



## Systematic literature review: Integrating problem-based learning with teaching at the right level to enhance problem solving skills

Daffa Aditya Ardana, Venissa Dian Mawarsari\*, Dwi Sulistyaningsih  
Universitas Muhammadiyah Semarang, Indonesia  
[berjanganuye@gmail.com](mailto:berjanganuye@gmail.com). [venissa@unimus.ac.id](mailto:venissa@unimus.ac.id). [dwisulis@unimus.ac.id](mailto:dwisulis@unimus.ac.id).

---

### ***Corresponding Author\****

Venissa Dian Mawarsari  
Universitas Muhammadiyah Semarang,  
Fakultas Ilmu Pendidikan dan Humaniora, indonesia  
[venissa@unimus.ac.id](mailto:venissa@unimus.ac.id).  
Contact Person: 085879668654

### ***Article Info:***

Received : 17 Dec 2025  
Revised : 31 Dec 2025  
Accepted : 18 Jan 2026

---

### ***How to Cite:***

Ardana, D. A., Mawarsari, V. D., & Sulistyaningsih, D. (2026). Systematic literature review: Integrating problem-based learning with teaching at the right level to enhance problem solving skills. *Jurnal Theorems (The Original Research of Mathematics)*, 11(1), 1-15.

---

### **ABSTRACT**

Mathematical problem-solving ability is a fundamental competence in the *Merdeka* Curriculum, demanding student adaptability to global challenges. However, empirical reality reveals low student achievement due to the dominance of conventional teaching methods that overlook students' cognitive diversity. This study offers a solution through the integration of the Problem-Based Learning (PBL) model with the Teaching at the Right Level (TaRL) approach to create inclusive and adaptive learning. The objective is to systematically evaluate the distribution profile, integration patterns, and effectiveness of this model on students' mathematical abilities. This study employed a Systematic Literature Review (SLR) method using the PRISMA protocol to ensure methodological rigor. The selection process involved screening 991 initial articles from Google Scholar, ERIC, and Scopus, filtering 50 duplicates and 880 irrelevant entries, resulting in 22 empirical articles published between 2020–2025. The concrete results indicate a significant upward trend in publications, with a dominant integration pattern where TaRL is applied through content differentiation in the orientation phase and process differentiation in the investigation phase. The implementation of this model effectively enhances problem-solving skills and mathematical literacy by keeping learning challenges within the students' Zone of Proximal Development (ZPD). This study contributes to the literature by providing a specific pedagogical framework for integrating PBL and TaRL, bridging the gap in heterogeneous classrooms. Future research is suggested to expand on longitudinal studies and the use of adaptive technology to address classroom management constraints.

**Keywords:** Problem Based Learning, Teaching at the Right Level, Problem Solving.

### **INTRODUCTION**

The implementation of the *Merdeka* Curriculum explicitly positions problem-solving skills as a fundamental competence that students are required to master to navigate the dynamics of the 21st century. This curricular orientation necessitates a pedagogical transition from merely mastering routine procedures to developing higher-order thinking skills that align with the vision of critical reasoning in the *Profil Pelajar Pancasila* (Rahayu et al., 2022; Lubaba & Alfiansyah, 2022; Wati et al., 2024). Recent bibliometric analyses of global research confirm that mathematical problem-solving has become a dominant research theme post-pandemic, reflecting a worldwide urgency to equip students with adaptive reasoning skills to face future uncertainties (Hendriani et al., 2025). The ability to formulate, model, and solve contextual problems has now become a primary indicator of success in mathematical literacy, where students are expected to devise solution strategies independently and adaptively (OECD, 2023; Septiani et al., 2022).



A significant disparity persists between curricular ideals and field reality, as indicated by international and national evaluation data. The 2022 PISA report ranks Indonesian students' mathematical literacy poorly, a result attributed to their weak capacity in resolving non-routine and contextual problems (Nabiila & Listiyani, 2024; OECD, 2023; Wijaya et al., 2024). Various literature studies from the 2020–2024 period confirm that the dominance of conventional methods causes students to experience difficulties in the phases of understanding problems and devising solution plans, thereby hindering their adaptability at higher levels of education (Amalia et al., 2023; Faizzah & Sutarni, 2023; Rosehana & Haerudin, 2023). This observation is corroborated by the findings of Wulandari et al. (2024) whose Systematic Literature Review (SLR) highlights that an in-depth analysis of students' thinking processes—including the identification of *pseudo-thinking*—is crucial for validly improving mathematical problem-solving abilities.

To address the heterogeneity of student abilities, the Teaching at the Right Level (TaRL) approach has gained global recognition. Recent large-scale evaluations indicate that TaRL interventions, which regroup students by ability rather than grade, are among the most cost-effective strategies for improving foundational learning outcomes in low-and middle-income countries (Angrist et al., 2020). TaRL approach ensures instruction is tailored to students' actual readiness levels through precise diagnostic assessment, allowing teachers to map learning needs accurately (Faiz et al., 2022; Suharyani et al., 2023). The synergy of these two elements allows learning to proceed contextually while respecting individual comprehension capacities, ensuring that the interventions provided are more targeted (Eko Wahyu Saputro et al., 2024; Hanafi et al., 2024).

Addressing these challenges requires strategic efforts, specifically through the integration of the Problem-Based Learning (PBL) model with the Teaching at the Right Level (TaRL) approach. A recent meta-analysis of 30 studies conducted between 2020-2024 confirms that PBL has a large positive effect size (1.132) on students' mathematical abilities compared to traditional instruction, particularly in fostering reasoning and problem-solving skills (Salsabila & Cahya Mulyaning Asih, 2024). PBL has proven effective in providing real-world contexts to stimulate critical reasoning, whereas TaRL ensures instruction is tailored to students' actual readiness levels through precise diagnostic assessment (Aimin et al., 2024; Eko Wahyu Saputro et al., 2024b; Sinaga & Sihombing, 2025). The synergy of these two elements allows learning to proceed contextually while respecting individual comprehension capacities, ensuring that the interventions provided are more targeted (Hanafi et al., 2024; Putri et al., 2024).

Implementing the combination of PBL and TaRL establishes a learning ecosystem where challenges are presented within the Zone of Proximal Development (ZPD), making learning more personalized and effective in improving outcomes. Empirical evidence indicates that this integration yields a significantly positive impact on enhancing mathematical literacy and problem-solving skills compared to conventional approaches (Naipospos & Simanjuntak, 2025; Lestari et al., 2024; Rahma & Nursasonko, 2024). Consequently, this study aims to conduct a Systematic Literature Review (SLR) to provide a comprehensive evaluation regarding the current status, effectiveness, and future trends of this integration.

This research is designed to address five specific research questions:

1. What is the distribution profile of TaRL-integrated PBL research from 2020–2025 in terms of publication trends and educational levels?
2. What are the instructional syntax integration patterns developed in the literature to harmonize PBL phases with the TaRL approach?
3. To what extent does the effectiveness of the TaRL-integrated PBL model implementation provide a significant impact on improving students' mathematical problem-solving abilities?
4. What factors constitute critical constraints and critical success factors in the implementation of TaRL-integrated PBL?
5. What are the pedagogical implications and research gaps that need to be addressed by future studies?

