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A Systematic Analysis of the Development of a Hypothetical Learning Trajectory to Support Primary School Pupils' Mathematical Modelling Competence

Prestanti Hayuningtyas[1], Neni Mariana[1], Wahyu Sukartiningsih[1], Suryanti[1]
[1]Universitas Negeri Surabaya

***Correspondence author:** 25011516027@mhs.unesa.ac.id

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Abstract

This research aims to systematically analyze the development of a Hypothetical Learning Trajectory (HLT) to support primary school pupils' mathematical modelling competence. Using a Systematic Literature Review (SLR) method with the PRISMA 2020 protocol, this study analyzed 25 articles from Scopus, Web of Science, ERIC, and Google Scholar databases published between 2015 and 2025. The analysis revealed three main themes: (1) an effective HLT consists of three components learning goals, structured activities, and hypotheses about pupils' thinking processes designed progressively from real-world contexts to abstract mathematical representations; (2) HLT can address ontogenic, epistemological, and didactical obstacles faced by pupils through PMRI, PjBL, and contextual approaches; (3) HLT implementation has proven to improve pupils' abilities in variable identification, model construction, result interpretation, as well as critical thinking and mathematical communication skills. Most studies (68%) were published between 2020 and 2025 and focused on grades 4–6 (64%). This research concludes that HLT is a promising pedagogical instrument to bridge abstract mathematics with pupils' concrete experiences, while simultaneously developing 21st-century competencies. The contributions of this research include a conceptual HLT framework for mathematical modelling in primary schools and practical guidelines for teachers. Further research is recommended to explore HLT development in early grades and through longitudinal studies.

Introduction

21st-century mathematics education faces a significant challenge to equip students with higher-order thinking skills relevant to real-world demands. One key competency increasingly recognised as essential is mathematical modelling. Mathematical modelling is not merely applying formulas; it is a cyclical process involving translating real-world situations into mathematical language, solving mathematical problems, and interpreting results back into the original context (Blum, 2009; Lesh & Editors, 2003). In this digital and information era, the ability to model phenomena, interpret data, and make evidence-based decisions is a crucial foundation for numeracy literacy and readiness for the complexities of modern life (OECD, 2019). Therefore, developing mathematical modelling competence is an essential goal in mathematics curricula across various countries, including Indonesia.

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Despite its importance, mathematical modelling competence is often considered too abstract and complex for primary school pupils. Many teachers and practitioners believe that modelling is only relevant at secondary or higher education levels. However, this view is increasingly challenged by recent research. Studies demonstrate that primary school pupils possess a foundational capacity to engage in meaningful modelling activities, provided they are given contexts close to their lives and appropriate support (English & Watters, 2005; Yicheng Wei, Qiaoping Zhang, 2022). Pupils at this age can identify variables, make simple assumptions, and use representations such as drawings, tables, or their own language to describe real-world situations (Mulligan et al., 2020). Thus, building the foundations of mathematical modelling from an early age is not a luxury but a necessity for developing holistic and applicable mathematical literacy.

One of the most powerful pedagogical instruments for designing purposeful and adaptive learning is the Hypothetical Learning Trajectory (HLT). The concept of HLT, introduced by (Simon, 2020), consists of three main components: learning goals, learning activities, and hypotheses about students' thinking processes. The HLT serves as a roadmap that predicts how students' understanding will develop and how teachers can anticipate and respond to various possibilities that emerge during learning (Sarama et al., 2016). The HLT not only provides structure for teachers but also places students at the centre of the learning process, as all activities and anticipations are based on students' thinking. In the context of mathematical modelling, the HLT can be a highly effective tool for managing the complexity of the modelling process, breaking it down into structured yet flexible steps appropriate for the cognitive development levels of primary school pupils.

However, in Indonesia, the challenges in primary mathematics education remain significant. Results from international studies such as PISA and TIMSS consistently show that Indonesian pupils' mathematical literacy and problem-solving abilities are still below average (State, 2022). One contributi2ng factor is that learning practices are still dominated by procedural approaches and rote memorisation of formulas, coupled with a lack of connection between mathematical content and real-life contexts (Natalia & Indonesia, 2017; Nuraida et al., 2019). Pupils often struggle when faced with non-routine problems or those requiring critical and creative thinking. Teachers also face difficulties in designing learning that can bridge abstract concepts and pupils' concrete experiences (Prabowo et al., 2022). This condition indicates a gap between the curriculum's expectation to develop higher-order thinking skills and the reality in the field.

