

Teachers' Competence in Developing Mathematics Teaching Modules Using the Realistic Mathematics Education Approach

Ati Aryani, Riyadi, Sandra Bayu Kurniawan

Universitas Sebelas Maret
riyadi_pgsd_fkip@staff.uns.ac.id

Article History

accepted 1/2/2026

approved 1/3/2026

published 31/3/2026

Abstract

Mathematics learning requires a contextual learning approach. One approach that can be used is Realistic Mathematics Education (RME). This study aims to analyze teachers' competence in developing RME-based mathematics teaching modules through a Systematic Literature Review (SLR) approach. Articles were obtained through Google Scholar and selected using inclusion and exclusion criteria. The articles were collected using the Publish or Perish tool from the Google Scholar database. The selection resulted in five articles that were relevant and appropriate for the analysis topic. Data analysis was conducted using thematic analysis. The results of the study show Teacher competencies are the key factors needed in developing RME-based mathematics teaching modules. These include pedagogical competence, professional competence, Pedagogical Content Knowledge (PCK), and Technological Pedagogical Content Knowledge (TPACK). All four are essential, with professional competence emerging as the most dominant. These findings confirm that comprehensive strengthening of teacher competency is necessary to support the effective development and implementation of RME-based mathematics teaching modules.

Keywords: *mathematics teaching module, realistic mathematics education, systematic literature review, teacher competency*

Abstrak

Pembelajaran matematika membutuhkan pendekatan pembelajaran kontekstual. Salah satu pendekatan yang dapat digunakan adalah Pendidikan Matematika Realistik (RME). Studi ini bertujuan untuk menganalisis kompetensi guru dalam mengembangkan modul pengajaran matematika berbasis RME melalui pendekatan Tinjauan Literatur Sistematis (SLR). Artikel diperoleh melalui Google Scholar dan dipilih menggunakan kriteria inklusi dan eksklusi. Artikel dikumpulkan menggunakan alat Publish or Perish dari basis data Google Scholar. Hasil seleksi menghasilkan lima artikel yang relevan dan sesuai dengan topik analisis. Analisis data dilakukan menggunakan analisis tematik. Hasil penelitian menunjukkan bahwa kompetensi guru merupakan faktor kunci yang dibutuhkan dalam mengembangkan modul pengajaran matematika berbasis RME. Ini termasuk kompetensi pedagogis, kompetensi profesional, Pengetahuan Konten Pedagogis (PCK), dan Pengetahuan Konten Pedagogis Teknologi (TPACK). Keempatnya penting, dengan kompetensi profesional muncul sebagai yang paling dominan. Temuan ini menegaskan bahwa penguatan kompetensi guru secara komprehensif diperlukan untuk mendukung pengembangan dan implementasi modul pengajaran matematika berbasis RME yang efektif.

Kata kunci: modul pengajaran matematika, pendidikan matematika realistik, tinjauan pustaka sistematis, kompetensi guru.

INTRODUCTION



Mathematics learning aims to develop students' essential skills such as logical thinking, critical thinking, and problem-solving. Numerous studies have shown that mathematics is viewed as an abstract subject that cannot be learned (Nurhayanti et al., 2021). This is exacerbated by the procedural presentation of mathematics instruction with little direct connection to real-life situations (Nurhaliza, 2022). This situation requires teachers not only to master mathematics material but also to possess adequate pedagogical competence in designing meaningful and contextual learning (Cabero-Almenara et al., 2022; Skantz-Åberg et al., 2022). Although there is broad agreement on the importance of meaningful mathematics instruction, the reality of classroom practice has not yet fully addressed this need or effectively resolved students' comprehension issues. Mathematics instruction often fails to incorporate real-world and concrete contexts. This underscores the need for effective solutions and strategies to design contextual mathematics instruction that actively engages students in the learning process.

