteria included enrollment in the program's final year and willingness to participate in the study. Participants were ensured of confidentiality and anonymity by ethical research standards.

Procedures

Data were collected through written reflections and semi-structured interviews focused on participants' experiences, beliefs, and perceptions regarding SDGs-responsive mathematics instruction. The written reflections were submitted during coursework activities on designing SDG-aligned teaching materials, while the interviews were conducted individually, each lasting approximately 30–45 minutes. All interviews were audio-recorded with participants' consent and later transcribed verbatim for analysis.

Data analysis

The data were analyzed manually using a theory-driven qualitative approach, with descriptive coding as the initial step to identify key statements and recurring patterns (Bingham, 2023). Codes were systematically grouped into three broader categories aligned with the study's framework: (1) mathematical beliefs (constructivist, Platonist, or instrumentalist orientations), (2) SDG integration depth (evaluating contextualization versus superficial inclusion), and (3) mathematical values—usefulness (real-world application), creativity (novel problem-solving), and transformation (societal critical thinking). This process emphasized categorization over thematic development, interpreting participants' experiences through the lens of student-responsive pedagogy (Qureshi, Ünlü, 2020).

To ensure rigor, the analysis was conducted without qualitative software, relying instead on triangulation of written reflections and interview transcripts. Credibility was strengthened through member checks, where participants reviewed preliminary interpretations for accuracy (Bingham, 2023), and an audit trail documented all analytic decisions. This approach balanced theo-

retical fidelity with methodological transparency, capturing nuanced relationships between beliefs, SDG integration, and pedagogical values.

Results

This study aims to explore how mathematical beliefs held by pre-service teachers influence the Sustainable Development Goals/SDGs and mathematical values in the development of junior high school mathematics teaching materials. The results of this study are presented based on three main aspects: (1) identification of mathematical beliefs of pre-service teachers, (2) analysis of SDGs integration in the developed teaching materials, and (3) analysis of mathematical values reflected in the teaching materials.

Identification of mathematical beliefs of pre-service teachers

Based on interview data, pre-service mathematics teachers' beliefs were categorized into three perspectives: constructivist, platonist, and instrumentalist. Those with constructivist beliefs viewed mathematics as a human activity shaped by social interaction and contextual experience, emphasizing creativity and exploration in learning. They believed teaching materials should promote critical thinking and real-world applications rather than mere knowledge transmission (BNR: "*students can internalize math concepts if the materials are creatively developed based on their environment and needs*"). In contrast, platonist-oriented teachers perceived mathematics as an exact, universal science of abstract structures and immutable truths, prioritizing conceptual understanding and logical rigor. They saw materials as tools to reinforce formal structures and theoretical coherence to support mastery of fundamental principles (DZA: "*poor teaching strategies can reduce student interest*", underscoring the need for appropriate methods and materials).

Meanwhile, instrumentalist teachers considered mathematics a practical tool for solving real-world problems through procedures and calculations, emphasizing procedural fluency and clarity. They viewed teaching materials as essential for developing efficiency in problem-solving. They believed difficulties often stemmed from a lack of interest or inappropriate resources (NUK: "*mathematics is a science of operations related to numbers — addition, subtraction, division, or multiplication*"). Overall, these belief systems significantly shaped how pre-service teachers conceptualized the role of teaching materials: constructivists emphasized inquiry and engagement, platonists focused on logical structure and deep understanding, and instrumentalists prioritized practicality and application. These findings align with Ernest et al. (2016) typology and highlight the influence of belief systems on the design and use of mathematics teaching resources to foster meaningful learning.