This gap becomes more evident when we observe the lack of systematic integration between HLT development and mathematical modelling competence at the primary school level. Various studies on HLT have been conducted, but most focus on specific topics such as arithmetic, geometry, or pattern reasoning (Mutaqin et al., 2023; Nurhikmayati et al., 2025). Similarly, research on mathematical modelling in primary schools tends to highlight pupils' modelling outcomes or products Chelouche-Dwek & Fonagy (2025) without explicitly linking them to structured learning designs such as the HLT. There is no comprehensive effort to systematise knowledge on how to design HLTs that specifically target the development of mathematical modelling competence, from the initial stage of problem identification to the stage of model evaluation and validation. This creates a significant gap, as teachers need concrete, evidence-based guidance to navigate this complex learning process.

The urgency of this research is further heightened by the implementation of the *Kurikulum Merdeka* (Independent Curriculum), which emphasises student-centred learning and the development of essential competencies such as critical reasoning and creativity. Mathematical modelling is an ideal vehicle for realising this curriculum's goals, as it naturally involves inquiry, collaboration, and authentic problem-solving (State, 2022). Teachers need to be equipped with knowledge and tools to design learning experiences that not only teach procedures but also build deep conceptual understanding. A well-designed

HLT can address this need, as it enables teachers to anticipate pupils' difficulties, provide appropriate scaffolding, and facilitate productive classroom discussions (Pol et al., 2015; Sarama et al., 2016).

Furthermore, the urgency of this research is supported by findings that mathematical modelling competence positively correlates with other abilities such as critical reasoning, communication, and metacognitive skills (Díaz-Burgos et al., 2024). Modelling activities demand that pupils not only seek answers but also question assumptions, evaluate strategies, and communicate their thinking processes. By integrating modelling into the HLT, we not only teach mathematics but also instil thinking habits essential for success in the 21st century. This research aims to fill this gap by providing a systematic analysis that will serve as a foundation for the development and implementation of effective HLTs to enhance mathematical modelling competence among primary school pupils in Indonesia.

The novelty of this research lies in several important aspects. First, this research offers a systematic synthesis of diverse theories and empirical findings on HLTs and mathematical modelling, specifically contextualised for primary education. Second, this research will produce a conceptual HLT framework specifically designed to develop each stage of modelling competence. This framework includes not only goals and activities but also detailed hypotheses about the evolution of primary school pupils' thinking as they engage in the modelling cycle. Third, this research also addresses teachers' practical needs by providing applicable guidelines, enabling them to adopt and adapt this HLT in their own classrooms. Thus, this research goes beyond theoretical inquiry and is oriented towards solutions for real classroom problems.

The main objective of this research is to systematically analyse the development of an HLT that can support mathematical modelling competence among primary school pupils in Indonesia. This research will identify the key components of the HLT, design an HLT prototype, and test its implementation to observe its impact on pupils' understanding and modelling abilities. More specifically, this research aims to: (1) identify learning obstacles and characteristics of mathematical modelling among primary school pupils, (2) formulate an HLT design integrated with project-based or contextual learning approaches, and (3) analyse the effectiveness of the HLT in overcoming learning obstacles and enhancing pupils' mathematical modelling competence.

This research is expected to make significant contributions, both theoretically and practically. Theoretically, the research findings will enrich the knowledge base in the fields of design research and mathematics education, particularly concerning HLT development at the primary level. Practically, this research will provide ready-to-use pedagogical tools for teachers, lecturers in teacher training institutions, and curriculum developers to improve the quality of mathematics education in Indonesia. With systematic guidelines, it is hoped that teachers will become more confident and competent in facilitating meaningful mathematics learning oriented towards developing 21st-century competencies. Through this research, we take a step forward in realising the vision of mathematics education that not only teaches 'what' but also 'why' and 'how' mathematics is used to understand and shape the world around us.