This abstract learning can be addressed with an appropriate learning approach. In this regard, Realistic Mathematics Education (RME) is an appropriate solution to facilitate abstract learning by adapting it to real-life contexts (Siswantari et al., 2025). The RME approach positions mathematics learning as a human activity based on contextual problems developed through mathematical procedures (Asmaarobiyah et al., 2025). By using RME, students are expected to construct their understanding of mathematical concepts with teacher guidance (Febriana, 2021). This will create more meaningful learning and influence conceptual understanding.

The implementation of RME in mathematics learning is closely related to the role of teachers as organizers and designers of learning activities. One of the most important roles of teachers is the ability to develop mathematics teaching modules aligned with the RME concept (Hafizah et al., 2024). Mathematics teaching modules can be used as teaching materials containing activities and learning materials (Erita, 2022). The quality of teaching modules is greatly influenced by teachers' competence in integrating pedagogical approaches, mathematical content, and appropriate curriculum requirements.

Current curriculum developments, coupled with the demands of 21st-century learning, require teachers to possess the appropriate competencies in developing mathematics teaching modules. Teachers are required to possess pedagogical competence to translate abstract mathematical concepts into contexts that students can understand. Teachers must also be able to develop digital-based teaching modules or e-modules. These student skills and expertise are essential prerequisites for the effective implementation of RME-based mathematics teaching modules. With competent teachers, the integration of RME and the development of learning modules can be achieved effectively and optimally, thereby fostering meaningful learning outcomes in mathematics.

Although numerous studies have been conducted on RME and the development of mathematics teaching modules, research specifically focusing on teacher competency in developing RME-based mathematics teaching modules has not been systematically described. Most studies emphasize the effectiveness of teaching modules or student learning outcomes, while the competency of teachers as module designers is often discussed implicitly. This situation indicates the need for studies that can comprehensively map the teacher competencies required to develop RME-based mathematics teaching modules. The novelty of this study lies in its ability to synthesize the findings of previous research specifically to identify and map the competencies required of teachers in developing RME-based mathematics teaching modules. Unlike other studies, this review focuses on the effectiveness of and the role of teachers as key actors in designing RME-based teaching modules.

Therefore, this study aims to conduct a Systematic Literature Review (SLR) to identify and analyze teacher competency in developing mathematics teaching modules using the RME model. Data synthesis was conducted through thematic analysis of relevant articles. The findings of this synthesis are expected to provide an overview of teacher competency in developing teaching modules and serve as a reference for the development of learning practices and further research in the field of mathematics education.

METHOD

This research is a literature study using a Systematic Literature Review (SLR) with the aim of synthesizing various previous research findings related to teacher competency in developing mathematics teaching modules using the RME model. The SLR approach was chosen because it provides readers with a comprehensive, systematic, and structured overview of previous research findings (Irawan et al., 2026). This study also identified patterns and gaps in previous research findings.

The articles analyzed were obtained by searching credible and trusted scientific journal databases and portals. This is because the researchers used the Publish or Perish software to collect relevant articles and group them according to the study criteria. The search was conducted using Google Scholar to locate published national scientific articles. To facilitate the search, keywords tailored to the research focus were used and combined with Boolean operators. The operators used included "teacher competence," "teacher competency," "mathematics teaching module," "mathematics learning module," "Realistic Mathematics Education," and "RME." The search was conducted for articles in both Indonesian and English that were relevant to the research topic.

To determine the suitability of the articles analyzed, inclusion and exclusion criteria were used. Inclusion criteria were used to determine whether the articles were worthy of further analysis. In addition, exclusion criteria were used to determine whether articles were not considered for further analysis.

Table 1. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
1. Research articles discussing RME-based mathematics learning.	1. Non-research articles, such as opinion pieces or articles without empirical data.
2. Articles discussing aspects of teacher competency, either explicitly or implicitly, in the development and development of teaching modules.	2. Articles focusing solely on student learning outcomes without any connection to the role or competency of teachers.
3. Articles published in accredited national journals.	3. Articles irrelevant to the research focus
4. Articles accessible in full text.	