## METHODS

This study employed the Systematic Literature Review (SLR) method adopting the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol to ensure the literature selection process was conducted transparently and accountably (Iffah et al., 2025). The SLR method was selected for its capability to identify, evaluate, and synthesize relevant empirical evidence to comprehensively answer research questions regarding the effectiveness of learning models (Septiani et al., 2022). The PRISMA protocol was utilized to minimize bias at every stage of selection, ranging from identification and screening to determining the eligibility of articles for analysis (Turmuzi et al., 2024).

**Data Search Strategy** The literature search process was conducted systematically across reputable indexed databases, including Google Scholar, ERIC, and Scopus, utilizing the *Publish or Perish* software to maximize data coverage (Hendriyanto et al., 2023). The keywords used in the search consisted of a combination of the terms "Problem Based Learning", "Teaching at the Right Level", "TaRL", "Differentiation", and "Mathematics Problem Solving" (Lidinillah et al., 2022). The search was restricted to articles published within the last five years, specifically from 2020 to 2025, to capture the most current research trends and learning innovations (Iffah et al., 2025). This timeframe was imposed to maintain the relevance of findings with the dynamics of the *Kurikulum Merdeka*, which emphasizes differentiated learning (Turmuzi et al., 2024).

**Inclusion and Exclusion Criteria** Inclusion criteria were strictly established to guarantee data quality, namely: (1) the article is a result of empirical field research; (2) the research subject focuses on the integration of PBL with the TaRL approach or differentiation; and (3) the article is available in full-text (Iffah et al., 2025). Articles that did not meet these requirements, such as pure review articles or studies that did not involve mathematical problem-solving variables, were excluded from this study (Septiani et al., 2022).

**Study Selection Process** Based on the initial search results in the identification stage, a total of 991 documents relevant to the specified keywords were found (Sari et al., 2024). After checking for duplication and title relevance, 50 non-conforming articles were removed, leaving 941 articles for the screening stage (Andriani & Trisnowati, 2025). In the screening stage, articles were examined based on their abstracts and contents to ensure alignment with the topic of PBL and TaRL integration; 880 articles were excluded as they were irrelevant, leaving 61 articles for eligibility testing. After a full-text examination, 39 articles were excluded because they did not meet the inclusion criteria, resulting in a final total of 22 empirical articles (published between 2020–2025) selected for analysis to answer the research questions. These 22 articles consist of 14 earlier studies and 8 recent studies specifically discussing the impact of PBL and TaRL integration on students' mathematical abilities (Rahma, 2025).

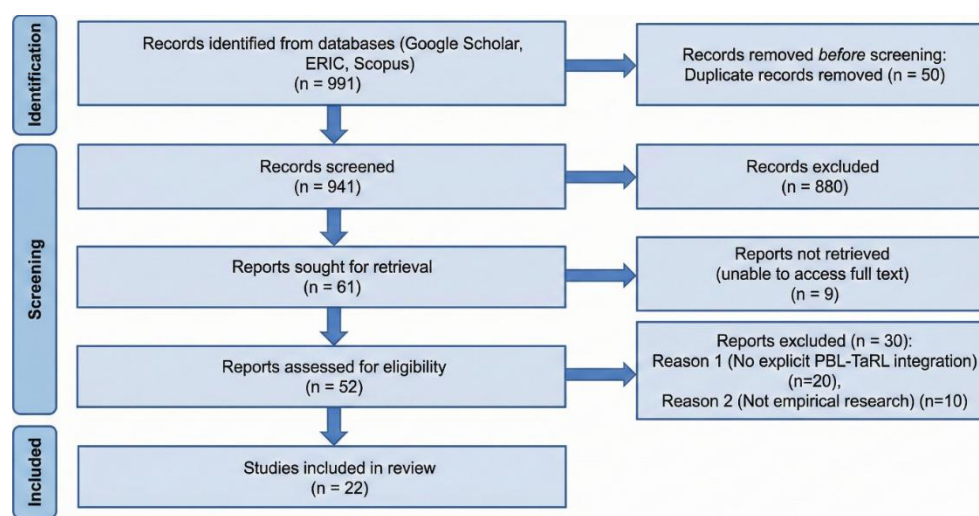


Figure 1. PRISMA flow diagram of the study selection process.

## FINDINGS

### RQ1: Distribution Profile of PBL-TaRL Integration Research (2020–2025)

A comprehensive analysis of the literature published between 2020 and 2025 reveals progressive dynamics in research regarding the integration of the Problem-Based Learning (PBL) model with the Teaching at the Right Level (TaRL) approach. As illustrated in Figure 2, there is a significant upward trend in the number of publications, particularly peaking in 2024 and 2025. This trend reflects the adaptive response of the research community to the *Kurikulum Merdeka* policy, which prioritizes differentiated learning. (Syahputra & Fathani, 2025; Sari et al., 2024). To visualize this significant upward trend in research productivity, the distribution of publication frequency is presented in Figure 2 below.

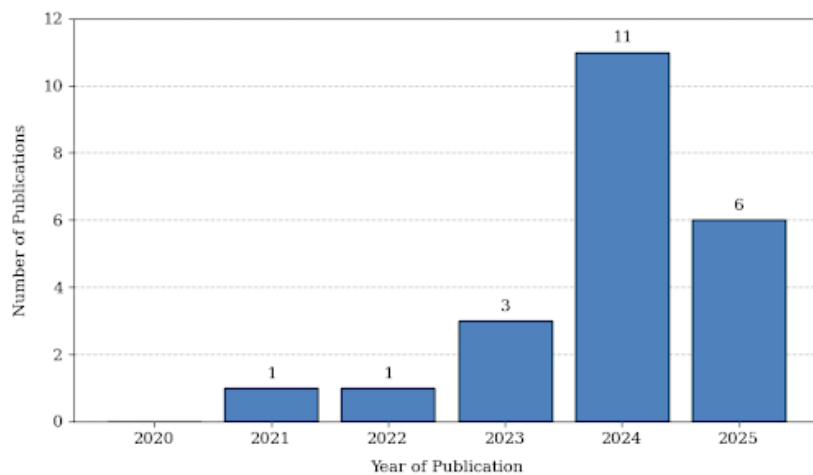


Figure 2. Distribution of publication frequency by year (2020–2025)

Furthermore, regarding the research subjects, it is essential to map the distribution of educational levels to understand the focus of current interventions. To clearly visualize the proportion of studies conducted at different educational stages, the composition of study subjects is illustrated in Figure 3 below.

