

The Role of Problem Posing in Developing Students' Mathematical Communication: A Systematic Literature Review

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ABSTRACT

Mathematical communication is a key competency in 21st-century learning but often overlooked in traditional approaches that emphasize procedural knowledge. However, it is apparent that problem posing has emerged as a promising instructional approach to be gaining more attention as an alternative approach to encourage students to critically and express mathematical ideas actively. This study examined the effectiveness of problem posing towards improving students' mathematical communication through a Systematic Literature Review (SLR). Following the PRISMA framework, a total of 10 relevant literature published between 2015 and 2025 were located across particular academic databases. A bibliometric analysis was then conducted using VOSviewer. The findings revealed that problem posing plays a pivotal role in pedagogical strategies surrounding the learning of mathematics and promoting communication. This was particularly evident in areas of representation, reasoning, and both written and oral expression. However, its effectiveness depends on factors such as task design, teacher support, and learning context. This study concluded that problem posing holds significant potential to foster mathematical communication, but its implementation requires careful and systematic design. These findings offer valuable directions for future research and the development of more communicative instructional strategies.

KEYWORDS

Problem Posing, Mathematical Communication, SLR, Mathematics Education, PRISMA.

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A. Introduction

Mathematical communication is widely recognized as a fundamental competency in modern mathematics education, enabling students to articulate their reasoning, present mathematical ideas, and engage in meaningful mathematical discourse. This skill supports students not only in understanding mathematical concepts but also in developing critical thinking and collaborative problem-solving abilities (Kosko & Wilkins, 2010). With increasing emphasis on 21st-century skills in education worldwide, mathematical communication has become a key learning outcome in curricula across various levels.

Despite its acknowledged importance, traditional mathematics instruction often centers around memorization and algorithmic procedures, providing limited opportunities for students to express their mathematical thinking both verbally and in writing (Rellensmann et al., 2017). Such approaches may reduce students' motivation and confidence in sharing their ideas, which can hinder their deeper understanding and limit active engagement in classroom discourse (Herlinawati et al., 2024). This communication gap has prompted educators to seek alternative instructional methods that foster richer mathematical dialogue.

One pedagogical strategy that has attracted growing attention is problem posing, which involves encouraging students to create or formulate their own mathematical problems based on given contexts or knowledge. Problem posing actively engages students by shifting them from passive

recipients of knowledge to active constructors of mathematical ideas, thus providing authentic opportunities for communication and expression (See & Ibbotson, 2018). This approach fosters creativity and encourages students to reflect on their understanding as they generate problems.

The potential benefits of problem posing in enhancing mathematical communication are supported by research indicating that it stimulates curiosity, promotes critical thinking, and encourages students to articulate their reasoning in both oral and written forms (Cai et al., 2023). By requiring students to develop problems, this approach deepens their engagement with mathematical concepts and supports meaningful interaction among peers and teachers. It also helps students develop metacognitive skills by reflecting on problem structures and solution strategies.

Despite its promise, the literature on problem posing reveals a variety of approaches, methodologies, and contexts, with mixed findings regarding its effectiveness in improving mathematical communication (Cai & Rott, 2023). Studies differ in terms of student age groups, cultural settings, and types of communication assessed, making it challenging to draw definitive conclusions about best practices and overall impact. This diversity underscores the need for a systematic review to consolidate current evidence (Lindenbauer et al., 2024). Key questions arise from this fragmented research landscape: How consistent and significant are the effects of problem posing on students' ability to express mathematical ideas clearly and confidently? Addressing these questions is essential for guiding future educational practice and research in this area.

To provide a comprehensive synthesis of existing knowledge, this study employs a systematic literature review (SLR) methodology, which offers a transparent, reproducible, and rigorous approach to identifying, selecting, and analyzing relevant studies (Ayvaz & Durmuş, 2021). SLR reduces selection bias and enables researchers to evaluate the overall state of evidence concerning problem posing's role in developing mathematical communication across diverse educational contexts.

