Journal of Educational Sciences Vol. 10 No. 1 (Jan, 2026) 2128-2140

Journal of Educational Sciences
Journal homepage: https://jes.ejournal.unri.ac.id/index.php/JES

P-ISSN 2581-1657
E-ISSN 2581-2203

Literature Review: The Application of Problem Posing Models in Primary School Mathematics Learning (2020–2025)

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ARTICLE INFO

Article history:
Received: 28 Nov 2025
Revised: 12 Jan 2026
Accepted: 20 Jan 2026
Published online: 28 Jan 2026

Keywords:
Critical Thinking
Student Creativity
Problem Posing,
Mathematics Learning,
Elementary School

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Article Doi:
https://doi.org/10.31258/jes.10.1.p.2128-2140

A B S T R A C T

Mathematics learning in elementary schools continues to face challenges in strengthening students' critical thinking, creativity, and active engagement. This study conducts a Systematic Literature Review (SLR) to analyze the implementation of the Problem Posing model in mathematics learning from 2020 to 2025, following the PRISMA stages of identification, screening, eligibility, and inclusion. A total of 25 national and international articles were reviewed based on publication year, context, research focus, and reported outcomes. The findings show that the Problem Posing model consistently improves students' conceptual understanding, problem-solving skills, critical thinking, and creativity, while also enhancing motivation and active participation in learning. Its effectiveness increases when integrated with real-life contexts, digital media, and collaborative strategies that foster metacognitive reflection. Nonetheless, challenges such as limited instructional time, teacher readiness, and the absence of standardized creativity assessment tools remain. Overall, the evidence demonstrates that the Problem Posing model is an innovative and relevant approach aligned with the Independent Curriculum, offering strong potential for developing essential 21st-century competencies among elementary school students.

1. Introduction

Mathematics learning in elementary schools plays a crucial role in developing students' rational, evaluative, and inventive reasoning capabilities. However, a significant number of students continue to experience difficulties in understanding abstract mathematical concepts, as learning practices are often dominated by conventional approaches emphasizing memorization and routine exercises (Christidamayani & Kristanto, 2020). Such practices result in monotonous, teacher-centered learning environments that limit students' opportunities to actively construct knowledge, particularly when abstract mathematical concepts are not supported by concrete and visual learning media (Zahro et al., 2024). Bahtiar and Suryarini (2019) noted that low levels of creative thinking among students stem from instructional approaches that fail to provide adequate space for idea exploration, while Darlena et al. (2022) confirmed that teacher-centered instruction significantly hinders active student participation. In response, constructivist-oriented learning innovations have been strongly recommended to promote meaningful mathematical engagement (Solikhah et al., 2024).

Recent studies also emphasize the role of technology-integrated learning, including augmented reality–assisted multimedia, in enhancing student activity and conceptual understanding by increasing learning interactivity and sensory engagement (Khusnunnisa & Andriani, 2025). Mustika et al. (2024) demonstrated that the integration of the TPACK framework through Project-Based Learning (PBL) significantly increased student learning activity in elementary mathematics classrooms. Similarly, the development of interactive learning media, such as augmented reality (AR), has been shown to improve learning outcomes, engagement, and numeracy skills by visualizing abstract mathematical concepts in more concrete and interactive forms (Muti'ah et al., 2024; Syahrir et al., 2025; Oktama et al., 2026). Similarly, the development of interactive learning media, such as augmented reality (AR), has been shown to improve learning outcomes and engagement by visualizing abstract concepts in more concrete forms (Syahrir et al., 2025; Oktama et al., 2026). These findings suggest that student-centered and technology-supported approaches are essential in addressing persistent challenges in elementary mathematics learning. Consequently, learning models that encourage independent thinking, conceptual construction, and problem-solving skills are urgently needed, one of which is the problem-posing model (Rahmah & Lubis, 2024).

The problem-posing model is an instructional approach that trains students to generate, modify, and solve mathematical problems independently. Through the process of creating problems, students are encouraged to think from the teacher's perspective, particularly in determining relevance, complexity, and logical structure. This activity strengthens conceptual understanding while fostering higher-order thinking skills (Bahtiar & Suryarini, 2019). Empirical evidence from Nuridayanti et al. (2023) indicates that students engaged in problem-posing activities demonstrate significantly higher motivation and conceptual mastery compared to those taught using traditional methods. Additionally, Arifin et al. (2024) found that problem posing enhances social interaction and collaborative learning among students. The model also nurtures creativity, as students are free to design problems based on real-life situations and personal experiences (Hendrajaya et al., 2022).