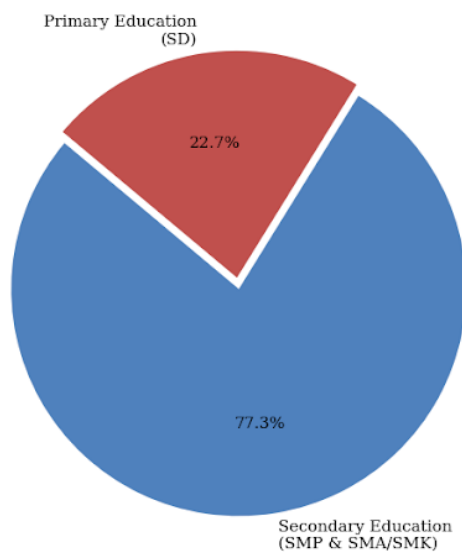


Figure 3. Percentage of studies based on educational level (Primary vs. Secondary)

Regarding the research subjects, the distribution of educational levels is visualized in Figure 3. The data indicates a dominance of secondary education (Junior and Senior High Schools) compared to



primary education. Mathematics materials with high levels of abstraction—such as systems of linear equations and trigonometry—become the primary focus of intervention at the secondary level to reduce disparities in students' conceptual understanding (Tobuto et al., 2025; Yuliana et al., 2024). Conversely, research at the primary school level is predominantly directed toward strengthening numeracy literacy foundations and basic mathematical concepts through concrete approaches (Manggalastawa et al., 2023; Aldiyansah et al., 2024). To provide a complete overview of the included literature, the detailed summary of the 22 empirical articles analyzed in this study is presented in Table 1.

Table 1. Summary of Selected Empirical Studies on PBL and TaRL Integration (2020–2025)

No	Author(s) & Year	Educational Level	Methodology	Main Findings / Focus
1	Adawiyyah et al. (2024)	Primary School	Qualitative	Implementation of TaRL through differentiated learning effectively accommodates diverse student readiness.
2	Aimin et al. (2024)	Senior High School	Classroom Action Research (CAR)	PBL-TaRL integration significantly improves cognitive learning outcomes and reduces the learning gap.
3	Aldiyansah et al. (2024)	Primary School	Quantitative	The integration model enhances students' mathematical literacy foundation.
4	Andriani & Trisnowati (2025)	Junior High School	Mixed Method	Improved collaboration skills and student engagement through differentiated grouping in PBL.
5	Asiah & Festiyed (2024)	Senior High School	R&D	Developed valid diagnostic and formative assessments to support critical thinking in PBL-TaRL.
6	Azzahra et al. (2024)	Junior High School	Quantitative	Significant increase in learning outcomes and student confidence in mathematical communication.
7	Dewanda et al. (2025)	Senior High School	Experiment	Heterogeneous grouping in PBL-TaRL effectively facilitates peer tutoring.
8	Dini et al. (2025)	Senior High School	Experiment	Differentiated guidance intensity significantly impacts critical thinking skills.
9	Faiz et al. (2022)	Teachers (Training)	Qualitative	Conceptual framework of differentiation in the <i>Guru Penggerak</i> program.
10	Faizzah & Sutarni (2023)	Senior High School	Qualitative	Identification of student difficulties in HOTS problems to design targeted TaRL interventions.
11	Hanafi et al. (2024)	Primary School	CAR	Improvement in cognitive abilities on basic arithmetic operations through TaRL.



No	Author(s) & Year	Educational Level	Methodology	Main Findings / Focus
12	Lestari et al. (2024)	Junior High School	CAR	PBL-TaRL integration improves learning outcomes for Grade VII students.
13	Manggalastawa et al. (2023)	Primary School	Experiment	Positive effect of PBL on cognitive outcomes in differentiated learning settings.
14	Mustafa et al. (2024)	Higher Education/School	R&D	Collaboration of TaRL and PBL creates an adaptive learning environment.
15	Naipospos & Simanjuntak (2024)	Junior High School	Experiment	PBL effectiveness in improving mathematical problem-solving abilities.
16	Putri et al. (2024)	Senior High School	CAR	Increased student learning interest and engagement through the integrated model.
17	Rahma & Nursasongko (2024)	Senior High School	Mixed Method	GeoGebra-assisted PBL-TaRL improves mathematical literacy and visualization.
18	Saputra & Pujiastuti (2024)	Junior High School	Descriptive	Analysis of critical thinking skills within the PBL framework.
19	Sari et al. (2024)	Junior High School	Experiment	PBL-TaRL keeps challenges within ZPD, improving problem-solving skills.
20	Suharyani et al. (2023)	Primary School	Mixed Method	Implementation of TaRL effectively improves numeracy literacy through precise diagnostic assessment and level-based grouping.
21	Syahputra et al. (2025)	Junior High School	R&D	Development of differentiated PBL modules for SPLDV material.
22	Widyastuti et al. (2024)	Senior High School	Experiment	Influence of PBL-TaRL on mathematical problem-solving capabilities.

**RQ2: Instructional Syntax Integration Patterns: Harmonizing TaRL and PBL through Differentiated Instruction**

The review of the selected literature demonstrates that the harmonization of Problem-Based Learning (PBL) with Teaching at the Right Level (TaRL) is structurally mediated through Differentiated Instruction (Adawiyah et al., 2024; Tobuto et al., 2025). The instructional syntax developed in the analyzed studies does not merely add TaRL as an appendage, but rather embeds differentiation strategies into the core phases of PBL to accommodate diverse student needs (Andriani & Trisnowati, 2025; Mustafa et al., 2024). The specific integration patterns identified are categorized by differentiation domains as follows:

1. Phase 1: Orientation via Content Differentiation In the initial phase, the integration pattern involves Content Differentiation, where the complexity of the problem is adjusted to match the cognitive readiness of students. Studies by (Aimin et al., 2024) and (Mustafa et al., 2024) highlight that teachers present problems with varying complexities or provide diverse initial scaffolding so

- the problem context is understood by students of all levels without causing cognitive overload. This ensures that lower-ability students can identify the problem elements accurately.
2. Phase 2: Organization via Environment Differentiation This phase represents the structural foundation of the integration, characterized by Environment Differentiation through grouping strategies based on diagnostic assessment results. Two dominant patterns emerge in the literature:
    - Homogeneous Grouping: Utilized to facilitate focused intervention. Research by (Dewanda et al., 2025) and (Lestari et al., 2024) emphasizes that grouping students by similar ability levels allows teachers to deliver specific materials suited to that level
    - Strategic Heterogeneous Grouping: Utilized to facilitate peer tutoring. (Syahputra & Fathani, 2025) applied this to encourage collaboration, where higher-level students reinforce their understanding by teaching peers.
  3. Phase 3: Investigation via Process Differentiation The most critical modification occurs in the investigation phase through Process Differentiation. The "one-size-fits-all" guidance is replaced by differentiated scaffolding intensity.
    - Intensive Scaffolding: For lower-achiever groups, teachers provide step-by-step guidance and concrete aids to prevent procedural errors, as emphasized by (Dini et al., 2025).
    - Tiered Worksheets: The use of differentiated worksheets (LKPD) is reported by (Aldiyansah et al., 2024) and (Hanafi et al., 2024) to help students maintain a systematic inquiry flow according to their capacity.
  4. Phase 4 & 5: Evaluation via Product Differentiation and Growth Assessment Finally, the syntax allows for Product Differentiation, where students are given autonomy to present solutions in various forms (visual, digital, or verbal). (Rahma & Nursasongko, 2024) specifically highlight the use of technology like GeoGebra to visualize concepts. The evaluation is then conducted based on individual growth rather than a single standardized benchmark, providing a fairer assessment of progress (Yuliana et al., 2024). The conceptual framework of this integration is visualized in Figure 4.