A literature review is essential in academic research, offering insights into existing knowledge, gaps, and trends (Emre-Akdoğan, 2023). In mathematics education, it helps evaluate how instructional methods like problem posing influence outcomes such as mathematical communication. Unlike narrative reviews, a Systematic Literature Review (SLR) follows a structured, transparent process with predefined criteria to minimize bias and ensure replicability ((Bevan & Capraro, 2021; Geteregechi, 2025). SLRs enhance credibility by organizing and synthesizing data methodically, allowing for reliable conclusions and deeper understanding of research patterns (Vale & Barbosa, 2024). In this study, the SLR approach is used to examine the effectiveness of problem posing in improving students' mathematical communication, providing evidence-based insights that inform teaching practices and support innovation in mathematics education.

The review focuses on empirical journal articles published from 2015 to 2025, retrieved from major academic databases including Scopus, ERIC, Web of Science, and others to ensure broad and relevant coverage. Criteria for inclusion include peer-reviewed empirical studies that specifically investigate problem posing interventions aimed at enhancing students' mathematical communication skills (Duong et al., 2021). This timeframe captures recent developments and contemporary pedagogical trends. By synthesizing findings from multiple studies, this review seeks to offer theoretical and practical insights for educators and researchers. It aims to identify effective problem posing strategies and highlight contextual factors influencing its impact on communication skills (Peng et al., 2022). Moreover, it intends to point out gaps in the current literature to stimulate further research efforts in this important domain of mathematics education.

Ultimately, the results of this review are expected to contribute to improving mathematics teaching by promoting instructional approaches that empower students to communicate mathematical ideas more effectively and creatively. Such improvements align with broader educational goals of

fostering lifelong learning, critical thinking, and problem-solving competencies that are vital for students' success in an increasingly complex world (English, 2020).

1. *The PRISMA Framework*

To ensure both transparency and methodological rigor in conducting a Systematic Literature Review (SLR), the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework is employed (Tang et al., 2023). PRISMA serves as a widely accepted protocol designed to improve the quality of systematic reviews by providing a standardized and structured reporting guideline. This framework comprises a four-step process that facilitates the comprehensive identification and selection of relevant studies while reducing potential bias.

The first step, Identification, involves conducting extensive and systematic searches across multiple academic databases to locate potentially relevant studies. This step ensures that the literature search is exhaustive and that the scope of the review captures a broad range of research related to the topic. The second step, Screening, entails the removal of duplicate records and the preliminary exclusion of titles and abstracts that clearly do not meet the inclusion criteria. This process streamlines the dataset while retaining the studies most aligned with the research objectives.

Following this, the Eligibility step requires a more detailed examination of abstracts and full-text articles to assess their relevance and methodological quality. This step plays a critical role in ensuring that only rigorously conducted and contextually appropriate studies are considered for inclusion. Finally, the Inclusion step consists of selecting the final set of studies that will undergo data extraction and thematic or quantitative synthesis. These studies represent the most relevant and high-quality sources from which conclusions will be drawn.

By adhering to the PRISMA framework, the current study benefits from enhanced validity and reliability. It provides a transparent documentation of each phase of the review process, allowing for reproducibility and critical appraisal by other researchers. Moreover, PRISMA strengthens the interpretability of findings by making explicit how decisions were made at each stage of the review, thereby supporting the integrity of the SLR and reinforcing its contributions to the field of mathematics education—particularly regarding the effectiveness of problem posing in enhancing mathematical communication skills.

2. *Tools for Managing the Review*

To effectively organize, analyze, and visualize the body of literature collected during the systematic review process, digital tools are essential in enhancing clarity, efficiency, and depth of analysis. One such tool employed in this study is VOSviewer, a powerful and widely used software designed for mapping scientific landscapes through the visualization of bibliometric data. VOSviewer enables researchers to explore conceptual relationships, trace thematic patterns, and identify emerging trends within a given field of study (van Eck & Waltman, 2010). The use of VOSviewer is particularly urgent in the context of increasingly vast and diverse educational research outputs, where manual synthesis may overlook hidden patterns or thematic connections. By offering visual clarity and data-driven insights, VOSviewer helps ensure that the systematic review captures not only the scope of existing literature but also its structure and evolution over time. Specifically, it supports the analysis of keyword co-occurrence, citation-based linkages, and collaborative networks among authors and institutions.