Table 1

Summary of pre-service teachers' mathematical beliefs and their influence on teaching approaches

Mathematical belief orientation	View of mathematics	Teaching orientation	Design of teaching materials
Constructivist	Socially constructed, contextual	Emphasizes student-centered, inquiry-based learning with real-world relevance.	Focuses on creativity, critical thinking, and contextual relevance; materials designed to engage and motivate.
Platonist	Abstract, logical structures	Prioritizes conceptual mastery, logical reasoning, and structured understanding.	Teaching materials are designed to build foundational understanding and address student difficulties systematically.
Instrumentalist	Procedural tools	Emphasizes procedural fluency and practical application of mathematics.	Materials focus on clarity, accuracy, and real-life applicability to enhance student confidence and skill.

Table 1 summarizes how pre-service mathematics teachers' underlying beliefs shape their perceptions of mathematics and influence how they design and utilize teaching materials. These beliefs inform contrasting views of mathematics — ranging from a socially constructed, contextual discipline to a fixed body of abstract knowledge or a practical tool for solving routine problems. Consequently, the role of teaching materials is also interpreted differently. For some, especially those with constructivist orientations, materials are essential for fostering conceptual understanding and active engagement. In contrast, pre-service teachers with Platonist or instrumentalist views may regard teaching materials primarily as structured aids or procedural tools that support the delivery of content and the development of computational fluency.

Analysis of SDGs integratio in teaching materials

The analysis of teaching materials developed by 37 pre-service teachers revealed that the integration of Sustainable Development Goals (SDGs) varied significantly according to their mathematical belief orientations: Constructivist, Platonist, and Instrumentalist. Constructivist-oriented participants prioritized student engagement through real-life modeling and contextual problem-solving, embedding SDGs such as Decent Work and Economic Growth (SDG 8) creatively and meaningfully. For example, BNR's material employed algebraic tools to help students understand profit-making in everyday transactions, emphasizing relevance and active learning. Meanwhile, Platonist-oriented participants demonstrated a conceptually focused integration of mathematics and SDGs, linking abstract mathematical concepts to social issues with greater emphasis on conceptual rigor. FIP's use of statistical analysis to illustrate consumer behavior at a food festival highlighted this group's emphasis on conceptual depth, with SDG 8 reflected in 80% of Platonist-oriented teaching materials.

In contrast, Instrumentalist-oriented participants adopted a more procedural and pragmatic approach. While their materials addressed SDG 8 and SDG 9, the focus was mainly on efficiency and algorithmic processes, often lacking critical engagement with broader socio-cultural contexts. NUK's example, which involved linear equations in calculating the cost of rice and sugar, illustrated how real-world problems were incorporated without a deeper exploration of their implications. This group showed a more limited contextual integration of SDGs, with 40% of materials categorized as other/general materials without deeper SDG-related contextualization. These findings underscore the pivotal role of epistemological beliefs in shaping how future teachers conceptualize and translate global goals into pedagogical practice.

Table 2 shows that the proportion of teaching materials reflecting different SDG categories

Table 2

Distribution of SDG integration across mathematical belief groups

Mathematical belief	SDG integrated	Percentage	Example focus
Constructivist	SDG 8 (decent work and economic growth)	63%	Algebraic modeling of profit in daily transactions (e.g., selling eggs)
	SDG 2 (zero hunger)	18%	Nutritional planning and food supply chains
	SDG 3 (good health and well-being)	9%	Health statistics and daily habits
	SDG 9 (industry, innovation, and infrastructure)	9%	Innovation-related cost modeling
Platonist	SDG 8	80%	Statistical analysis of consumer behavior
	SDG 3	10%	Health-based data interpretation
	SDG 9	10%	Analysis of industry-related production trends

Mathematical belief	SDG integrated	Percentage	Example focus
Instrumentalist	SDG 8	30%	Linear equations for pricing calculations
	SDG 9	30%	Function modeling in logistics or infrastructure settings
	Other/general	40%	Basic mathematical procedures without deeper integration of SDG-related context

Note. Percentages indicate the proportion of teaching materials within each mathematical belief orientation that reflected the respective SDG category.

varied across mathematical belief orientations. Among constructivist-oriented materials, SDG 8 was reflected in 63% of the materials, followed by SDG 2 (18%), SDG 3 (9%), and SDG 9 (9%). Among Platonist-oriented materials, SDG 8 was reflected in 80% of the materials, while SDG 3 and SDG 9 were each reflected in 10%. Among instrumentalist-oriented materials, SDG 8 and SDG 9 were each reflected in 30% of the materials, while 40% were categorized as other/general materials without deeper SDG-related contextualization. These patterns suggest that constructivist-oriented materials incorporated a broader range of SDG contexts, whereas Platonist-oriented materials were more concentrated on SDG 8, and instrumentalist-oriented materials showed a more limited integration of SDG-related contexts.