The article selection process involved three stages. The first stage identified articles based on titles and abstracts relevant to the search keywords. The second stage screened articles based on their compliance with the inclusion and exclusion criteria. The third stage examined the entire text to ensure their relevance to the focus of teacher competency in developing RME-based mathematics teaching modules. Based on the selection process, five relevant articles were identified and met the criteria for further analysis. The stage presented in Figure 1.

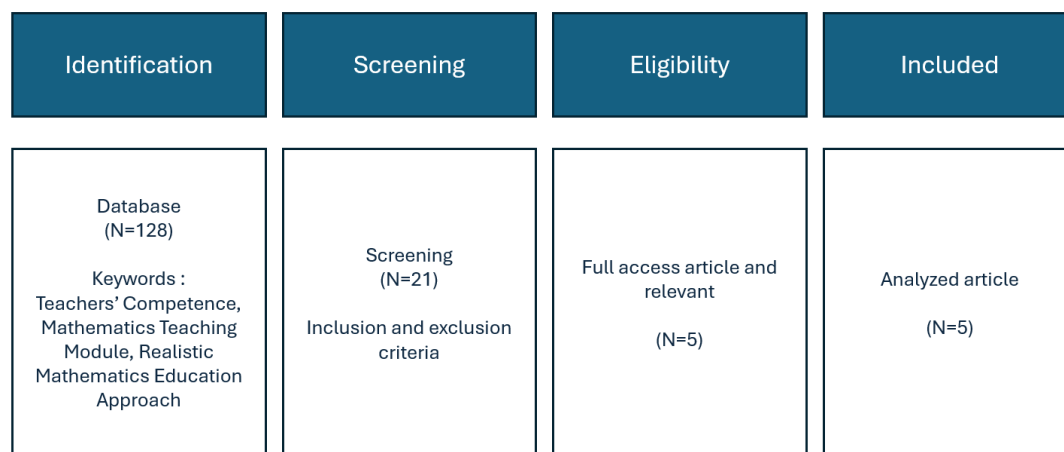


Figure 1. Selection stage

Data were collected through a comprehensive review of the articles' content. Data extraction was conducted using an extraction table that included key information and relevant research findings. The data extraction process was conducted carefully and maintained the consistency and accuracy of the analyzed data. Data analysis was conducted using thematic analysis that included several stages such as 1). reading and understanding the contents of the article thoroughly; 2). identifying important findings that correspond to teacher competencies in developing RME-based mathematics teaching modules; 3). grouping appropriate findings; and 5). describing various key findings based on the patterns of findings found between articles. The analysis in this study was conducted based on four main themes: RME-based teacher pedagogical competencies, teacher professional competencies in developing teaching modules, teacher Pedagogical Content Knowledge (PCK), and teacher technological competencies (TPACK) in developing RME modules or e-modules. The four themes were determined based on the research objectives and review conducted to explain teachers' competencies in developing Mathematics Teaching Modules Using the RME Approach

RESULT AND DISCUSSION

Table 1. Research Description

Authors	Findings
(Ihsan et al., 2025)	Teachers' ability to design and use learning modules effectively plays a crucial role in improving student learning outcomes and independence.
(Aulia & Prahmana, 2022)	teachers' ability to integrate technology into learning through the use of e-modules, which indicates the application of TPACK competencies in supporting the development of students' mathematical thinking.
(Zubaidah et al., 2023)	Teachers' Pedagogical Content Knowledge (PCK) is a key factor in the success of learning through the integration of subject matter understanding and teaching strategies.
(Hayuningrat & Rosnawati, 2022)	Teachers demonstrate competence in developing and implementing systematic instructional materials, thereby effectively enhancing student engagement and participation.
(Salsabila et al., 2025)	The success of implementing RME depends on teachers' pedagogical ability to design and manage contextual learning that systematically links real-world situations with mathematical concepts

Theme 1. Teacher Pedagogical Competence Based on Realistic Mathematics Education (RME)

Teachers' pedagogical competence in mathematics learning based on Realistic Mathematics Education (RME) can be seen from their ability to design learning based on real-world contexts and students' direct experiences. The five synthesized articles demonstrate that teachers with strong pedagogical competence are able to use relevant contextual problems, enhance exploration in learning, and encourage students to build mathematical concepts gradually through horizontal and vertical mathematization processes (Aulia & Prahmana, 2022; Salsabila et al., 2025). Teaching modules developed using the RME approach can help students understand mathematical concepts more meaningfully. This is because the learning emphasizes modeling real-world problems (Da, 2022).