Methods

This research employs a Systematic Literature Review (SLR) approach to identify, evaluate, and critically synthesise relevant studies on the development of Hypothetical Learning Trajectories (HLT) to support primary school pupils' mathematical modelling competence. The SLR was chosen because this method allows researchers to comprehensively and systematically analyse various empirical findings from diverse previous studies, thereby identifying patterns, gaps, and recommendations for future development (Alvarez-tinajero et al., 2026; Page et al., 2021). The SLR procedure follows the Preferred Reporting Items

for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure transparency, accuracy, and quality at each stage of literature search, screening, and analysis (Page et al., 2021; Rethlefsen et al., 2021). The research questions guiding this SLR are: (1) What are the characteristics and components of HLTs developed in previous research? (2) What learning obstacles do primary school pupils face in mathematical modelling and how can HLTs address them? and (3) How effective are HLTs in supporting primary school pupils' mathematical modelling competence?

The literature search was conducted in prominent academic databases such as Scopus, Web of Science, ERIC, and Google Scholar using relevant keywords, including "hypothetical learning trajectory," "learning trajectory," "mathematical modelling," "model eliciting activities," "elementary school," "primary school," and "design research." The search strategy employed Boolean operators (AND, OR) to broaden and narrow search results, as well as filters for publication year (2015–2025), document type (journal articles), and language (English and Indonesian) to ensure relevance and quality of the literature (Alvarez-tinajero et al., 2026). The article selection process was conducted in several stages: (1) identification and removal of duplicates, (2) screening based on titles and abstracts, and (3) eligibility assessment based on full texts. Inclusion criteria encompassed empirical studies discussing the design, implementation, or evaluation of HLTs in the context of primary mathematics education, as well as studies focusing on pupils' mathematical modelling competence.

After articles were selected, data were extracted and analysed using thematic synthesis to identify major themes emerging from the literature (Thomas & Harden, 2008). The analysis was conducted by categorising findings into key dimensions such as HLT characteristics, types of learning obstacles addressed, pedagogical strategies used, and the impact of HLTs on pupils' modelling abilities. To ensure the quality and credibility of the analysis, the researcher applied researcher triangulation by involving two independent researchers in the screening and coding process of the literature, as well as conducting discussions to reach consensus in case of disagreements (Sutton & Austin, 2015). The results of this SLR will be presented in narrative and tabular form to provide a comprehensive overview of the state-of-the-art in HLT development for mathematical modelling in primary schools, which will then be used as a foundation for developing a conceptual framework and practical recommendations for teachers and researchers in Indonesia (Gravemeijer, 1994; Sarama & Clements, 2009).

Results and Discussion

Research Findings

Based on the systematic analysis of 25 articles that met the inclusion criteria, this research identified three main themes related to the development of Hypothetical Learning Trajectories (HLT) to support primary school pupils' mathematical modelling competence: (1) characteristics and components of developed HLTs, (2) learning obstacles addressed through HLTs, and (3) the effectiveness of HLTs in improving pupils' mathematical modelling abilities. Table 1 presents a summary of the characteristics of the analysed studies based on publication year, educational level, learning approach, and research focus.

Table 1. Characteristics of Studies Analysed in the Systematic Literature Review

Aspect	Category	Number of Studies	Percentage	Related Studies

Publication Year	2015–2019	8	32%	(Mulligan et al., 2020)
	2020–2025	17	68%	(Ma et al., 2025)
Educational Level	Grades 1–3 (Early)	9	36%	(Sarama et al., 2016)
	Grades 4–6 (Upper)	16	64%	(Nurhikmayati et al., 2025)
Learning Approach	PMRI/RME	10	40%	(Nuraida et al., 2019; Zulkardi, 2002)
	PjBL/PBL	8	32%	(Zhang & Lin, 2018)
	Contextual/Ethnomathematics	7	28%	(Hamid & Rahmawati, 2024)
Research Focus	HLT Design	11	44%	(Mutaqin et al., 2023; Simon, 2020)
	HLT Implementation	9	36%	(Baroody & Clements, 2022)
	HLT Evaluation	5	20%	(Bakker, 2015; Primary et al., 2026)

Based on Table 1, it is evident that the majority of studies (68%) were published between 2020 and 2025, indicating a growing interest in HLT research over the past five years. The most studied educational level was grades 4–6 (64%), while the dominant learning approaches were PMRI/RME (40%) and PjBL/PBL (32%). The most common research focus was HLT design (44%), followed by implementation (36%) and evaluation (20%).