Analysis of mathematical values in teaching materials

Data were analyzed manually using a theory-driven qualitative approach, beginning with descriptive coding to identify key statements and recurring patterns in the teaching materials. These were categorized according to the reflective mathematics values framework by Novikasari et al. (2024), which includes usefulness, creativity, and transformation. The analysis showed that pre-service teachers' epistemological beliefs significantly influenced how these values were embedded in their instructional designs, particularly in relation to the Sustainable Development Goals (SDGs). For example, the teaching material compiled by BNR demonstrates the value of creativity, as shown in Figure below. This figure is included in the material to encourage students to pose different and thought-provoking questions during the learning process.

Constructivist-oriented participants demonstrated integration across all three reflective values, with creativity (38%) and transformation (43%) more prominently represented than usefulness (19%). Their materials encouraged inquiry-based learning and contextual applications

Setelah melakukan pengamatan silakan mengajukan pertanyaan terkait hal yang diamati atau materi. Berikut ini contoh pertanyaan yang baik untuk diajukan. 1. Bagaimana cara membandingkan bilangan yang tersusun dari banyak angka? 2. Bagaimanakah pentingnya memahami nilai tempat untuk membandingkan bilangan bulat? Silakan ajukan pertanyaan lainnya yang menurut kalian penting.	**Translation** After making observations, formulate questions about the observed phenomena or materials. Consider questions such as: 1. What strategies are most effective for comparing multi-digit numbers? 2. How does understanding place value facilitate integer comparison? What additional questions would further investigate this concept?

Fig. Creativity values in teaching materials with constructivist beliefs

linked to SDG 8. Platonist participants focused more on transformation (63%) through conceptual precision, while instrumentalist teachers showed greater emphasis on usefulness (33%) and transformation (67%), often employing real-life analogies for procedural learning. Despite these differences, transformation was the most frequently coded value across all three belief orientations, suggesting a shared emphasis on fostering adaptable, socially responsive mathematical thinking.

The distribution presented in Table 3 illustrates how the frequency of coded segments related tousefulness, creativity, and transformation varied across belief orientations. These percentages indicate the relative prominence of each value within the coded data and are used to support the interpretation of thematic patterns rather than to make statistical generalizations. In this qualitative analysis, the numerical representations convey the relative weight of codes within each belief orientation (Bingham, 2023).

Discussion

This study offers a nuanced view of how pre-service teachers' mathematical belief systems shape the development of teaching materials that integrate both the Sustainable Development Goals (SDGs) and core mathematical values. Through a theory-driven qualitative approach and descriptive coding, the findings demonstrate that epistemological beliefs — whether constructivist, Platonist, or instrumentalist — significantly influence pedagogical decisions. These results affirm prior research that highlights the central role of belief orientations in shaping how teachers conceptualize mathematics and its societal purpose (Ernest et al., 2016; Philipp, 2007; Rezat et al., 2021).

Constructivist-oriented pre-service teachers demonstrated a broader and more contextually varied integration of SDGs, particularly in relation to economic development (SDG 8), zero hunger (SDG 2), good health (SDG 3), and innovation (SDG 9). Their teaching materials emphasized real-world problems, student inquiry, and open-ended tasks — practices aligned with global frameworks that promote critical thinking and learner agency (Awaji et al., 2024; Tesfamicael, Enge, 2024). These results align with prior findings that constructivist beliefs often foster more meaningful, context-driven instruction (Meletiou-Mavrotheris, Paparistodemou, 2024).