Furthermore, teachers' pedagogical competence is also evident in their ability to manage the learning flow within the teaching module and adapt it to student characteristics. Research findings from several articles emphasize the need for teachers to systematically and purposefully design the stages of activities within the RME module (Saputri et al., 2025; Sari & Khaidir, 2023). This design includes context introduction, group discussions, and conceptual reflection (Hayuningrat & Rosnawati, 2022; Ihsan et al., 2025). This demonstrates that the success of RME teaching modules is highly dependent on teachers' skills in integrating pedagogical principles with the characteristics of a realistic approach.

Theme 2. Teacher Professional Competence in Developing Mathematics Teaching Modules

Teacher professional competence was the most dominant theme in the five articles analyzed. This competence encompasses teachers' ability to develop mathematics teaching modules systematically and structured. The development process includes formulating learning objectives, selecting materials, designing activities based on the RME context, and developing assessment instruments. All articles demonstrate that teachers with strong professional competence can produce RME teaching modules that meet the criteria of being valid, practical, and effective (Aulia & Prahmana, 2022; Hayuningrat & Rosnawati, 2022; Salsabila et al., 2025).

Furthermore, teachers' professional competence is also demonstrated through their ability to adapt RME teaching modules to the applicable curriculum. Several articles emphasize that teachers must be able to integrate the RME approach with learning outcomes, learning objectives, and assessments according to the applicable curriculum (Ihsan et al., 2025). These findings indicate that teachers' professional competence is related to their understanding and ability to develop mathematics teaching modules.

Theme 3. Teachers' Pedagogical Content Knowledge (PCK) in RME Learning

Teachers' pedagogical content knowledge (PCK) emerged as a key factor in the successful development of RME-based mathematics teaching modules. Articles that explicitly discuss PCK indicate that teachers need a deep understanding of mathematical concepts as well as pedagogical strategies aligned with RME principles. Teachers with strong PCK are able to translate abstract mathematical concepts into real-world contexts. Furthermore, teachers are able to select appropriate representations and identify student misconceptions during the learning process (Zubaidah et al., 2023).

Several findings in other articles also reinforce that the quality of RME teaching modules is significantly influenced by teachers' PCK levels. This occurs, although it is not always measured explicitly and specifically. Modules developed by teachers with a strong understanding of the content and appropriate pedagogical strategies tend to be more effective in facilitating students' conceptual understanding (Aulia & Prahmana, 2022; Hayuningrat & Rosnawati, 2022). This indicates that PCK is an important

foundation underlying teachers' pedagogical and professional competencies in developing RME-based teaching modules.

Theme 4. Teacher Technological Competence (TPACK) in Developing RME Modules/E-Modules

Teachers' technological competency within the Technological Pedagogical Content Knowledge (TPACK) framework is necessary for developing RME-based mathematics e-modules. Synthesis findings indicate that teachers must be able to integrate their skills with RME pedagogical approaches and mathematics content. Teachers with TPACK competencies are able to develop e-modules that are interactive, contextual, and support active student engagement in learning (Hayuningrat & Rosnawati, 2022; Ihsan et al., 2025).

However, several articles also explain that teachers' technological competence remains a challenge in developing RME teaching modules. Technology integration that is not aligned with RME principles has the potential to shift the learning focus from conceptual understanding to the utilization of digital media (Salsabila et al., 2025). Therefore, teachers' technological competence needs to be developed in a balanced manner with pedagogical competence and PCK so that the resulting RME e-modules remain conceptually meaningful.