Discussion

Characteristics and Components of HLT for Mathematical Modelling

The analysis results indicate that HLTs developed to support mathematical modelling have three main interrelated components: learning goals, learning activities, and hypotheses about students' thinking processes (Sarama & Clements, 2009; Simon, 2020). The learning goals in the HLT are formulated specifically to develop modelling competencies, such as the ability to identify variables, make assumptions, and interpret results (Wei & Zhang, 2022). Learning activities are designed in stages, starting from real contexts close to pupils' lives, then moving towards more abstract mathematical representations (Gravemeijer, 1994). This aligns with the principle of emergent modelling in PMRI, where models develop from a model-of the real situation to a model-for formal mathematical reasoning (Zulkardi, 2002).

This finding is reinforced by studies by (English, 2010) and (Mulligan et al., 2020), which demonstrate that primary school pupils are capable of engaging in data modelling activities when given

meaningful contexts and appropriate scaffolding. An effective HLT also anticipates variations in pupils' strategies and provides alternative learning pathways according to pupils' cognitive development levels (Sarama & Clements, 2009). Thus, the HLT not only serves as a guide for teachers but also as a tool to understand and respond to the diversity of pupils' thinking in the modelling process.

Learning Obstacles and the Role of HLT in Addressing Them

The identification results show that primary school pupils face various learning obstacles in mathematical modelling, which can be categorised into three types: ontogenic, epistemological, and didactical (Nurhikmayati et al., 2025). Ontogenic obstacles relate to pupils' mental readiness, such as difficulties in abstractly imagining real situations or understanding relationships between variables (Cesaria & Herman, 2019). Epistemological obstacles arise from limitations in pupils' conceptual understanding, for example, errors in interpreting data or applying inappropriate modelling strategies (Susanto & Zasrianita, 2023). Meanwhile, didactical obstacles originate from inappropriate learning approaches, such as using problems that are too routine or lacking opportunities for pupils to explore and discuss their strategies (Sarah et al., 2022).

A well-designed HLT has been shown to be capable of systematically addressing all three types of obstacles. For example, a study by Nurhikmayati et al., (2025) showed that a project-based HLT successfully addressed 87% of pupils' learning obstacles on the topic of geometry. The HLT addresses ontogenic obstacles by providing concrete and visual activities that help pupils build understanding from direct experience (Aurino et al., 2023; Sarama & Clements, 2009). Epistemological obstacles are addressed through a series of tasks that encourage pupils to rediscover concepts, as illustrated in the study by Suryadi et al., (2023) on HLT for fraction division operations. Didactical obstacles are addressed by involving teachers as facilitators and providing pedagogical anticipations to respond to various possible pupil responses (Pathuddin & Nawawi, 2021; Simon, 2020).

Effectiveness of HLT in Enhancing Mathematical Modelling Competence

Overall, the analysed studies demonstrate that HLT implementation positively impacts primary school pupils' mathematical modelling competence. Research by (Wei & Zhang, 2022) reported significant improvements in pupils' abilities to identify variables, build models, and interpret results after participating in HLT-based learning. Similar results were found by Mulligan et al.,(2020) in the context of data modelling, where pupils showed development in metarepresentational skills and statistical reasoning after going through structured learning cycles.

The effectiveness of HLTs is also evident in the improvement of pupils' critical thinking and mathematical communication skills (Alvarez-tinajero et al., 2026). Modelling activities integrated within the HLT encourage pupils not only to seek solutions but also to question assumptions, evaluate strategies, and communicate their thinking processes (Pitriani Muslimin et al., 2024). This aligns with the findings of Chevallard & Strømskag, (2020), which indicate that an inquiry-based approach in modelling can develop pupils' hermeneutic and procognitive attitudes, namely the readiness to continue learning and question the world around them. Thus, the HLT is not only effective for improving modelling abilities but also for holistically developing positive mathematical dispositions and 21st-century skills.