3. *Conceptual Basis: Problem Posing in Mathematics Education*

The concept of problem posing refers to the cognitive and pedagogical process in which students generate new mathematical problems or reformulate existing ones based on given situations,

solutions, or mathematical concepts (Tang et al., 2023). Unlike traditional problem-solving tasks that focus primarily on finding correct answers, problem posing shifts the emphasis to the construction of meaningful questions, thereby engaging learners in deeper levels of thinking and reasoning (Mishra & Iyer, 2015). This approach is deeply rooted in constructivist theories of learning, particularly those advanced by Piaget and Vygotsky, which emphasize the active role of learners in constructing knowledge through exploration, reflection, and social interaction. In this framework, problem posing serves as both a learning activity and an assessment tool, enabling students to demonstrate their understanding of mathematical concepts while simultaneously developing higher-order thinking skills such as creativity, critical analysis, and logical reasoning (Baumanns & Rott, 2022). Moreover, as students engage in problem-posing activities, they are required to articulate their thoughts, justify their reasoning, and communicate their ideas clearly—practices that naturally support and enhance mathematical communication.

4. *Mathematical Communication: The Target Skill*

Mathematical communication refers to the ability to articulate mathematical ideas clearly and coherently through various forms, including written explanations, oral discussions, and visual representations such as diagrams, graphs, and models (Vale & Barbosa, 2024). It encompasses not only the accurate use of mathematical language and symbols but also the capacity to justify solutions, explain reasoning processes, and engage in meaningful mathematical discourse (Bevan & Capraro, 2021). As a key process skill, mathematical communication supports deeper conceptual understanding by encouraging learners to organize their thoughts, reflect on their problem-solving strategies, and make connections between abstract concepts and real-world applications (Chahine, 2018). Furthermore, it fosters collaborative learning environments where students can clarify misunderstandings, negotiate meaning, and refine their thinking through interaction with peers and teachers (Papadopoulos et al., 2022). Given its integral role in enhancing both cognitive and social dimensions of learning, developing strong mathematical communication skills is essential for effective mathematics instruction and long-term student success.

5. *Linking Problem Posing to Communication*

Mathematical communication refers to the ability to articulate mathematical ideas clearly and coherently through various forms, including written explanations, oral discussions, and visual representations such as diagrams, graphs, and models (Fernández & Molina, 2017). It encompasses not only the accurate use of mathematical language and symbols but also the capacity to justify solutions, explain reasoning processes, and engage in meaningful mathematical discourse (Rizos & Gkrekas, 2023). As a key process skill, mathematical communication supports deeper conceptual understanding by encouraging learners to organize their thoughts, reflect on their problem-solving strategies, and make connections between abstract concepts and real-world applications (Zhang et al., 2024). Furthermore, it fosters collaborative learning environments where students can clarify misunderstandings, negotiate meaning, and refine their thinking through interaction with peers and teachers. Given its integral role in enhancing both cognitive and social dimensions of learning, developing strong mathematical communication skills is essential for effective mathematics instruction and long-term student success.

The impact of problem posing on communication varies depending on educational level, cultural context, and implementation strategy (Kozakli Ulger et al., 2022). For instance, structured problem posing in secondary education may yield different outcomes compared to open-ended problem posing at the elementary or tertiary levels. Recognizing these nuances is essential for contextualizing findings in the review.

The theoretical framework integrates constructivist learning theory, communication theory, and systematic review methodology to explore how and why problem posing contributes to mathematical communication (Lee et al., 2018) . By combining educational theory with methodological rigor, this study aims to offer a nuanced and evidence-based understanding of a pedagogical strategy with wide-ranging implications for classroom practice and curriculum design.