Real-world contexts constitute a vital element of the problem-posing approach, as they enable students to connect abstract mathematical ideas with concrete experiences, particularly when supported by augmented reality–based learning modules that visualize abstract concepts more meaningfully (Syahrir et al., 2025). This contextual linkage helps learners understand not only how mathematical procedures are performed but also why they are meaningful. Studies have shown that problem posing becomes increasingly effective when integrated with project-based learning and digital technology at the elementary level (Amalia & Hariyono, 2022). In line with this, research on conceptual change and mental models highlights that students' misconceptions can be reduced when learning emphasizes active knowledge construction and meaningful representation (Alqadri & Munawwarah, 2025). Furthermore, international perspectives, such as Roy Chowdhury (2025), reinforce that supportive learning environments and interactive strategies significantly influence students' engagement and learning quality from an early educational stage. Collectively, studies conducted between 2020 and 2025 consistently report positive impacts of problem posing on learning outcomes, motivation, creativity, and conceptual understanding in mathematics education.

Despite its proven effectiveness, the implementation of the problem-posing model still faces several challenges. Efendi et al. (2024) reported that many teachers lack sufficient understanding of the procedural steps required for effective implementation. Christidamayani and Kristanto (2020) emphasized that learning outcome improvements remain limited when teachers do not master appropriate scaffolding strategies. Time constraints, limited learning resources, and difficulties in assessing student creativity using standardized rubrics have also been identified as significant obstacles (Arifin et al., 2024). Solikhah et al. (2024) further stressed the need for continuous professional development to ensure the sustainable and effective application of innovative learning models, including problem posing.

Based on a synthesis of previous studies, this literature review aims to analyze and integrate research findings on the application of the problem-posing model in elementary school mathematics learning during the 2020–2025 period. The analysis focuses on implementation strategies, impacts on learning outcomes, creativity, critical thinking, and student motivation. The expected contributions of this study are: (1) providing a comprehensive overview of the effectiveness of problem posing as a 21st-century learning model; (2) serving as a reference for teachers in designing active and student-centered mathematics instruction; (3) offering policy recommendations for teacher training and curriculum development; and (4) enriching the literature on best practices in implementing problem posing within the context of Indonesian primary education.

2. Methodology

This research uses a systematic literature review with reference to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to collect, select, and analyze research findings on the problem posing model in mathematics learning in elementary schools for the period 2020-2025. The SLR approach was chosen because this method allows researchers to systematically identify existing research trends and gaps. This systematic approach is important so that the analysis results are reliable and reflect the current state of the effectiveness of implementing the Problem Posing model in the context of elementary education. The systematic literature review (SLR) process is carried out with four main phases according to the PRISMA guidelines, namely: identification, screening, eligibility, and inclusion.

Identification

In the identification stage, the researcher conducted a literature search using Publish or Perish, using data sources from Google Scholar and Scopus. The search was conducted using the keywords "problem posing," "mathematics learning," "critical thinking," "elementary school," and "learning outcomes" for the 2020-2025 period. This combination of keywords was used to identify articles relevant to the research focus. The initial search results yielded 356 articles potentially relevant to the research topic. This substantial number indicates that the study of Problem Posing is receiving increasing attention from academics in various countries.

Screening

The screening process was conducted by reading the main sections of the articles, based on the title, abstract, and keywords. Articles that did not contain information on the implementation of Problem Posing or were solely opinions and conceptual reviews without empirical research were excluded. Furthermore, articles not directly related to mathematics learning in elementary schools were also eliminated. After this initial screening process, 98 articles were deemed relevant for the next stage. This stage is crucial because it ensures that only studies with empirical data are analyzed further.

Eligibility

The eligibility stage was conducted by thoroughly reading the introduction, methods, results, and discussion sections of each article. This process aimed to ensure that only studies with clear research objectives, appropriate methodologies, and relevant findings were included in the review. Articles that did not include empirical results or did not clearly describe the steps for implementing the Problem Posing model were excluded to maintain the rigor and relevance of the analysis. As a result of this screening process, 25 articles remained eligible for further analysis. This number was considered adequate to capture variations in research designs, contexts, and outcomes, and was deemed sufficient to reflect research trends related to the Problem Posing model during the 2020–2025 period.