Discussion

The findings of this literature synthesis indicate that teacher competency in developing mathematics teaching modules based on Realistic Mathematics Education (RME) encompasses four main aspects: pedagogical competency, professional competency, Pedagogical Content Knowledge (PCK), and technological competency (TPACK). These four competencies are interrelated and play a crucial role in producing teaching modules that are contextual, systematic, and capable of facilitating students' understanding of mathematical concepts. These findings confirm that the success of implementing RME in teaching modules is determined by the learning model used and the teacher's capacity to implement comprehensive learning.

In general, teacher professional competency is the most dominant aspect. This is because teacher professionalism is directly related to the ability to structure teaching modules, design learning activities, and develop assessments based on conceptual understanding. Meanwhile, pedagogical competency and PCK serve as the conceptual and pedagogical foundations in real-world contexts used to support the mathematics learning process. Technological competency aligns with the context of developing digital teaching modules, which align with the demands of 21st-century learning (Caena & Redecker, 2019). Thus, effective mathematics instruction depends on teachers' professional and pedagogical competence (Yang & Kaiser, 2022).

The findings of this study align with previous theoretical and empirical studies that confirm that RME requires teachers to act as learning designers capable of connecting mathematics to the realities of students' lives (Hakim et al., 2024; Papadakis et al., 2021). Previous research indicates that teachers need strong pedagogical competence to select meaningful contexts and guide the mathematization process gradually so that students can construct conceptual understanding independently (Skantz-Åberg et al., 2022). The integration and combination of various teacher competencies are key factors in the effective implementation of RME in an effective mathematics learning environment (Nguyen et al., 2023).

Furthermore, this study aligns with previous research that emphasizes the importance of teachers' Pedagogical Content Knowledge (PCK) in mathematics learning. PCK is core to teaching competence because it enables teachers to effectively integrate content knowledge and pedagogy (Chan, 2022; Jibril & Adedokun-Shittu, 2023). In the context of RME, previous research indicates that teachers with strong PCK are able to

design contextualized teaching materials that are aligned with students' thinking styles (Gao et al., 2021). These findings also reinforce studies on TPACK, which emphasize that technology integration in mathematics learning must remain aligned with pedagogical objectives and content to avoid compromising conceptual understanding (Hidayat & Firmanti, 2024; Verawati & Nisrina, 2025).

The strength of this research lies in its ability to comprehensively map teacher competencies in the context of developing RME-based mathematics teaching modules. Thematic analysis allows for the identification of the most dominant and relevant competency aspects, providing a clear picture of teacher competency needs for effectively implementing RME. Furthermore, the focus on teaching modules makes these findings relevant and aligned with learning practices in schools. However, several limitations exist in this research's findings. Most of the articles analyzed assessed teacher competency indirectly through the quality of the teaching modules. This could lead to bias in the measurement of teacher competency. Furthermore, the variety of research contexts and methods used in these articles could potentially influence the generalizability of the research findings

CONCLUSION

A synthesis of the existing literature concludes that teacher competencies are the primary factors required to develop RME-based mathematics teaching modules. The competencies required include pedagogical competencies, professional competencies, PCK, and TPACK. All four competencies play a crucial role, with professional competencies being the most dominant. These four competencies can serve as a means to contextualize mathematical concepts and utilize current learning technologies. Therefore, strengthening these four competencies is crucial to supporting the effectiveness of mathematics learning. These findings confirm that the successful implementation of RME in mathematics teaching modules is highly dependent on the competence of teachers as learning designers. Therefore, strengthening teacher competence needs to be a primary concern in the development of mathematics learning. Future research is recommended to include a wider range of articles and include empirical studies that specifically measure teacher competency in the context of RME. Furthermore, future research could examine the relationship between teacher competency and its impact on student learning outcomes in greater depth. Further development of the teacher competency model for developing RME-based mathematics teaching modules, including empirical testing, is also needed.