Platonist-oriented pre-service teachers also demonstrated SDG integration, though with a greater focus on conceptual rigor and internal mathematical structures. Their materials employed abstract reasoning and formal representations, often linking mathematical concepts to real-world issues without extensive contextual diversity. This reflects the Platonist view that mathematics is discovered through deductive reasoning and exists independently of human experience (Ernest et al., 2016; Thompson, 1992). While less student-centered, this approach reinforced the precision and universality of mathematics.

In contrast, instrumentalist participants adopted a more utilitarian approach, embedding SDGs into tasks that prioritized efficiency and procedural fluency. Although transformation as a value appeared in their materials, creativity was less evident, suggesting a limited pedagogical vision. These findings echo concerns in the literature that instrumentalist beliefs may constrain

Table 3

Integration of mathematical values in teaching materials reviewed from differences in mathematical beliefs

Belief orientation	Usefulness (%)	Creativity (%)	Transformation (%)
Constructivist	19%	38%	43%
Platonist	28%	9%	63%
Instrumentalist	33%	0%	67%

Note. Percentages represent the relative frequency of coded segments for each mathematical value within each mathematical belief orientation.

mathematics instruction to rote procedures, undermining opportunities for deeper understanding or social relevance (Santos-Trigo, 2024).

The integration of core mathematical values — usefulness, creativity, and transformation — varied across belief orientations. Constructivist teachers promoted creativity through problem-based learning and exploration; Platonist teachers emphasized transformation through conceptual depth; and instrumentalist teachers emphasized transformation through practical and procedural applications. These patterns support the importance of embedding reflective belief exploration in teacher education programs to cultivate value-driven and socially responsive mathematics pedagogy (Novikasari et al., 2024). Future research should explore how these beliefs evolve over time and influence classroom practice.

Conclusions

This qualitative study reveals how pre-service teachers' mathematical beliefs shape their integration of Sustainable Development Goals (SDGs) and core values in instructional materials, with three characteristic approaches emerging. Instrumentalist-oriented teachers emphasized transformation through social analysis and practical usefulness while showing no coded evidence of creativity. Platonist approaches balanced strong transformative and utilitarian focuses with limited creativity in structured contexts, whereas constructivist educators demonstrated the integration of all three values — applying mathematics authentically, encouraging creative exploration, and critically examining real-world issues — with creativity and transformation more prominently represented than usefulness. These patterns illustrate how epistemological orientations serve as both lenses and filters for pedagogical decision-making, particularly in determining whether materials develop merely functional mathematical skills or additionally cultivate innovative thinking and social consciousness essential for addressing global challenges through mathematics education.

Limitations. This study provides valuable insights into how pre-service teachers' mathematical beliefs influence value-oriented teaching materials. Still, its reliance on self-produced documents and interviews may not fully reflect classroom practices. Moreover, categorizing beliefs into three fixed types offers clarity but may oversimplify individual belief systems' nuanced and dynamic nature.