Inclusion

Before presenting the visual illustration, the analysis process is first described in the preceding discussion. Articles that met all inclusion criteria were then analyzed in depth by reviewing several important aspects, such as the research title, year of publication, and methods used. The analysis also focused on the effectiveness, creativity, and student learning motivation, as well as the application of the Problem Posing model in elementary school mathematics learning. In addition, obstacles and supporting factors encountered during the implementation of the model in various learning contexts were examined. To provide a clearer overview of the systematic review process described above, the stages of article selection and screening are visually summarized in Figure 1. Furthermore, to illustrate the relationships and research trends related to the application of the Problem Posing model in primary school mathematics learning during the 2020–2025 period, a network visualization is presented in Figure 2.

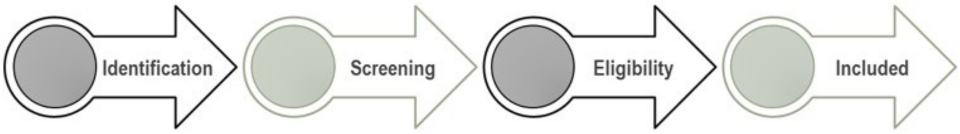

Figure 1. Stages of the PRISMA model

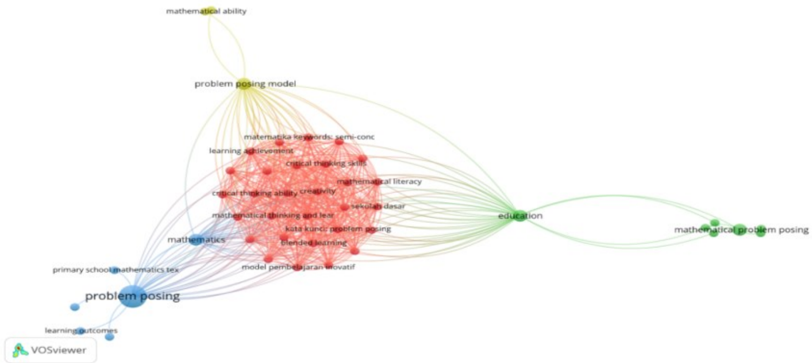

Figure 2. Network Visualization Problem Posing Models in Primary School Mathematics Learning (2020–2025)

3. Results and Discussion

Result

An analysis of 25 research articles published between 2020 and 2025 shows that the implementation of the Problem Posing model has a positive impact on various aspects of mathematics learning in elementary schools. Most studies report significant improvements in students' understanding of mathematical concepts, problem-solving abilities, and critical and creative thinking skills after participating in Problem Posing-based learning. These improvements demonstrate that when students are actively involved in problem-solving, they are encouraged to understand concepts more deeply and reflectively. This reflective process allows students to review the steps they took to solve the problem, fostering metacognitive awareness, which is essential for long-term learning (Baumanns & Rott, 2023). This metacognitive awareness helps students control their thinking processes, monitor errors, and seek alternative strategies when faced with difficulties. Thus, Problem Posing not only improves academic performance but also develops students' self-regulation skills in learning.

Furthermore, research findings indicate that this model can also increase student motivation and active participation. Students become more enthusiastic about participating in the learning process because they feel directly involved in creating the learning materials. This involvement fosters a sense of responsibility for their own learning outcomes (Rahmah & Lubis, 2024). This sense of responsibility fosters greater curiosity, encouraging students to continually ask questions and discover new solutions. This naturally occurring questioning activity demonstrates that learning has shifted from passive to active and meaningful learning.

Publication analysis also shows an increase in the number of studies on the Problem Posing model since 2023, indicating growing interest in this model among researchers. The majority of studies were conducted in Indonesia, with others originating from Turkey, the Philippines, China, and several European countries. The predominance of research from Indonesia indicates that the implementation of Problem Posing is highly relevant to the spirit of the Independent Curriculum, which emphasizes active and student-centered learning. Student-centered learning encourages active participation and learning autonomy, where students play a significant role in constructing their own knowledge through challenging and creative activities. To clarify the publication trend over time, the distribution of scientific publications on the Problem Posing learning model from 2020 to 2025 is presented in Figure 3. The figure illustrates a significant increase in the number of publications from 2023 to 2025, indicating rising researcher attention to the application of this model in elementary and mathematics education.