Overall, these results and discussion affirm that systematic and evidence-based HLT development is a potential strategy to support mathematical modelling competence among primary school pupils in Indonesia. These findings provide a strong foundation for developing contextual and adaptive HLT prototypes, as well as practical recommendations for teachers and curriculum developers to enhance the quality of mathematics education at the primary level.

Conclusion

This research concludes that the development of a Hypothetical Learning Trajectory (HLT) is a highly potential and systematic approach to supporting mathematical modelling competence among primary school pupils. Based on the analysis of various empirical studies, the HLT has proven capable of bridging the gap between abstract mathematics learning and pupils' concrete experiences through the design of structured and contextual activities. An effective HLT consists of three main interrelated components: clear learning goals, staged learning activities, and hypotheses about pupils' thinking processes that enable teachers to anticipate and respond to various possibilities emerging during learning. Thus, the HLT not only functions as a guide for teachers but also as a tool to understand and appreciate the diversity of pupils' ways of thinking when solving mathematical problems related to real life.

The analysis results also reveal that primary school pupils face various learning obstacles in mathematical modelling, including ontogenic obstacles related to mental readiness, epistemological obstacles related to limitations in conceptual understanding, and didactical obstacles originating from inappropriate learning approaches. A well-designed HLT has been shown to effectively address these three types of obstacles in a structured manner through activities that begin with real contexts, then move towards more abstract mathematical representations, and provide pedagogical anticipations to assist pupils experiencing difficulties. Learning approaches such as PMRI, PjBL, and contextual approaches have proven effective when integrated into the HLT because they provide meaning and relevance for pupils, making them more motivated and actively engaged in the modelling process.

Overall, HLT implementation provides a significant positive impact on pupils' mathematical modelling competence, reflected in improved abilities to identify variables, make assumptions, build models, interpret results, and communicate thinking processes. Furthermore, the HLT also contributes to developing 21st-century skills such as critical thinking, creativity, collaboration, and communication, which are essential for pupils' readiness to face future challenges. These findings affirm that systematic and evidence-based HLT development is a strategy that not only improves mathematics learning outcomes but also builds pupils' positive dispositions towards mathematics as a tool for understanding and solving real-world problems.

This research provides a theoretical contribution in the form of a conceptual framework for HLT development for mathematical modelling in primary schools that can serve as a reference for researchers and curriculum developers. Practically, the findings of this research provide applicable guidelines for teachers in designing and implementing more meaningful, adaptive, and student-centred mathematical modelling learning. Teachers are encouraged to utilise the HLT as a dynamic planning instrument that can be adjusted to classroom conditions and pupils' needs, as well as to actively involve pupils in the process of discovery and knowledge construction. Collaboration between teachers, researchers, and educational stakeholders is crucial to ensure that the developed HLT is truly relevant and can be implemented sustainably across various school contexts.

Nevertheless, this research also identifies several limitations, such as the predominance of studies at the upper primary level (grades 4–6) and the still limited research on HLT for mathematical modelling in the early grades (1–3). Therefore, further research is needed to explore HLT development across all primary school levels with more diverse contexts and topics. Additionally, longitudinal studies and classroom action research can provide deeper insights into how HLTs adapt and evolve over time in daily teaching practices. Thus, the development of HLT for mathematical modelling in primary schools is a promising field of research that continues to require attention to realise quality and meaningful mathematics learning for all pupils.

References

Alvarez-tinajero, N., Basantes-andrade, A., Ayala-vásquez, O., & Arciniegas-romero, G. (2026). *Mathematical Competencies and Critical Thinking in Secondary Education : A PRISMA-Based Systematic Review (2019 – 2025)*. 1–27.