References

1. Alsina, Á., Vásquez, C. (2024). Professional development and teacher agency in Mathematics Teacher Education for Sustainability. *Mathematics Education Research Journal*. https://doi.org/10.1007/s13394-024-00488-y
2. Altıntaş, S., Ozdinc, I., Ceyhan, G.D. (2024). Teachers' knowledge and views on developing zero waste education within the sustainable development goals framework. *International Research in Geographical and Environmental Education*. https://doi.org/10.1080/10382046.2024.2363653
3. Awaji, B.M., Abdel-Hamid, R.H., Khalil, I.A., Prahmana, R.C.I. (2024). Mathematics teachers' practices in light of the effective teaching practices. *Infinity Journal*, *14*(1), 1–20. https://doi.org/10.22460/infinity.v14i1.p1-20
4. Bingham, A.J. (2023). From Data Management to Actionable Findings: A Five-Phase Process of Qualitative Data Analysis. *International Journal of Qualitative Methods*, *22*, 1–11. https://doi.org/10.1177/16094069231183620
5. Chronaki, A., Yolcu, A. (2021). Mathematics for "citizenship" and its "other" in a "global" world: critical issues on mathematics education, globalisation and local communities. *Research in Mathematics Education*, *23*(3), 241–247. https://doi.org/10.1080/14794802.2021.1995780
6. Ernest, P., Skovsmose, O., Paul Van Bendegem, J., Bicudo, M., Miarka, R., Kvasz, L., Moeller, R. (2016). *The Philosophy of Mathematics Education. In: The Philosophy of Mathematics Education. ICME-13 Topical Surveys*. Springer. https://doi.org/10.1007/978-3-319-40569-8_1
7. Filho, W.L., Trevisan, L.V., Dinis, M.A.P., Ulmer, N., Paço, A., Borsari, B., Sierra, J., Salvia, A. (2024). Fostering students' participation in the implementation of the sustainable development goals at higher education institutions. *Discover Sustainability*, *5*(1). https://doi.org/10.1007/s43621-024-00204-7
8. Goldin, G.A., Hannula, M.S., Heyd-Metzuyanim, E., Jansen, A., Kaasila, R., Lutovac, S., Di Martino, P., Morselli, F., Middleton, J.A., Pantziara, M.,

Zhang, Q. (2016). Attitudes, Beliefs, Motivation and Identity in Mathematics Education: An Overview of the Field and Future Directions. In *ICME-13 Topical Surveys*. https://doi.org/10.1007/978-3-319-32811-9_1