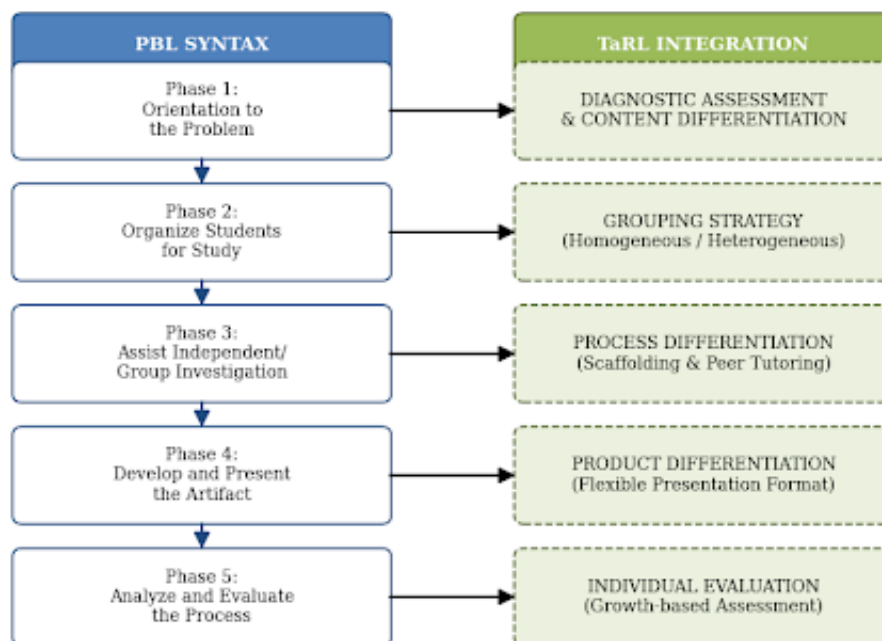


Figure 4. Conceptual framework of PBL syntax integration with TaRL differentiation strategies.

**RQ3: The Effectiveness of TaRL-Integrated PBL on Mathematical Problem-Solving Abilities**

To determine the extent of the model's impact, this review analyzed the empirical outcomes reported in the selected studies. The findings consistently indicate that the TaRL-integrated PBL model has a significant positive impact on improving students' mathematical problem-solving abilities

compared to conventional methods (Naipospos & Simanjuntak, 2025; Lestari et al., 2024; Rahma & Nursasongko, 2024). The dominance of problem-solving ability as the primary measured outcome in the literature is visualized in Figure 5.

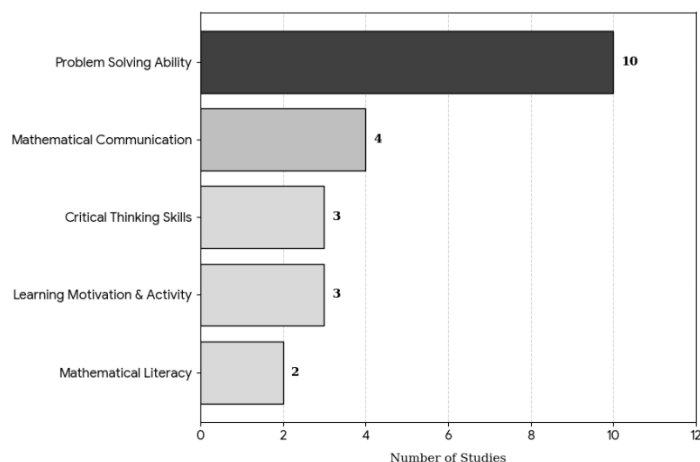


Figure 5. Distribution of mathematical competencies impacted by PBL-TaRL, highlighting the dominance of problem-solving ability.

1. Optimization of the Zone of Proximal Development (ZPD) The primary factor driving this effectiveness is the model's capacity to maintain learning challenges within the students' Zone of Proximal Development (ZPD). (Sari et al., 2024) found that this synergy minimizes frustration among lower-ability students while preventing boredom among higher-ability students. This balance effectively bridges the gap in conceptual understanding between high and low achievers in heterogeneous classrooms.
2. Impact on Specific Problem-Solving Indicators Evidence of effectiveness is further observed through improvements across specific problem-solving stages, as summarized in Table 3:

Table 3. Matrix of the Linkage Between TaRL-Integrated PBL Syntax and Problem-Solving Improvement

PBL Model Syntax	Linkage to Problem-Solving Indicators	Study Evidence & Specific Implementation (n=22)
Phase 1: Orientation of Students to the Problem	Stage 1: Understanding the Problem  Contextual problem presentation trains students to identify known and asked information. Content differentiation (TaRL) ensures appropriate difficulty levels so students do not experience cognitive blocks ("stuck") at the initial understanding process.	Studies by (Aimin et al., 2024; Mustafa et al., 2024) demonstrate that providing problems relevant to students' cognitive levels (TaRL) significantly improves students' ability to restate the problem in their own words. This is supported by Naipospos & Simanjuntak (2025), who found that adaptive problem orientation helps lower-ability students identify problem elements more accurately.
Phase 2: Organizing Students for Study	Stage 2: Devising a Plan  Group discussions (homogeneous/heterogeneous) facilitate strategy exchange. TaRL interventions allow students to devise realistic strategies according to their abilities or gain	Syahputra & Fathani (2025) found that heterogeneous grouping (peer tutoring) helps students struggling to devise solution plans by receiving scaffolding from peers. Conversely, Dewanda et al. (2025) and Lestari et al. (2024) noted that in homogeneous groups, teachers can guide the formulation of mathematical