B. Research Method

This section outlines the method, which adopts a Systematic Literature Review (SLR) approach. SLR is a rigorous and structured method for identifying, evaluating, and synthesizing existing studies related to a particular research question or topic. In this study, the SLR approach is applied to explore how the problem posing approach contributes to the development of students' mathematical communication. The method ensures transparency, replicability, and reduced bias in the review process. This systematic process allows for a comprehensive overview of the current state of research and the identification of key patterns, gaps, and implications (Awang et al., 2025). The following sections elaborate on the SLR procedure, keywords, databases, inclusion and exclusion criteria, PRISMA flow, and data synthesis used in this study.



Figure 1. Stages of Systematic Literature Review

As shown in figure 1, the Systematic Literature Review (SLR) procedure consists of several key stages to ensure a comprehensive and unbiased synthesis of existing research. First, planning the review involves formulating clear research questions, designing the review protocol, and establishing inclusion and exclusion criteria to guide the search and selection process. Second, conducting the review includes systematic searching of multiple academic databases using predefined keywords, followed by screening titles and abstracts to eliminate irrelevant studies. This is followed by a thorough evaluation of full-text articles to determine their eligibility based on the criteria. Finally, reporting the review involves synthesizing the extracted data, identifying common themes and gaps, and discussing the implications of the findings. Throughout this process, employing frameworks such as PRISMA enhances transparency and replicability by documenting the flow of study selection. This structured approach has become the standard in educational research to systematically assess the effectiveness of teaching strategies and interventions.

Tabel 1. Inclusion and Exclusion Criteria

Criteria	Details
Inclusion Criteria	
Publication Year	Published between 2015-2025
Language	Written in English
Source Type	Peer-reviewed journal articles (excluding proceedings, books, or theses)
Study Focus	Studies focused on problem posing in relation to students' mathematical communication
Participants	Students or university students
Exclusion Criteria	
Language	Non-English articles
Source Type	Non-peer-reviewed sources
Study Focus	Studies focusing solely on teacher perspectives or other unrelated cognitive skills
Methodological Quality	Articles with insufficient methodological clarity or lacking full-text access

To retrieve relevant literature, Boolean operators were strategically employed alongside a carefully selected set of keywords to ensure comprehensive and focused search results (MacFarlane et al., 2022). The primary search strings included combinations such as “Problem Posing” and “Mathematical Communication,” “Student Communication” and “Problem Posing Approach,” “Creative Thinking” and “Mathematical Expression,” “Mathematics Teaching” and “Open-Ended Problems,” and “Classroom Interaction” and “Problem Generation” . These terms were systematically applied to titles, abstracts, and keywords within academic databases to maximize both relevance and coverage of the topic. The deliberate use of Boolean logic helped refine the search process, reducing irrelevant results while capturing diverse perspectives and empirical studies pertinent to problem posing and its impact on mathematical communication (Carrera-Rivera et al., 2022).

To capture a comprehensive and reputable set of studies, literature searches were conducted across several prominent academic databases, including Web of Science, ERIC (Education Resources Information Center), Scopus, ScienceDirect, and SpringerLink. These databases were selected due to their extensive coverage of educational research and their inclusion of peer-reviewed scientific publications, ensuring the reliability and academic rigor of the sources gathered. Table 1 outlines the inclusion and exclusion criteria employed in the article selection process.

Figure 2 illustrates the systematic selection process conducted in this review. The study employed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure a systematic selection process:



Figure 2. PRISMA Flow

The final set of 10 selected articles was carefully reviewed using a data extraction form to systematically collect relevant information. Key details gathered included the authors’ names, publication year, and country of study; participants’ educational levels; study design and methodology; main findings related to the problem posing approach and its impact on mathematical communication; and the implications for teaching practice. The extracted data were then analyzed thematically to identify common patterns, methodological trends, and contextual factors that influenced the outcomes across the studies.