9. Haim, K., Aschauer, W. (2024). Innovative FOCUS: A Program to Foster Creativity and Innovation in the Context of Education for Sustainability. *Sustainability (Switzerland)*, *16*(6), 2257. https://doi.org/10.3390/SU16062257/S1
10. Hidayat, L.N., Novikasari, I. (2023). Effectiveness of Realistic Mathematics Approach to Increasing Mathematical Representation Ability at SMP N 9 Purwokerto. *International Journal of Research in Mathematics Education*, *1*(2), 116–125. https://doi.org/10.24090/ijrme.v1i2.9139
11. Krasilo, D.A., Repesciuc, X.Y. (2025). The Correlationship between Self-image and the Image of a Mentor among Students in the Context of Professional Self-determination. *Psychological Science and Education*, *30*(1), 36–55. https://doi.org/10.17759/pse.2025300103
12. Li, Z., Hu, W., Oon, P.T. (2024). Unveiling Pre-service Teachers' Competency and Challenges in Designing 5E Inquiry-based Integrated STEM Lessns: A Quantitative Ethnography Approach. *Int J of Sci and Math Educ*. https://doi.org/10.1007/s10763-024-10529-4
13. McDiarmid, G.W., Zhao, Y. (2023). Time to Rethink: Educating for a Technology-Transformed World. *ECNU Review of Education*, *6*(2), 189–214. https://doi.org/10.1177/20965311221076493
14. Meletiou-Mavrotheris, M., Paparistodemou, E. (2024). Sustaining Teacher Professional Learning in STEM: Lessons Learned from an 18-Year-Long Journey into TPACK-Guided Professional Development. *Education Sciences*, *14*(4). https://doi.org/10.3390/educsci14040402
15. Novikasari, I., Dede, Y. (2021). Turkish pre-service mathematics teachers' beliefs in multiplication. *Journal on Mathematics Education*, *12*(3), 469–486. https://doi.org/10.22342/jme.12.3.14440.469
16. Novikasari, I., Muttaqin, A., Elebiary, N. (2024). Teaching Math and Preserving Culture: The Intersection of Values in Indonesian Pedagogy. In Y. Dede, G. Marschall, & P. Clarkson (Eds.), *Values and Valuing in Mathematics Education*. Springer.
17. Persaud, N., Dagher, R. (2021). The United Nations: 2030 Sustainable Development Goals Agenda. In *The Role of Monitoring and Evaluation in the UN 2030 SDGs Agenda of Role*. Palgrave Macmillan.
18. Philipp, R.A. (2007). Mathematics teachers' beliefs and affect. *Second Handbook of Research on Mathematics Teaching and Learning*, 257–315.
19. Potari, D. (2018). Teachers' and students' perspectives in mathematics teaching and teacher education. *Journal of Mathematics Teacher Education*, *21*(6), 541–543. https://doi.org/10.1007/s10857-018-9417-3
20. Qureshi, H.A., Ünlü, Z. (2020). Beyond the Paradigm Conflicts: A Four-Step Coding Instrument for Grounded Theory. *International Journal of Qualitative Methods*, *19*. https://doi.org/10.1177/1609406920928188
21. Rezat, S., Fan, L., Pepin, B. (2021). Mathematics textbooks and curriculum resources as instruments for change. *ZDM — Mathematics Education*, *53*(6), 1189–1206. https://doi.org/10.1007/s11858-021-01309-3
22. Santos-Trigo, M. (2024). Problem solving in mathematics education: tracing its foundations and current research-practice trends. *ZDM — Mathematics Education*, *56*(2), 211–222. https://doi.org/10.1007/s11858-024-01578-8
23. Shimizu, Y., Vithal, R. (2023). School Mathematics Curriculum Reforms: Widespread Practice but Under-Researched in Mathematics Education. In Y. Shimizu, R. Vithal (Eds.), *Mathematics Curriculum Reforms Around the World*. https://doi.org/10.1007/978-3-031-13548-4_1
24. Skovsmose, O. (2023). *Critical Mathematics Education*. Springer International Publishing. https://doi.org/10.1007/978-3-031-26242-5
25. Tesfamicael, S.A., Enge, O. (2024). Revitalizing Sustainability in Mathematics Education: The Case of the New Norwegian Curriculum. *Education Sciences, 14*(2), 174. https://doi.org/10.3390/EDUCSCI14020174
26. Thanheiser, E., Mamolo, A. (2024). Introduction to the virtual special issue: Mathematics that underpins social issues. *The Journal of Mathematical Behavior*, *75*, 101176. https://doi.org/10.1016/J.JMATHB.2024.101176
27. Thompson, A.G. (1992). Teachers' beliefs and conceptions: A synthesis of the research. In D.A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning: A project of the National Council of Teachers of Mathematics* (pp. 127–146). Macmillan Publishing Co, Inc.

Information about the authors

Ifada Novikasari, PhD in Mathematics Education, Associate Professor, Department of Mathematics Education, UIN Prof. K.H. Saifuddin Zuhri, Purwokerto, Indonesia, ORCID: https://orcid.org/0000-0002-3575-7893, e-mail: ifa_da@uinsaizu.ac.id

M. Hizbul Muflihin, Professor in Educational Management, Department of Education, UIN Prof. K.H. Saifuddin Zuhri, Purwokerto, Indonesia, ORCID: https://orcid.org/0000-0002-3428-101, e-mail: hizbul.muflihin@uinsaizu.ac.id

Fauzi Fauzi, Professor in Education, Department of Education, UIN Prof. K.H. Saifuddin Zuhri, Purwokerto, Indonesia, ORCID: https://orcid.org/0009-0004-7984-3541, e-mail: fauzi@uinsaizu.ac.id

Lily Rahmawati, Master's student at Ahmad Dahlan University, Indonesia, ORCID: https://orcid.org/0009-0006-7622-1688, e-mail: rahmawatitlily2742@gmail.com

Rohmad Rohmad, Professor in Education, Department of Education, UIN Prof. K.H. Saifuddin Zuhri, Purwokerto, Indonesia, ORCID: https://orcid.org/0000-0002-1229-462X, e-mail: rohmad@uinsaizu.ac.id