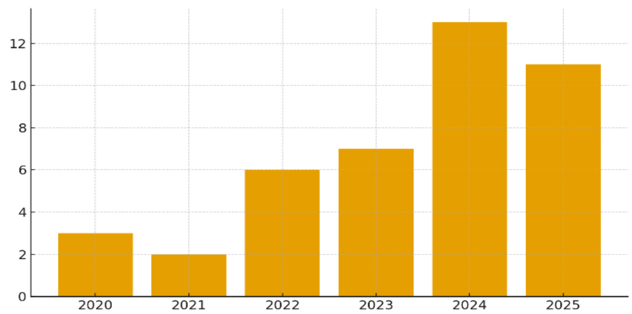

Figure 3. Distribution of Scientific Publications on the Problem Posing Learning Model (2020-2025)

In addition to publication trends, the geographical distribution of research provides important insights into the spread of the Problem Posing model. Figure 4 presents the distribution of analyzed articles by country or region. The figure shows that Indonesia contributes the largest proportion of publications, followed by studies from Turkey, the Philippines, China, and several European countries. This distribution highlights the broader international interest in the Problem Posing model, while also emphasizing Indonesia's central role in developing and implementing this approach in elementary school mathematics learning.

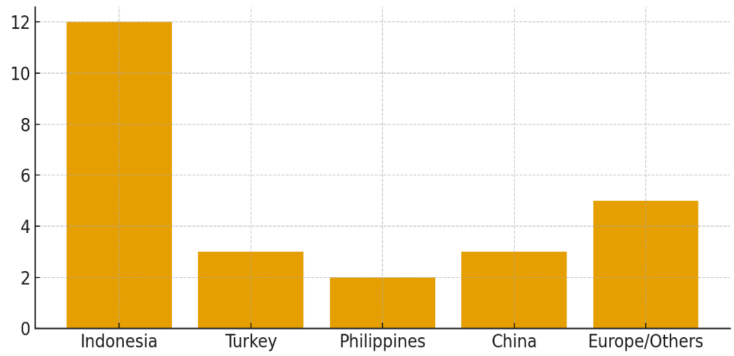

Figure 4. Distribution of Articles by Country/Region

The majority of the analyzed research originates from Indonesia, followed by studies from Turkey, the Philippines, China, and several European countries. This dominance of Indonesian research indicates that innovation in the Problem Posing model has received substantial attention within the context of the Independent Curriculum, which strongly promotes active, creative, and student-centered learning practices in schools. The strong alignment between the characteristics of the Problem Posing model and the objectives of the Independent Curriculum makes this approach particularly relevant and widely explored by Indonesian researchers. To further describe the characteristics of the analyzed studies, the types of publications included in this review are presented in Figure 5. This figure provides an overview of the distribution of research outputs, such as journal articles, conference proceedings, and other scholarly works, thereby offering additional insight into how research on the Problem Posing model is disseminated.

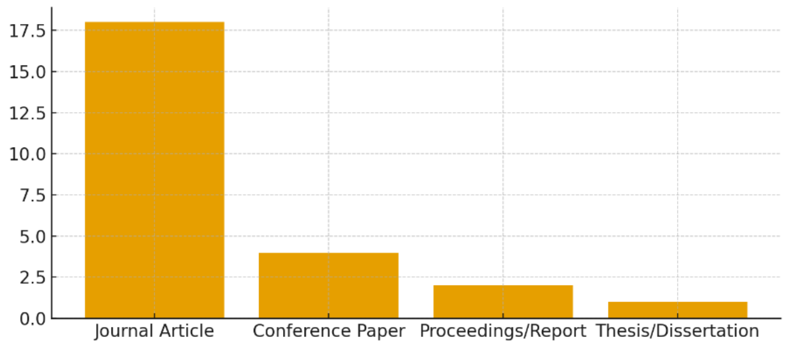

Figure 5. Publication Types

The majority of publications were scientific journal articles, accounting for 72% of the total, followed by conference proceedings, research reports, and theses. This distribution indicates that the topic of Problem Posing has become a major focus of formal and peer-reviewed academic publications, reflecting its recognized relevance and credibility within the research community. The dominance of journal articles also suggests that findings related to the Problem Posing model have undergone rigorous evaluation processes, strengthening their contribution to educational research. To complement this publication analysis, the research subjects involved in the analyzed studies are presented in Figure 6. This figure provides an overview of the educational levels and participant groups examined in research on the Problem Posing model, offering insight into how widely and at what levels this approach has been implemented.