C. Result & Discussion

As an initial step in the data analysis process, a keyword co-occurrence visualization was conducted using the bibliometric software VOSviewer. This visualization aims to identify relationships among key concepts frequently found in the literature related to “*problem posing*” and “*mathematical communication*.” The figure below presents the keyword mapping results from the initial 210 articles gathered before the screening process:

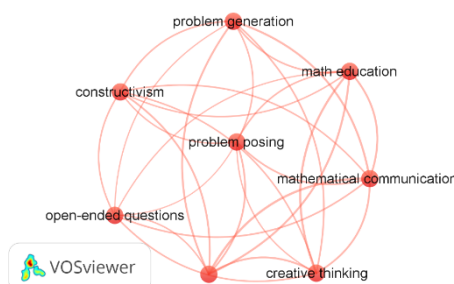


Figure 3. Co-occurrence relationships among keywords

The VOSviewer visualization illustrates the co-occurrence relationships among keywords that frequently appear in the selected literature (see the figure 3). At the center of the network is the keyword "problem posing", indicating its pivotal role in the discourse surrounding mathematics education. This central position reflects that most of the other keywords are directly connected to it, highlighting its importance as a foundational concept.

Keywords such as "mathematical communication", "creative thinking", and "open-ended questions" form strong links with "problem posing", suggesting that these elements often co-occur in studies and are conceptually related. The connection with "mathematical communication" emphasizes that problem posing is widely viewed as an effective strategy to enhance students' ability to express and interpret mathematical ideas. Meanwhile, the link with "creative thinking" indicates that engaging students in creating problems fosters higher-order thinking skills and innovation in mathematical contexts. Additional terms like "problem generation", "constructivism", and "math education" reinforce the theoretical and pedagogical framework in which problem posing is embedded. The presence of "constructivism" suggests a focus on learner-centered approaches where students actively build knowledge, while "problem generation" points to the productive nature of student-created tasks. Altogether, this visualization supports the conclusion that problem posing is not only central but also integrative, connecting diverse yet complementary aspects of teaching and learning mathematics. Following the initial bibliometric exploration, a systematic screening process was conducted to refine and select the most relevant studies for in-depth analysis. This phase adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure transparency and replicability in study selection.

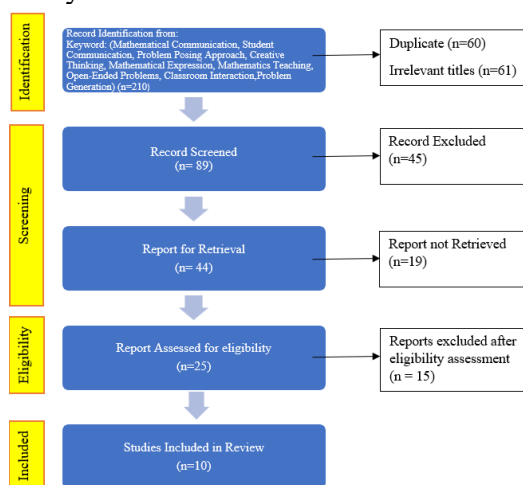


Figure 4. Phases of the PRISMA flow

The figure 4 presents the systematic process undertaken in the selection of studies for this review. Initially, a total of 147 records were identified based on relevant keywords such as *Mathematical Communication*, *Student Communication*, *Problem Posing Approach*, *Creative Thinking*, *Open-Ended Problems*, *Problem Generation*, and other related terms. During the identification stage, 60 records were removed due to duplication and 61 were excluded due to irrelevant titles, leaving 89 records for screening. In the screening stage, 45 records were excluded after evaluating the abstracts and initial content, resulting in 44 articles considered for retrieval. However, 19 of these records could not be retrieved due to access issues or incomplete availability of full texts, reducing the number of articles to 25. The eligibility assessment was then conducted on these 25 articles. As a result, 15 studies were excluded because they did not meet the inclusion criteria

based on a more thorough examination of their methodology, relevance, or completeness of data. Ultimately, only 10 studies met all the eligibility requirements and were included in the final systematic literature review. This structured and rigorous filtering process ensures that the included studies are of high quality and directly relevant to the focus of the research, thereby strengthening the validity and reliability of the review's findings.

The table 2 presents ten selected articles that were included in the final review based on relevance to the topics of problem posing, mathematical communication, and related themes. These studies span from 2015 to 2025, indicating a growing interest and evolving research in the field over the past decade. Most of the articles (8 out of 10) are published in Q1-ranked journals, demonstrating that the studies selected come from high-impact and reputable academic sources.