<b>PBL Model Syntax</b>	<b>Linkage to Problem-Solving Indicators</b>	<b>Study Evidence &amp; Specific Implementation (n=22)</b>
Phase 3: Guiding Individual and Group Investigations	strategy inspiration from peer tutors. Stage 3: Carrying out the Plan Students execute solution strategies. Process differentiation (teacher guidance) ensures students do not make fatal procedural errors. Lower-level students are guided step-by-step, while upper-level students are encouraged to find alternative solutions.	models more directly according to the group's level. Research by Widyastuti et al. (2024) and Dini et al. (2025) confirms that intensive guidance in this phase is crucial for low-achievers to complete calculation algorithms correctly. Studies by Aldiyansah et al. (2024) and Hanafi et al. (2024) also report that using tiered worksheets helps students maintain a systematic and logical problem-solving flow.
Phase 4: Developing and Presenting Artifacts/Exhibits	Stage 4: Looking Back & Communication When presenting work, students indirectly verify their generated solutions. Product differentiation allows students to validate their answers through various representations (visual, graphic, or verbal).	Rahma & Nursasongko (2024) and (Rahma, 2025) show that using technology (like GeoGebra) in result presentation helps students visualize the correctness of their solutions (verification). Furthermore, Tobuto et al. (2025) and Azzahra et al. (2024) found that presenting artifacts trains students to provide logical arguments (reasoning) for their chosen solutions.
Phase 5: Analyzing and Evaluating the Problem-Solving Process	Metacognitive Reflection Students evaluate the effectiveness of the strategies used. Growth-based evaluation (TaRL) builds student awareness of their own progress in thinking methods for solving problems compared to before.	The study by (Asiah & Festiyed, 2024) emphasizes the importance of formative assessment at this stage to measure the improvement of students' critical thinking skills. (Yuliana et al., 2024) and (Andriani & Trisnowati, 2025) conclude that teacher-guided final reflection helps students internalize problem-solving steps (metacognition) so they can be applied to similar problems.

- Understanding the Problem: Contextual assistance in the orientation phase has been proven to help lower-ability students identify known and asked information more accurately (Naipospos & Simanjuntak, 2025).
  - Devising and Carrying Out the Plan: Differentiated guidance ensures students do not make fatal procedural errors during the investigation. (Widyastuti et al., 2024) and (Dini et al., 2025) confirm that intensive guidance is crucial for low-achievers to complete calculation algorithms correctly.
  - Looking Back (Verification): The integration of technology and peer verification in the presentation phase trains students to validate their answers and provide logical arguments for their solutions (Tobuto et al., 2025).
3. Statistical Significance Quantitatively, the majority of reviewed studies report significant improvements in learning outcomes. Aimin et al. (2024). reported a significant reduction in the learning gap between student groups. Azzahra et al. (2024) found significant increases in student confidence and mathematical communication alongside their problem-solving scores, indicating that the model's impact extends beyond cognitive scores to affective domains.



**RQ4: Critical Constraints and Success Factors in Implementation**

Despite the proven effectiveness, the implementation of the model faces several structural challenges. The review identified critical constraints primarily related to teacher workload and classroom management complexity (Rosehana & Haerudin, 2023; Rahma & Nursasongko, 2024). However, the literature also proposes specific success factors to mitigate these issues, as summarized in Table 4.

Table 4. Critical Constraints and Corresponding Success Factors in TaRL-PBL Implementation

Implementation Constraints	Critical Success Factors (Mitigation Strategies)	Supporting Studies
High Teacher Workload: Teachers are burdened by the time required to design diagnostic instruments and personalized teaching materials for multiple levels.	Utilization of Digital Technology: Using AI-based tools or apps (e.g., GeoGebra) to automate material distribution and assessment without overburdening teachers.	Dini et al. (2025); Rahma & Nursasongko (2024)
Classroom Management Complexity: Difficulty in managing diverse activities and delivering different interventions simultaneously in one class.	Peer Tutoring Strategy: Empowering higher-ability students to assist lower-ability peers, distributing the guidance role so it does not rest solely on the teacher.	Andriani & Trisnowati (2025); Syahputra & Fathani (2025)
Validity of Diagnostics: Risk of inaccurate grouping if the initial assessment does not validly reflect student abilities.	Valid Assessment Instruments: Developing and validating robust diagnostic (cognitive & non-cognitive) instruments prior to implementation.	Asiah & Festiyed (2024); Rosehana & Haerudin (2023)

The analysis of these constraints reveals that the "administrative burden" on teachers is the most critical hurdle, often stemming from the lack of ready-to-use differentiated materials (Rosehana & Haerudin, 2023; Rahma & Nursasongko, 2024). To address this, the integration of technology serves as a vital enabler, significantly reducing the time required for differentiation logistics (Dini et al., 2025). Furthermore, optimizing peer tutoring strategies not only aids in classroom management but also reinforces the conceptual understanding of the student tutors themselves, creating a mutually beneficial learning environment (Andriani & Trisnowati, 2025; Syahputra & Fathani, 2025).

**RQ5: Pedagogical Implications and Research Gaps**

The findings of this review carry significant pedagogical implications. Teachers are required to shift their role from mere information transmitters to "diagnostic facilitators" who are competent in designing adaptive learning (Andriani & Trisnowati, 2025; Suharyani et al., 2023). For policymakers, this necessitates a priority on teacher training focused on differentiated classroom management and the development of flexible teaching modules (Faiz et al., 2022; Rosehana & Haerudin, 2023). Regarding future research directions, several critical gaps remain:

1. Longitudinal Studies: Most current studies are cross-sectional. There is an urgent need for longitudinal research to test the retention of the model's long-term impact on students' mathematical competence (Septiani et al., 2022).
2. Affective Variables: Future studies should explore affective variables such as math anxiety and student resilience in differentiated settings, beyond just cognitive outcomes.
3. AI Integration: The development of Artificial Intelligence (AI) based adaptive systems to automate the grouping process represents a strategic research gap to address the teacher workload issue and improve implementation efficiency (Dini et al., 2025; Mustafa et al., 2024).



## DISCUSSION

This section interprets the findings reported in the results section, structured according to the research questions, and discusses them in relation to existing theoretical frameworks and prior empirical studies.

### **Dynamics of Research Trends and Contextual Relevance**

The surge in publications related to TaRL-integrated PBL in 2024 and 2025 indicates a strong academic response to the Kurikulum Merdeka policy in Indonesia, which explicitly mandates differentiated instruction. This finding aligns with observations that recent educational reforms have triggered a significant shift in research focus toward adaptive and inclusive learning models to address learning loss (Syahputra & Fathani, 2025; Sari et al., 2024).

The dominance of studies at the secondary education level (Junior and Senior High School) can be attributed to the high level of abstraction in mathematics materials at this stage, such as algebra and trigonometry. Empirical studies confirm that students in the transition phase to formal abstract thinking require scaffolding that is precisely adjusted to their cognitive readiness to prevent cognitive overload (Tobuto et al., 2025; Yuliana et al., 2024). This stands in contrast to primary education, where the focus remains on strengthening concrete numeracy foundations and basic arithmetic operations (Manggalastawa et al., 2023; Aldiyansah et al., 2024).

### **Syntax Harmonization through Differentiated Instruction**

The synthesis of the instructional syntax reveals that the integration of PBL and TaRL is not merely additive but transformative, mediated strictly through Differentiated Instruction strategies. The findings consistently confirm that the "Organization of Students" and "Investigation" phases are the most critical points where TaRL principles modify the standard PBL flow (Andriani & Trisnowati, 2025; Mustafa et al., 2024).