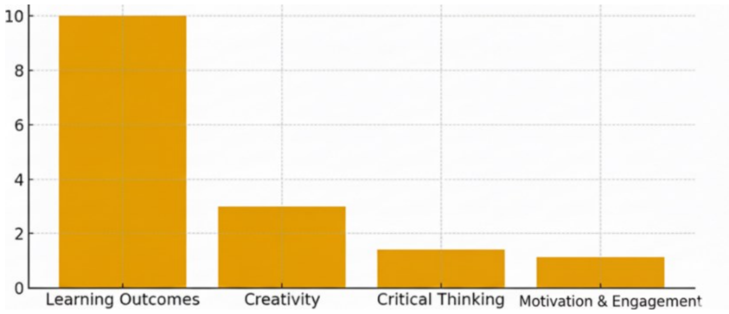

Figure 6. Research Subjects

The research predominantly focuses on learning outcomes and creativity, followed by critical thinking skills and student learning motivation. This pattern indicates that the Problem Posing model is widely regarded as relevant and effective in enhancing higher-order thinking skills among elementary school students. By encouraging students to formulate their own problems, this approach supports deeper conceptual understanding, creative thinking, and active engagement in the learning process. To further explain how these research outcomes were measured, the types of instrument tests used in the analyzed studies are presented in Figure 7. The figure shows that most studies employed pre-test and post-test designs to measure improvements in learning outcomes and critical thinking skills. In addition, several studies used observations, interviews, and instrument validation techniques to strengthen qualitative data and provide a more comprehensive understanding of the learning process.

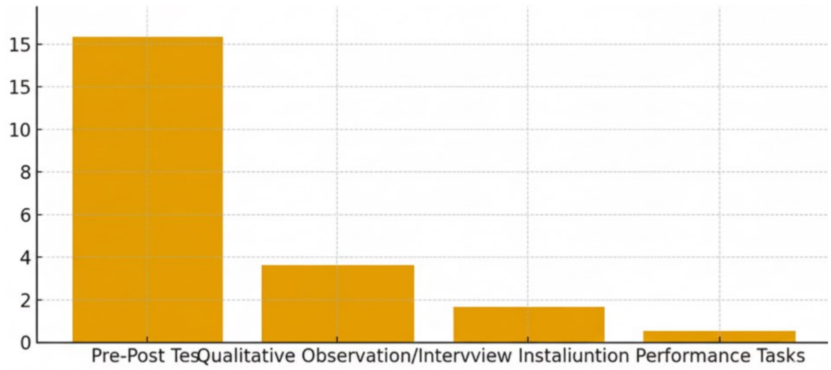

Figure 7. Types of Instrument Tests

Most studies use pre-post tests to measure improvements in learning outcomes and critical thinking, while others utilize observation, interviews, and instrument validation to strengthen qualitative data. Several studies also employ quasi-experimental designs to compare the effectiveness of the Problem Posing model with conventional learning approaches. In addition, questionnaire-based instruments are frequently used to capture students' motivation, attitudes, and learning engagement during the implementation process. The combination of quantitative and qualitative methods provides a more comprehensive understanding of the impact of the Problem Posing model on elementary mathematics learning.

Discussion

The findings across studies from 2020–2025 reveal that different forms of the Problem Posing model ranging from free problem posing, structured problem posing, semi-structured posing, to contextual and technology-assisted posing produce distinct impacts on specific aspects of elementary mathematics learning. Structured and semi-structured problem posing, as seen in Agustina et al. (2020), strongly support conceptual understanding; the guided formulation of probability questions led to a 24.44 point improvement, showing that scaffolding helps students reorganize prior knowledge into clearer conceptual frameworks. Meanwhile, contextual problem posing, highlighted by Bahtiar & Suryarini (2019), stimulates mathematical creativity through open-ended tasks that require flexible reasoning. This aligns with findings from Anisa (2022), who noted that creative thinking and mathematical reasoning improve most significantly when the model encourages students to generate varied problems based on everyday situations.