REFERENCES

- Asmaarobiyah, R., Rosmilawati, I., & Juansah, D. E. (2025). Pendekatan Pendidikan Matematika melalui Realistic Mathematics Education (RME) di Sekolah Dasar: Systematic Literature Review. *Journal of Instructional and Development Researches*, 5(3), 251–267. <https://doi.org/10.53621/jider.v5i3.527>
- Aulia, E. T., & Prahmana, R. C. I. (2022). Developing interactive e-module based on realistic mathematics education approach and mathematical literacy ability. *Jurnal Elemen*, 8(1), 231–249. <https://doi.org/10.29408/jel.v8i1.4569>
- Cabero-Almenara, J., Guillén-Gámez, F. D., Ruiz-Palmero, J., & Palacios-Rodríguez, A. (2022). Teachers' digital competence to assist students with functional diversity: Identification of factors through logistic regression methods. *British Journal of Educational Technology*, 53(1), 41–57. <https://doi.org/10.1111/bjet.13151>
- Caena, F., & Redecker, C. (2019). Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for

- Educators. *European Journal of Education*, 54(3), 356–369. <https://doi.org/10.1111/ejed.12345>
- Chan, K. K. H. (2022). A critical review of studies using the pedagogical content knowledge map approach. *International Journal of Science Education*, 44(3), 487–513. <https://doi.org/10.1080/09500693.2022.2035011>
- Da, N. T. (2022). Designing a teaching model based on the Realistic Mathematics Education (RME) approach and its application in teaching calculus. *Journal of Mathematics and Science Teacher*, 2(1), em006. <https://doi.org/10.29333/mathsciteacher/11918>
- Erita, S. (2022). Development of an e-modules for learning mathematics based on a scientific approach to help the online learning process. *International Journal of Trends in Mathematics Education Research*, 5(4), 411–416. <https://doi.org/10.33122/ijtmer.v5i4.170>
- Febriana, R. (2021). Application of the RME Approach to Improve Students' Mathematical Concepts Understanding. *Tarbawi: Jurnal Ilmu Pendidikan*, 17(2), 118–125. <https://doi.org/10.32939/tarbawi.v17i2.1006>
- Gao, S., Damico, N., & Gelfuso, A. (2021). Mapping and reflecting on integration of the components of pedagogical content knowledge (PCK) for teaching natural selection: A case study of an experienced middle-school science teacher. *Teaching and Teacher Education*, 107, 103473. <https://doi.org/10.1016/j.tate.2021.103473>
- Hafizah, N., Ahmad, S., Zainil, M., & Bentri, A. (2024). Validity of the Elementary School Mathematics E-Module on Fractional Material Based on the Realistic Mathematics Education (RME) Approach. *Mimbar Sekolah Dasar*, 11(2), 328–338. <https://doi.org/10.53400/mimbar-sd.v11i2.72099>
- Hakim, N., Apriyanto, A., Mardiaty, M., & Sitepu, E. (2024). Implementation of the Realistic Mathematics Education (RME) Approach in Geometry Learning in Secondary Schools. *Aksioma Education Journal*, 1(3), 17–30. <https://doi.org/10.62872/rgn3w339>
- Hayuningrat, S., & Rosnawati, R. (2022). Development of learning tools based on realistic mathematics approach that oriented to high school students' mathematical generalization ability. *Jurnal Riset Pendidikan Matematika*, 9(2), 191–200. <https://doi.org/10.21831/jrpm.v9i2.52197>
- Hidayat, A., & Firmanti, P. (2024). Navigating the tech frontier: a systematic review of technology integration in mathematics education. *Cogent Education*, 11(1). <https://doi.org/10.1080/2331186X.2024.2373559>
- Ihsan, N. A., Sulasteri, S., & Latuconsina, N. K. (2025). Development of a mathematics teaching module based on the realistic mathematics education (RME) approach for grade VII algebra material at MTs Negeri Gowa. *Edumaspul Journal*, 9(2). <https://doi.org/10.33487/edumaspul.v9i1>
- Irawan, I. D. A., Khusaini, K., Islamiyah, M., Basri, N. A., & Ardilla, S. L. (2026). Students' Conceptual Understanding And Difficulties On Static Fluids: A Literature Review. *Jurnal Phi Jurnal Pendidikan Fisika Dan Fisika Terapan*, 12(1), 1–8. <https://doi.org/10.22373/p-jpft.v12i1.30339>
- Jibril, M., & Adedokun-Shittu, N. A. (2023). Enhancing Education: A Comprehensive Framework for Integrating Technological Pedagogical Content Knowledge (TPACK) Into Teaching and Learning. *Indonesian Journal of Multidisciplinary Research*, 4(1), 181–188. <https://doi.org/10.17509/ijomr.v4i1.72044>
- Nguyen, G. T. C., Pham, C. T. H., Pham, C. X., & Nguyen, B. N. (2023). Primary School Teachers' Determinants of Integrated Teaching for Realistic Math Education. *European Journal of Educational Research*, volume-12-2023(volume-12-issue-1-january-2023), 253–263. <https://doi.org/10.12973/eu-jer.12.1.253>
- Nurhaliza, D. (2022). Pengaruh alat peraga kotak matriks (Komat) terhadap kemampuan penalaran matematis siswa kelas XI SMA Negeri 2 Bandar T.A 2022/2023. *JURNAL*