Tabel 2. Articles Included Based on the Established Inclusion Criteria

No	Author	Year	Title	Journal	Cit	Journal Rank
1.	Lyn D. English	2020	Teaching and learning through mathematical problem posing: commentary	International Journal of Educational Research	79	Q1
2.	Jinfa Cai & Benjamin Rott	2023	On understanding mathematical problem-posing processes	ZDM – International Journal on Mathematics Education	27	Q1
3.	Jinfa Cai & Roza Leikin	2020	Affect in mathematical problem posing: conceptualization, advances, and future directions for research	Educational Studies in Mathematics Research and Practice in Technology Enhanced Learning	153	Q1
4.	Shitanshu Mishra & Sridhar Iyer	2015	An exploration of problem posing-based activities as an assessment tool and as an instructional strategy	Research and Practice in Technology Enhanced Learning	82	Q1
5.	Duong Huu Tong a, Bui Phuong Uyen, & Ngo Van Anh Quoc	2021	The improvement of 10 th students' mathematical communication skills through learning ellipse topics.	Heliyon	100	Q1
6.	Ling Zhang, Gabriel J. Stylianides & Andreas J. Stylianides	2024	Enhancing mathematical problem posing competence: a meta-analysis of intervention studies	International Journal of STEM Education Center for Educational Policy Studies Journal	7	Q1
7.	Ioannis Papadopoulos, Nafsika Patsiala, Lukas Baumanns, & Benjamin Rott	2021	Multiple Approaches to Problem Posing: Theoretical Considerations Regarding its Definition, Conceptualisation, and Implementation	Research in Science Education	24	Q2
8.	Nimet Akben	2020	Effects of the Problem-Posing Approach on Students' Problem Solving Skills and Metacognitive Awareness in Science Education	Research in Mathematics Education	221	Q1
9.	Lukas Baumanns & Benjamin Rott	2021	Developing a framework for characterizing problem-posing activities: A review	Research in Mathematics Education	56	Q2

No	Author	Year	Title	Journal	Cit	Journal Rank
10.	Joash Geteregech	2025	An examination of undergraduate students' problem-posing and its interaction with problem-solving processes	Educational Studies in Mathematics	2	Q1

1. *Synthesis of Key Findings from the 10 Selected Studies*

The synthesis of the ten selected studies reveals several critical insights into the interplay between problem posing and mathematical communication. A recurring theme across the literature is the role of problem posing as a catalyst for enhancing mathematical communication skills. Problem posing is not merely a technique but acts as a key driver that stimulates students' mathematical communication abilities. For instance, Tong et al. (2021) provided empirical evidence that instructional designs integrating problem posing significantly improve students' ability to articulate and justify their mathematical thinking, especially in topics such as ellipses. By encouraging students to create their own problems, this approach transforms them from passive recipients of knowledge into active mathematical communicators. This aligns with broader findings suggesting that problem posing creates meaningful opportunities for students to engage in mathematical dialogue, use mathematical language precisely, and reflect on their reasoning processes. Problem posing enhances mathematical communication across three key forms: oral communication through discussions and explanations of self-created problems, written communication through documentation and justification of problem-creation processes, and visual/symbolic communication through the incorporation of diagrams, graphs, and mathematical notation (Baumanns, 2022). This multimodal approach creates a comprehensive framework where students develop fluency in all essential forms of mathematical expression, from verbal articulation to precise written language and effective use of visual representations (Baumanns & Rott, 2022).