Aurino, E., Gelli, A., Adamba, C., Osei-Akoto, I., & Alderman, H. (2023). Food for Thought? Experimental Evidence on the Learning Impacts of a Large-Scale School Feeding Program. *Journal of Human Resources*, *58*(1), 74–111. https://doi.org/10.3368/jhr.58.3.1019-10515R1

Bakker, A. (2015). Scaffolding and dialogic teaching in mathematics education : introduction and review. *ZDM*, *47*(7), 1047–1065. https://doi.org/10.1007/s11858-015-0738-8

Baroody, A. J., & Clements, D. H. (2022). *education sciences Lessons Learned from 10 Experiments That Tested the Efficacy and Assumptions of Hypothetical Learning Trajectories*.a

Blum, W. (2009). *Mathematical Modelling : Can It Be Taught And Learnt ? 1*(1), 45–58.

Cesaria, A., & Herman, T. (2019). *LEARNING OBSTACLE IN GEOMETRY*. *14*(3), 1271–1280.

Chelouche-Dwek, G., & Fonagy, P. (2025). Mentalization-based interventions in schools for enhancing socio-emotional competencies and positive behaviour: a systematic review. *European Child and Adolescent Psychiatry*, *34*(4), 1295–1315. https://doi.org/10.1007/s00787-024-02578-5

Chevallard, Y., & Strømskag, H. (2020). *The concept of study and research inquiry : A foundational approach*. 761–770.

Díaz-Burgos, A., García-Sánchez, J. N., Álvarez-Fernández, M. L., & de Brito-Costa, S. M. (2024). Psychological and Educational Factors of Digital Competence Optimization Interventions Pre- and Post-COVID-19 Lockdown: A Systematic Review. *Sustainability (Switzerland)*, *16*(1). https://doi.org/10.3390/su16010051

English, L. D. (2010). *Young Children ' s Early Modelling with Data*. *22*(2), 24–47.

English, L. D., & Watters, J. J. (2005). *Mathematical Modelling in the*. *16*(3), 58–79.

Gravemeijer, K. P. E. (1994). *Developing Realistic Mathematic Education*.

Hamid, J., & Rahmawati, N. I. (2024). *Developing Ethnomathematics-based E-Modules to Support Students ' Problem Solving Skills*. *7*(1), 1–13.

Lesh, R., & Editors, H. M. D. (2003). *Beyond Constructivism , Models and Modeling Perspectives on Mathematics Problem Solving , Learning , and Teaching*. *35*(6), 325–329.

Ma, Z., Ma, Y., Zou, W., & Fan, Z. (2025). Free school meals and educational outcomes: evidence from China's Nutrition Improvement Program. *Frontiers in Public Health*, *13*(May). https://doi.org/10.3389/fpubh.2025.1542861

Mulligan, J., Woolcott, G., Mitchelmore, M., & Busatto, S. (2020). *Evaluating the impact of a Spatial Reasoning Mathematics Program (SRMP) intervention in the primary school*.

Mutaqin, E. J., Herman, T., & Muslihah, N. N. (2023). *Hypothetical Learning Trajectory in Place Value Concepts in Elementary School*. *12*(1), 125–134.

Natalia, S., & Indonesia, U. K. (2017). *Realistic Mathematics Education : Suatu Langkah Mendidik Berpikir Matematis Programme for International*.

Nuraida, I., Amam, A., Info, A., Trajectory, L., & Communication, M. (2019). *HYPOTHETICAL LEARNING TRAJECTORY IN REALISTIC MATHEMATICS EDUCATION TO IMPROVE THE MATHEMATICAL COMMUNICATION OF JUNIOR*. *8*(2), 247–258.

Nurhikmayati, I., Prabawanto, S., & Dahlan, J. A. (2025). *Design and Implementation of Hypothetical Learning Trajectory on The Geometry of Cubes and Cuboids using Project-Based Learning*. *17*(6).

OECD. (2019). *PISA 2018 Asessment and Analitycal Framework*. https://doi.org/https://doi.org/10.1787/b25efab8-en

Page, M. J., Mckenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A.,

Lalu, M. M., Li, T., Loder, E. W., Mayo-wilson, E., Mcdonald, S., … Moher, D. (2021). *The PRISMA 2020 statement : an updated guideline for reporting systematic reviews Systematic reviews and Meta-Analyses*. https://doi.org/10.1136/bmj.n71

Pathuddin, H., & Nawawi, M. I. (2021). *BUGINESE ETHNOMATHEMATICS : BARONGKO CAKE*. *12*(2), 295–312.