- PEMBELAJARAN DAN MATEMATIKA SIGMA (JPMS), 8(2), 145–153. <https://doi.org/10.36987/jpms.v8i2.3352>
- Papadakis, S., Kalogiannakis, M., & Zaranis, N. (2021). Teaching mathematics with mobile devices and the Realistic Mathematical Education (RME) approach in kindergarten. *Advances in Mobile Learning Educational Research*, 1(1), 5–18. <https://doi.org/10.25082/AMLER.2021.01.002>
- Salsabila, E., Hajizah, M. N., & Sampoerno, P. D. (2025). Efektivitas Desain Didaktis Materi Lingkaran Berbasis Realistic Mathematics Education terhadap Kemampuan Pemahaman Konsep Matematis. *Jurnal Riset Pendidikan Matematika Jakarta*, 7(2), 64–73.
- Saputri, V., Kusumah, Y. S., Turmudi, T., & Jupri, A. (2025). E-Module Design Based on STEM and RME for Student Numeracy Development in Senior High Schools: Insights from a Needs Analysis. *International Conference on Science, Education and Technology*, 281–288. <https://proceeding.unnes.ac.id/ISET>
- Sari, N., & Khaidir, C. (2023). Needs Analysis and Design of FlipBook-Based E-Module Development with RME Model to Improve Students' Concept Understanding Ability. *JDIME: Journal of Development and Innovation in Mathematics Education*, 1(2), 12–24. <https://doi.org/10.32939/jdime.v1i2.2979>
- Siswanti, Sabon, S. S., Listiawati, N., Wirda, Y., Zulkardi, & Riyanto, B. (2025). Bridging mathematics and communication: Implementing realistic mathematics education principles for skill development. *Journal on Mathematics Education*, 16(2), 729–752. <https://doi.org/10.22342/jme.v16i2.pp729-752>
- Skantz-Åberg, E., Lantz-Andersson, A., Lundin, M., & Williams, P. (2022). Teachers' professional digital competence: an overview of conceptualisations in the literature. *Cogent Education*, 9(1). <https://doi.org/10.1080/2331186X.2022.2063224>
- Verawati, N. N. S. P., & Nisrina, N. (2025). Reimagining Physics Education: Addressing Student Engagement, Curriculum Reform, and Technology Integration for Learning. *International Journal of Ethnoscience and Technology in Education*, 2(1), 158. <https://doi.org/10.33394/ijete.v2i1.14058>
- Yang, X., & Kaiser, G. (2022). The impact of mathematics teachers' professional competence on instructional quality and students' mathematics learning outcomes. *Current Opinion in Behavioral Sciences*, 48, 101225. <https://doi.org/10.1016/j.cobeha.2022.101225>
- Zubaidah, T., Johar, R., Annisa, D., & Safitri, Y. (2023). Teacher's Pedagogical Content Knowledge (PCK) in implementing Realistic Mathematics Education (RME). *Beta: Jurnal Tadris Matematika*, 16(1). <https://doi.org/10.20414/betajtm.v16i1.550>