Moreover, studies such as those by Cai & Leikin (2020) and Akben (2020) highlight both the cognitive and emotional benefits of problem posing, showing how it fosters enhanced metacognitive awareness, sparks creativity, and deepens students' understanding of mathematical concepts. These findings suggest that when students are actively involved in generating their own problems, it not only boosts their ability to communicate mathematically but also cultivates higher-order thinking skills. Supporting this, the meta-analysis by Zhang et al. (2024) confirms that problem posing interventions consistently lead to significant improvements in students' mathematical competencies—particularly when communication skills are explicitly integrated into learning goals. The affective dimension of problem posing extends beyond cognitive benefits to encompass critical motivational and psychological factors, including enhanced intrinsic motivation through student autonomy (Voica et al., 2020; Ko & Park, 2024), strengthened self-efficacy as students develop confidence in their problem-creation abilities (Nicolaou & Philippou, 2007), and cultivated learning persistence through positive attitudes toward mathematical challenges (Ko & Park, 2024; Irvine, 2017). This multifaceted affective impact creates a supportive psychological environment where students are more willing to take intellectual risks, engage deeply with mathematical content, and persist through difficulties—all essential components for developing robust mathematical communication skills.

Theoretical contributions from Baumanns & Rott (2022) and Papadopoulos et al. (2021) offer valuable frameworks that emphasize the multifaceted nature of problem posing, framing it not merely

as a teaching technique but as an essential learning objective itself. Their research suggests that the effectiveness of problem posing in improving mathematical communication largely depends on how it is conceptualized, organized, and actively supported within the classroom environment. Furthermore, English (2020) and Mishra & Iyer (2015) highlight the dual role of problem posing as both an assessment tool and a formative teaching strategy, one that can uncover students' understanding and misconceptions by examining the language they use and the problems they generate.

This shift from passive learning to active problem creation not only empowers students but also transforms classroom interactions, encouraging peer discussions and collaborative reasoning that are essential for deep mathematical understanding. However, implementing problem posing effectively requires careful scaffolding and teacher facilitation to ensure students are adequately supported, which can be a significant challenge in classrooms with large student-teacher ratios or limited resources. Additionally, teachers often face substantial challenges in implementing problem posing due to insufficient professional development and training in this pedagogical approach, as well as difficulties in designing appropriate problem-posing tasks that balance cognitive challenge with accessibility for diverse learners. The complexity of creating effective problem-posing activities, assessing student-generated problems, and providing meaningful feedback further compounds these implementation barriers, particularly for educators who may lack experience with open-ended mathematical tasks or feel uncertain about managing the unpredictable nature of student-created problems. While the benefits of problem posing are well documented, further research is needed to explore its long-term effects on mathematical communication across diverse educational contexts and student populations. Aligning problem posing with contemporary educational goals that emphasize critical thinking and communication aligns well with global trends toward competency-based education, making it a promising focus for future pedagogical innovations.

Taken together, these studies collectively affirm that problem posing fosters an environment conducive to mathematical communication by promoting active participation, creativity, and reflection. The evidence points to a strong conceptual and empirical link between these two domains, supporting the research hypothesis that the integration of problem posing in mathematics instruction significantly contributes to the development of students' communication abilities. Furthermore, the literature suggests that teacher facilitation, task openness, and alignment with constructivist principles are essential for maximizing these outcomes. Thus, the selected studies provide a robust foundation for advocating the use of problem posing not only to improve mathematical achievement but also to cultivate expressive and interpretive mathematical communication among learners.

D. Conclusion

The integration of problem posing into mathematics instruction has been widely recognized as an effective strategy to enhance students' mathematical communication skills. This systematic literature review highlights how problem posing shifts the focus from passive learning to active knowledge construction, encouraging students to articulate their reasoning, engage in meaningful discourse, and develop a deeper conceptual understanding. Empirical evidence from recent studies (2015–2025) consistently supports the idea that problem posing fosters not only improved communication but also creativity, metacognitive awareness, and critical thinking. The synthesis of findings from ten selected high-quality studies reveals that when students are engaged in problem-posing activities, they demonstrate greater ability to express mathematical ideas clearly, justify solutions, and interact meaningfully with peers and teachers. The effectiveness of this approach, however, varies depending on educational level, cultural context, and instructional design. Structured frameworks, teacher

facilitation, and alignment with constructivist principles play crucial roles in maximizing the benefits of problem posing. Ultimately, this review underscores the importance of incorporating problem posing into mathematics education to support the development of essential 21st-century skills such as communication, collaboration, and creative problem solving. Future research should continue to explore contextual factors and long-term impacts to refine and expand its application across diverse learning environments.

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