This harmonization pattern suggests that TaRL acts as a filter for diagnostic grouping, while PBL provides the contextual framework for inquiry. Furthermore, this study extends previous understanding by identifying that Strategic Heterogeneous Grouping (peer tutoring) is as effective as Homogeneous Grouping in managing diverse classrooms. While some studies argue for homogeneous grouping to facilitate focused teacher intervention, others demonstrate that mixed-ability grouping fosters social constructivism, where higher-ability students reinforce their understanding by teaching peers (Dewanda et al., 2025; Syahputra & Fathani, 2025; Lestari et al., 2024).

### **Effectiveness on Mathematical Problem-Solving Ability**

The review confirms that the TaRL-integrated PBL model significantly improves mathematical problem-solving abilities, particularly in the indicators of "Understanding the Problem" and "Devising a Plan". The mechanism behind this success is best explained through Vygotsky's Zone of Proximal Development (ZPD) theory, where instruction is tailored to the "challenge level" that matches student capabilities (Mustafa et al., 2024; Sari et al., 2024).

The integration ensures that problems are neither too difficult, which causes frustration, nor too easy, which leads to boredom, thereby creating an optimal learning environment. This finding corroborates research showing that when students work on problems matching their diagnostic level, their anxiety decreases and their cognitive capacity to model mathematical problems increases (Naipospos & Simanjuntak, 2025; Putri et al., 2024). Moreover, the findings contradict the skepticism that differentiated instruction lowers expectations; on the contrary, low-achieving students often experience the highest N-Gain, effectively narrowing the achievement gap in heterogeneous classes (Aimin et al., 2024; Widyastuti et al., 2024).

### **Addressing Implementation Constraints**

While the model is effective, the discussion highlights that "Teacher Workload" in designing diagnostic assessments and differentiated materials remains a primary constraint faced by practitioners. Literature on differentiated instruction consistently cites time management and administrative



complexity as major hurdles in its implementation (Rosehana & Haerudin, 2023; Rahma & Nursasongko, 2024).

However, this review identifies that the integration of digital technology, such as GeoGebra and AI-based assessment tools, serves as a critical success factor in reducing this administrative (Dini et al., 2025; Rahma & Nursasongko, 2024). Additionally, utilizing peer tutors serves as a practical solution to the complexity of classroom management, proving that decentralized guidance (student-to-student) is effective in large classes (Andriani & Trisnowati, 2025; Asiah & Festiyed, 2024).

### **Pedagogical Implications and Future Research Directions**

The findings of this review carry significant pedagogical implications, primarily requiring a paradigm shift in the teacher's role from a mere transmitter of information to a "diagnostic facilitator" competent in designing adaptive learning environments (Andriani & Trisnowati, 2025; Suharyani et al., 2023). This transformation necessitates that policy makers prioritize teacher training programs specifically focused on differentiated classroom management and the development of flexible teaching modules to support diverse learner needs (Faiz et al., 2022; Rosehana & Haerudin, 2023).

Regarding future research directions, this review identifies a critical gap in the lack of longitudinal studies; thus, future research must extend beyond cross-sectional designs to test the long-term retention of the model's impact on students' mathematical competence over time (Septiani et al., 2022; Turmuzi et al., 2024). Furthermore, there is an urgent need to explore the integration of Artificial Intelligence (AI) based adaptive systems to automate the grouping process, as well as to investigate the impact of this model on affective variables such as student resilience and math anxiety (Dini et al., 2025; Mustafa et al., 2024).

### **CONCLUSION AND SUGGESTION**

A systematic synthesis of 22 empirical articles published between 2020 and 2025 confirms that the integration of the Problem-Based Learning (PBL) model with the Teaching at the Right Level (TaRL) approach is a pedagogical strategy proven effective in enhancing the quality of mathematics learning across various educational levels. The publication trend, which has escalated significantly in the last two years, indicates the relevance of this model to the demands of the *Kurikulum Merdeka*, which prioritizes student-centered learning (Syahputra & Halim Fathani, 2025; Sari et al., 2024). Substantially, the synergy between the authentic problem context of PBL and the differentiation intervention of TaRL has successfully created an inclusive learning ecosystem, where students' problem-solving abilities, mathematical literacy, and critical thinking skills have experienced significant improvement because the material presented aligns with each individual's Zone of Proximal Development (ZPD) (Mustafa et al., 2024; Tobuto et al., 2025).

The successful implementation of this model relies heavily on the precision of the initial diagnostic assessment, which serves as the primary foundation for mapping learning groups, whether homogeneous or heterogeneous. The most dominant syntax integration pattern places content differentiation in the problem orientation phase and process differentiation in the investigation guidance phase, which has been proven capable of reducing the performance gap between high and low-ability students (Andriani & Trisnowati, 2025; Yuliana et al., 2024). Nevertheless, the complexity of classroom management and the time burden on teachers in designing personalized learning instruments remain operational obstacles requiring tactical solutions, such as utilizing peer tutors and integrating digital technology (Rosehana & Haerudin, 2023; Rahma & Nursasongko, 2024).

Based on these findings, the practical implications of this study recommend that educational practitioners strengthen their diagnostic competencies and begin shifting from a "one size fits all" approach toward adaptive learning designs supported by technology. For policymakers, teacher training focused on differentiated classroom management and the development of flexible teaching modules becomes an urgent priority. Meanwhile, for future research, it is suggested that the focus be expanded to longitudinal studies to test the retention of the long-term impact of this model on students' mathematical disposition. In-depth exploration regarding the influence of affective variables and the development of artificial intelligence-based adaptive systems to automate the TaRL differentiation



process also represent strategic research gaps that need to be filled to perfect the effectiveness of this integration model (Dini et al., 2025; Septiani et al., 2022).