Problem posing models emphasizing student autonomy particularly free and inquiry-based posing demonstrate notable effects on problem-solving skills and metacognitive growth. Amalia & Hariyono's (2022) meta-analysis confirms that analytical reasoning increases when learners generate their own questions, as the act of posing requires planning, monitoring, and evaluating thinking processes. These metacognitive behaviors, further detailed by Baumanns & Rott (2023), determine the depth of students' problem-solving strategies and the quality of the questions they produce. When students actively evaluate their own problem formulations, they develop stronger self-regulation and error-awareness skills essential for long-term mastery.

Affective outcomes also vary by model type. Studies such as Christidamayani & Kristanto (2020) show that even when academic achievement does not increase sharply, the motivational impact of participatory problem posing is significant. Free and collaborative posing formats where students create problems in groups boost engagement, curiosity, and intrinsic motivation, as reported by Tesfaw et al. (2024) and Kovács et al. (2023). The sense of ownership created by designing their own problems transforms learners from passive recipients into active contributors. Santos et al. (2024) further demonstrates that contextual posing strengthens numeracy and literacy when students' questions emerge from real-life scenarios.

Implementation patterns in Indonesian studies reinforce these findings. Repeated cycles of Problem Posing intervention whether standalone or combined with media such as Dakota (Listiani et al., 2024) and thematic learning (Rizal Efendi et al., 2024) consistently raise mastery levels to above 85%, showing that iterative posing-reflection cycles are effective across subjects. Models enriched with digital tools, such as Cabri 3D in Hermiyati et al. (2024), show stronger impacts on critical thinking, increasing achievement to 88.10%, compared to 67.05% in traditional classes. Cooperative forms of Problem Posing, as in Sudarsono (2024), achieve higher conceptual performance because collaborative dialogue deepens reasoning and exposes students to multiple solution pathways.

International studies (Ran et al., 2025; Zhang et al., 2024) confirm these patterns: technology-assisted, contextual, and constructivist-based posing methods yield moderate to strong effects on overall mathematical competence. The effectiveness of each model type is strongly tied to how much autonomy, reflection, and real-world relevance it provides. Yet, challenges remain such as limited classroom time, uneven teacher preparedness, and the lack of standardized creativity assessment tools indicating the need for systemic curriculum support. Overall, the literature demonstrates that each variation of the Problem Posing model contributes uniquely to strengthening conceptual understanding, creativity, problem solving, and motivation. When integrated with digital media, collaborative approaches, and contextual tasks, Problem Posing becomes a powerful pedagogical innovation aligned with the Independent Curriculum, bridging solid conceptual mastery with the growth of critical, creative, and reflective thinkers in elementary mathematics.

4. Conclusion

The Problem Posing learning model has been proven to have a constructive impact on mathematics learning in elementary schools. This approach facilitates students' further assimilation of mathematical concepts because they not only solve problems but also create and modify their own. This activity trains students' rational reasoning, inventiveness, and problem-solving skills. Furthermore, education using Problem Posing can also elevate students' internal drive and self-confidence. Students become more active, bolder in expressing their opinions, and more interested in learning because they feel directly involved in the learning process. When this model is combined with real-life contexts, digital media, and group work, the results are even more effective. Students can discuss, collaborate, and reflect on their thinking, making the learning process more meaningful.

However, the implementation of this model still faces several obstacles. Many teachers lack a proper understanding of the steps for implementing Problem Posing, learning time is limited, and appropriate assessment tools are unavailable to measure students' creativity and critical thinking. Therefore, teachers need adequate training and policy support from schools for optimal implementation of this model. Increasing research trends since 2023 indicate that interest in Problem Posing continues to grow. This presents a significant opportunity to develop more engaging, meaningful mathematics learning that aligns with the requirements of 21st-century education. Through optimal application, Problem Posing has the potential to be a learning model that facilitates critical, creative, and independent thinking in students.

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How to cite this article:

Sarira, C., Wijayati, N., Widiyatmoko, A., & Subali, B. (2026). Literature Review: The Application of Problem Posing Models in Primary School Mathematics Learning (2020–2025). *Journal of Educational Sciences*, *10(1)*, 2128-2140.