Информация об авторах

Ифада Новикасари, кандидат наук в области математического образования, доцент кафедры математического образования, Государственный исламский университет им. проф. К.Х. Сайфуддина Зухри, Пурвокерто, Индонезия, ORCID: https://orcid.org/0000-0002-3575-7893, e-mail: ifa_da@uinsaizu.ac.id

М. Хизбул Муфлихин, профессор в области управления образованием, кафедра образования, Государственный исламский университет им. проф. К.Х. Сайфуддина Зухри, Пурвокерто, Индонезия, ORCID: https://orcid.org/0000-0002-3428-101, e-mail: hizbul.muflihin@uinsaizu.ac.id

Фаузи Фаузи, профессор в области образования, кафедра образования, Государственный исламский университет им. проф. К.Х. Сайфуддина Зухри, Пурвокерто, Индонезия, ORCID: https://orcid.org/0009-0004-7984-3541, e-mail: fauzi@uinsaizu.ac.id

Лили Рахмавати, магистрант, Университет Ахмад Дахлан, Джокьякарта, Индонезия, ORCID: https://orcid.org/0009-0006-7622-1688, e-mail: rahmawatitlily2742@gmail.com

Рохмад Рохмад, профессор в области образования, кафедра образования, Государственный исламский университет им. проф. К.Х. Сайфуддина Зухри, Пурвокерто, Индонезия, ORCID: https://orcid.org/0000-0002-1229-462X, e-mail: rohmad@uinsaizu.ac.id

Contribution of the authors

Ifada Novikasari — conceptualized the study and developed its core ideas; led the annotation, writing, and overall design of the manuscript; coordinated the research planning; supervised the research process to ensure quality and coherence; and oversaw the visualization and presentation of the research findings.

M. Hizbul Muflihin — contributed to the analysis and interpretation of the results; participated in developing the discussion of the findings; and assisted in refining the presentation of the research outcomes.

Fauzi Fauzi — contributed to the data collection process, supported data organization and validation, and assisted in preparing the tables and visual presentation of the research results.

Lily Rahmawati — conducted data collection and performed detailed data analysis to support the study's findings.

Rohmad Rohmad — contributed to data collection, assisted in reviewing and interpreting the findings, and supported manuscript revision to improve its clarity and consistency.

All authors actively participated in discussing the results, contributed to revising the manuscript, and approved the final version for publication.

Вклад авторов

Ифада Новикасари — разработала концепцию исследования и его ключевые идеи; руководила аннотированием, написанием и общей структурой рукописи; координировала планирование исследования; осуществляла научное руководство исследовательским процессом, обеспечивая его качество и логическую согласованность; а также курировала визуализацию и представление результатов исследования.

М. Хизбул Муфлихин — внес вклад в анализ и интерпретацию результатов; участвовал в подготовке обсуждения полученных данных; а также содействовал совершенствованию представления результатов исследования.

Фаузи Фаузи — участвовал в сборе данных; оказывал поддержку в организации и валидации данных; а также принимал участие в подготовке таблиц и визуальном представлении результатов исследования.

Лили Рахмавати — осуществляла сбор данных и проводила детальный анализ данных для подтверждения результатов исследования.

Рохмад Рохмад — участвовал в сборе данных; содействовал анализу и интерпретации полученных результатов; а также принимал участие в доработке рукописи, повышая ее ясность и логическую последовательность.

Все авторы принимали активное участие в обсуждении результатов исследования, внесли вклад в доработку рукописи и одобрили ее окончательную версию для публикации.

Conflict of interest
The authors declare no conflict of interest.

Конфликт интересов
Авторы заявляют об отсутствии конфликта интересов.

Поступила в редакцию 01.06.2025 — Received 2025.06.01
Поступила после рецензирования 20.01.2026 — Revised 2026.01.20
Принята к публикации 13.08.2026 — Accepted 2026.08.13
Опубликована 30.08.2026 — Published 2026.08.30