## REFERENCE

- Adawiyyah, R., Agustini, F., & Sari, R. N. (2024). Implementasi Pendekatan Teaching at The Right Level (TaRL) melalui Pembelajaran Berdiferensiasi. *As-Sabiqun: Jurnal Pendidikan Islam Anak Usia Dini*, 6(2). <https://ejournal.stitpn.ac.id/index.php/assabiqun/article/view/4558>
- Angrist, N., Evans, D. K., Filmer, D., Glennerster, R., Halsey, F., & Sabarwal, R. S. (2020). How to Improve Education Outcomes Most Efficiently? A Comparison of 150 Interventions Using the New Learning-Adjusted Years of Schooling Metric. <http://www.worldbank.org/prwp>.
- Aimin, N., Fauziyah, F., Adamura, F., & Maduretno, W. (2024). Problem Based Learning (PBL): Penerapan Model Pembelajaran Untuk Meningkatkan Hasil Belajar Dengan Pendekatan Teaching at The Right Level (TaRL). *Journal on Education*, 7(1), 5364–5374. <https://doi.org/10.31004/joe.v7i1.6825>
- Aldiyansah, R., Kurniawati, R. P., & Hadi, N. (2024). Integrasi Model Problem Based Learning dengan Pendekatan Teaching at The Right Level untuk Meningkatkan Literasi Matematis Siswa. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, 9(3), 417–426. <https://journal.unpas.ac.id/index.php/pendas/article/view/18880>
- Andriani, A., & Trisnowati, E. (2025). Integrating Problem-Based Learning and the Teaching at the Right Level Approach to Improve Students' Collaboration Skills. *International Journal of Education*, 7(1). <https://jurnal.yayasannurulyakin.sch.id/index.php/ijetz/article/view/515>
- Asiah, S., & Festiyed. (2024). Development of Diagnostic, Formative and Summative Assessment Instruments in the PjBL Model to Stimulate Students' Critical and Creative Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, 10(10), 7486–7492. <https://doi.org/10.29303/jppipa.v10i10.8757>
- Azzahra, S. I., Maharani, S., & Laila, D. J. (2024). Penerapan Model Pembelajaran PBL dengan Pendekatan TaRL untuk Meningkatkan Kemampuan Hasil Belajar Peserta Didik. *Innovative: Journal Of Social Science Research*, 4(6), 7763–7772. <https://j-innovative.org/index.php/Innovative/article/view/17354>
- Dewanda, K., Dewi, I. A. M. R., & Hayati, L. (2025). Penerapan Model Pembelajaran PBL Terintegrasi Pendekatan TaRL dalam Meningkatkan Hasil Belajar Matematika. *Jurnal Pendidikan, Sains, Geologi, dan Geofisika (GeoScienceEd Journal)*, 6(2), 831–837. <https://doi.org/10.29303/goescienceed.v6i2.765>
- Dini, F., Medriati, R., & Hamdani, D. (2025). The Effect of Problem Based Learning Model with Teaching at the Right Level Approach to Improve Critical Thinking Ability in Physics. *Jurnal Penelitian Pembelajaran Fisika*, 16(1), 10–20. <https://journal2.upgris.ac.id/index.php/jp2f/article/view/1385>
- Faiz, A., Pratama, A., & Kurniawaty, I. (2022). Pembelajaran Berdiferensiasi dalam Program Guru Penggerak pada Modul 2.1. *Jurnal Basicedu*, 6(2), 2846–2853. <https://doi.org/10.31004/basicedu.v6i2.2504>
- Faizzah, S. N., & Sutarni, S. (2023). Investigasi Kesulitan Siswa dalam Menyelesaikan Masalah HOTS Matematika. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 7(2), 1963–1975. <https://doi.org/10.31004/cendekia.v7i2.2438>
- Hanafi, I., Hanikah, H., & Laela, K. (2024). Implementasi Pendekatan Teaching at Right Level (TaRL) untuk Meningkatkan Kemampuan Kognitif pada Materi Penjumlahan & Pengurangan Bilangan Cacah di Sekolah Dasar. *PEDADIDAKTIKA: Jurnal Ilmiah Pendidikan Guru Sekolah Dasar*, 11(2), 413–424. <https://doi.org/10.17509/pedadidaktika.v11i2.74407>
- Hendriani, M., Made Arnawa, I., & Zainil, M. (2025). Global Research Trends in Mathematical Problem-Solving Skills: A Bibliometric Review of 2020–2024 Publications. *Seminars in Medical Writing and Education*, 4, 453. <https://doi.org/10.56294/mw2025453>
- Hendriyanto, A., Priatna, N., Juandi, D., Dahlan, J. A., Hidayat, R., Sahara, S., & Muhaimin, L. H. (2023). Learning Mathematics Using an Ethnomathematics Approach: A Systematic Literature



- Review. *Journal of Higher Education Theory and Practice*, 23(7), 59–74. <https://doi.org/10.33423/jhetp.v23i7.6012>
- Iffah, R. D. L., Subanti, S., Usodo, B., & Nurhasanah, F. (2025). Systematic literature review: Ethnomathematics research in Indonesia. *Journal of Research and Advances in Mathematics Education*, 10(1), 28–40. <https://doi.org/10.23917/jramathedu.v10i1.5621>
- Lestari, I. E., Maharani, S., & Sunarni, S. (2024). Penerapan Model Pembelajaran Problem Based Learning (PBL) Melalui Pendekatan Teaching at the Right Level (TaRL) untuk Meningkatkan Hasil Belajar Peserta Didik Kelas VII. *Journal on Education*, 6(4), 20998–21011. <https://jonedu.org/index.php/joe/article/view/6243>
- Lidinillah, D. A. M., Rahman, Wahyudin, & Aryanto, S. (2022). Integrating Sundanese Ethnomathematics Into Mathematics Curriculum and Teaching: A Systematic Review. *Infinity Journal*, 11(1), 33–54. <https://doi.org/10.22460/infinity.v11i1.p33-54>
- Lubaba, M. N., & Alfiansyah, I. (2022). Analisis Penerapan Profil Pelajar Pancasila Dalam Pembentukan Karakter Peserta Didik di Sekolah Dasar. *Jurnal Al-Azhar Indonesia Seri Humaniora*, 7(3), 123–133. <https://doi.org/10.36722/sh.v7i3.1303>
- Manggalastawa, M., Suhirno, S., & Rahmawati, S. (2023). Pengaruh Model Problem Based Learning Terhadap Hasil Belajar Kognitif Peserta Didik Kelas V SD Mata Pelajaran Matematika dalam Pembelajaran Berdiferensiasi. *Jurnal Analisis Ilmu Pendidikan Dasar*, 4(2), 65–71. <https://ejr.umku.ac.id/index.php/jaip/article/view/2129>
- Mustafa, S., Riana, R., & Baharullah, B. (2024). The Collaboration of Teaching at The Right Level Approach with Problem-Based Learning Model. *Open Education Studies*, 6(1). <https://doi.org/10.1515/edu-2024-0046>
- Naipospos, A. T., & Simanjuntak, S. D. (2024). Implementasi Model Problem Based Learning berbantuan Pendekatan Teaching at the Right Level untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis. *JERKIN: Jurnal Pengabdian Masyarakat dan Riset Pendidikan*, 3(4), 1575–1581. <https://doi.org/10.31004/jerkin.v3i4.551>
- Nursalam, N., Angriani, A. D., Darwis, M., & Baharuddin, B. (2023). Analisis Kesulitan Belajar Matematika Siswa dan Solusinya. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 7(3), 2567–2580. <https://doi.org/10.31004/cendekia.v7i3.2156>
- OECD. (2023). *PISA 2022 Results (Volume I): The State of Learning and Equity in Education*. OECD Publishing. <https://doi.org/10.1787/53f23881-en>
- Putri, Z. F., Rahman, A. A., & Tanjung, A. F. (2024). Penerapan Model Problem Based Learning Terintegrasi Pendekatan Teaching at the Right Level (TaRL) untuk Meningkatkan Minat Belajar Siswa. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, 4(2), 933–942. <https://doi.org/10.51574/kognitif.v4i2.1869>
- Rahayu, R., Rosita, R., Rahayuningsih, Y. S., Hernawan, A. H., & Prihantini, P. (2022). Implementasi Kurikulum Merdeka Belajar di Sekolah Penggerak. *Jurnal Basicedu*, 6(4), 6313–6319. <https://doi.org/10.31004/basicedu.v6i4.3237>
- Rahma, I. U., & Nursasongko, A. (2024). Penerapan Model PBL dengan Pendekatan TaRL untuk Meningkatkan Kemampuan Literasi Matematika Siswa Kelas XI-1 SMA N 7 Semarang. *PRISMA, Prosiding Seminar Nasional Matematika*, 7, 786–794. <https://journal.unnes.ac.id/sju/prisma/article/view/72921>
- Rahma, S. M. (2025). Peningkatan Kemampuan Visualisasi Matematis Melalui Pembelajaran Dinamis Berbasis Geogebra: Studi Kasus Materi Grafik Fungsi Trigonometri. *Martandu: Mathematic Research and Education Journal*, 1(1).
- Rosehana, S., & Haerudin, H. (2021). Analisis Kesulitan Guru dalam Menerapkan Model Pembelajaran Problem Based Learning (PBL) pada Pembelajaran Matematika. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 5(1), 536–545. <https://doi.org/10.31004/cendekia.v5i1.524>
- Salsabila, S., & Cahya Mulyaning Asih, E. (2024). The Effect of Problem-Based Learning Models on Students' Mathematical Problem-Solving Ability: A Meta-Analysis. *Jurnal Pendidikan MIPA*, 25(2), 864–877. <https://doi.org/10.23960/jpmipa/v25i2.pp864-877>