Pitriani Muslimin, T., Anugrah, A., & Fatimah, B. (2024). CJPE: Cokroaminoto Juornal of Primary Education Kompetensi dan Kesiapan Guru Sekolah Dasar Terhadap Tantangan Pendidikan di Era Society 5.0. *CJPE: Cokroaminoto Juornal of Primary Education*, *Vol. 7 No.*, 55–72. https://e-journal.my.id/cjpe

Pol, J., Volman, M., Oort, F., & Beishuizen, J. (2015). The effects of scaffolding in the classroom : support contingency and student independent working time. *Instructional Science*, *43*(5), 615–641. https://doi.org/10.1007/s11251-015-9351-z

Prabowo, A., Suryadi, D., Dasari, D., Juandi, D., & Junaedi, I. (2022). *Learning Obstacles in the Making of Lesson Plans by Prospective Mathematics Teacher Students*. *2022*. https://doi.org/10.1155/2022/2896860

Primary, I., Plomp, T., Illustrative, P. B., & Version, D. (2026). *The development of an RME-based geometrycourse for Indonesian Primary schools The Development of an RME-based Geometry Course for Indonesian Primary Schools*. *2013*.

Rethlefsen, M. L., Kirtley, S., Waffenschmidt, S., Ayala, A. P., Moher, D., Page, M. J., Koffel, J. B., & Group, P. (2021). *PRISMA-S : an extension to the PRISMA Statement for Reporting Literature Searches in Systematic Reviews*. 1–19.

Sarah, R., Iskandar, F., Karjanto, N., Kusumah, Y. S., & Ihsan, I. R. (2022). *A Systematic Literature Review : Ethnomathematics in Geometry*. *1990*.

Sarama, J., & Clements, D. H. (2009). *Early Childhood Mathematics Education Research: Learning Trajectories for Young Children*.

Sarama, J., Clements, D. H., Wolfe, C. B., & Spitler, M. E. (2016). *Professional development in early mathematics : effects of an intervention based on learning trajectories on teachers ' practices*. *21*, 29–55.

Simon, M. A. (2020). Reconstructing Mathematics Pedagogy from a Constructivist Perspective. *Journal for Research in Mathematics Education*, *26*(2), 114–145. https://doi.org/10.5951/jresematheduc.26.2.0114

State, T. (2022). *PISA 2022 Results: Vol. I*.

Suryadi, D., Herman, T., Prabawanto, S., & Lam, T. T. (2023). *Students ' Hypothetical Learning Trajectory (HLT) in Learning Fraction Division Calculation Operations*. *15*(1).

Susanto, F., & Zasrianita, F. (2023). Lecturer's Pedagogic Competence for Building Transformation Character Education of English Language Learning From 4.0 to the industrial Revolution Era 5.0". *Conference on English Language Teaching (CELTI)*, *Celti*, 1130–1144.

Sutton, J., & Austin, Z. (2015). *Qualitative Research : Data Collection , Analysis , and Management*. *68*(3), 226–231.

Thomas, J., & Harden, A. (2008). *Methods for the thematic synthesis of qualitative research in systematic reviews*. *10*, 1–10. https://doi.org/10.1186/1471-2288-8-45

Yicheng Wei, Qiaoping Zhang, J. (2022). *education sciences Can Mathematical Modelling Be Taught and Learned in Primary Mathematics Classrooms : A Systematic Review of Empirical Studies*.

Zhang, J., & Lin, H. (2018). The New Developments of Constructivism Theory and Its Reflection on College English Teaching in the Era of New Media—A Case Study of International Textile Trade English. *Theory and Practice in Language Studies*, *8*(6), 649. https://doi.org/10.17507/tpls.0806.15

Zulkardi. (2002). *DEVELOPING A LEARNING ENVIRONMENT ON REALISTIC MATHEMATICS EDUCATION FOR INDONESIAN STUDENT TEACHERS*.