- Saputro, E., & Rakhmawati, A. (2024). Implementasi Pendekatan Teaching at The Right Level (TaRL) Melalui Pembelajaran Berdiferensiasi pada Mata Pelajaran Bahasa Indonesia di SMP Negeri 1 Surakarta. *BLAZE: Jurnal Bahasa dan Sastra dalam Pendidikan Linguistik dan Pengembangan*, 2(1), 179–192. <https://jurnal.stikes-ibnusina.ac.id/index.php/BLAZE/article/view/920>
- Sari, N. A., Widodo, S. A., & Parwati, T. (2024). Improving Mathematical Problem-Solving Skills of Junior High School Students Through Problem-Based Learning Model With TaRL. *Proceedings of International Conference on Science and Technology*, 1(1). <https://seminar.ustjogja.ac.id/index.php/ICSTI/article/view/3287>
- Septiani, A., & Pujiastuti, H. (2022). Analisis Kemampuan Berpikir Tingkat Tinggi (HOTS) Matematis Siswa. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 6(2), 1474–1486. <https://doi.org/10.31004/cendekia.v6i2.1388>
- Septiani, A., Pujiastuti, H., & Faturrohman, M. (2022). Systematic Literature Review: Penerapan Model Problem Based Learning untuk Meningkatkan Kemampuan Pemecahan Masalah Matematika. *Edukatif: Jurnal Ilmu Pendidikan*, 4(6), 7882–7893. <https://doi.org/10.31004/edukatif.v4i6.4263>
- Sholihah, S. Z., & Mahmudi, A. (2023). Keefektifan Problem Based Learning Ditinjau dari Keterampilan Pemecahan Masalah dan Kemandirian Belajar Siswa. *Jurnal Riset Pendidikan Matematika*, 10(1), 112–124. <https://doi.org/10.21831/jrpm.v10i1.48682>
- Sihombing, L. N. A., Simarmata, E. J., & Harahap, A. (2024). Penerapan Pendekatan Teaching at the Right Level (TaRL) dalam Pembelajaran Matematika. *Jurnal Pendidikan Tambusai*, 8(1), 1234–1245. <https://jptam.org/index.php/jptam/article/view/12975>
- Suharyani, N. K. A. S., Suarti, N. K. A., & Astuti, F. H. (2023). Implementasi Pendekatan Teaching at the Right Level (TaRL) dalam Meningkatkan Kemampuan Literasi Numerasi Anak. *Jurnal Teknologi Pendidikan: Jurnal Penelitian dan Pengembangan Pembelajaran*, 8(2), 470–479. <https://doi.org/10.33394/jtp.v8i2.7590>
- Syahputra, I. F., Sunismi, & Fathani, A. H. (2025). Penerapan Pendekatan Pembelajaran Berdiferensiasi dengan Model Problem Based Learning (PBL) untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Peserta Didik Materi SPLDV Kelas VIII. *Jurnal Penelitian, Pendidikan, dan Pembelajaran*, 20(2). <https://jim.unisma.ac.id/index.php/jp3/article/view/27144>
- Tobuto, S. F., Setiawan, D. G. E., & Husain, R. (2025). The Influence of the Problem-Based Learning Model with a Differentiated Approach on Senior High School Students' Problem-Solving Ability. *International Journal of Humanities, Education and Social Sciences (IJHESS)*, 4(4). <https://jurnal.unismuhpalu.ac.id/index.php/IJHESS/article/view/8883>
- Turmuzi, M., Suharta, I. G. P., Astawa, I. W. P., & Suparta, I. N. (2024). Meta-analysis of the effectiveness of ethnomathematics-based learning on student mathematical communication in Indonesia. *International Journal of Evaluation and Research in Education*, 13(2), 903–913. <https://doi.org/10.11591/ijere.v13i2.25475>
- Wati, S. D., Nursalam, & Angriani, A. D. (2024). Pembelajaran Matematika dalam Kurikulum Merdeka. *Al-Irsyad Journal of Mathematics Education*, 3(1). <https://ejournal.stkipddipinrang.ac.id/index.php/wjme/article/view/105>
- Widyastuti, R., Zuhri, M. S., Rifai, A., & Shodiqin, A. (2024). Pengaruh Model Pembelajaran PBL dengan Pendekatan TaRL terhadap Kemampuan Pemecahan Masalah Matematis. *Innovative: Journal Of Social Science Research*, 4(4), 4849–4863. <https://j-innovative.org/index.php/Innovative/article/view/12638>
- Wulandari, H. T., Purnomo, E. A., & Mawarsari, V. D. (2024). Kemampuan Pemecahan Masalah Matematis Ditinjau dari Pikiran Pseudo: Systematic Literature Review (SLR). *JIP - Jurnal Ilmiah Ilmu Pendidikan*, 7(2), 1352–1359. <https://doi.org/10.54371/jiip.v7i2.3396>
- Yuliana, A., Syuhada, N., Sabria, Robbianto, M. T., Nugraha, A. H., & Muchlis. (2025). Penerapan Model Pembelajaran Problem Based Learning (PBL) dengan Pendekatan Teaching at the Right Level (TaRL) dalam Meningkatkan Hasil Belajar Kognitif Peserta Didik Kelas IX pada Materi Polinomial. *Jurnal Kolaboratif Sains*, 8(2), 1224–1230. <https://doi.org/10.56338/jks.v8i2.7104>