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A Comparative Study of Problem-Posing Implementation Between Indonesia and Abroad in Mathematics Education

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ABSTRACT

The application of problem posing in mathematics education faces challenges, including teacher misconceptions and difficulties. This study examines the implementation of problem posing in Indonesia and internationally, focusing on the improvements achieved and the steps taken to achieve them. A Systematic Literature Review (SLR) method with a qualitative descriptive approach was used, adhering to PRISMA guidelines, to explore the impact of problem posing on cognitive and affective aspects. Cognitive aspects include creativity, problem-solving skills, critical thinking, mathematical communication, and related skills, while affective aspects include motivation, curiosity, and enjoyment. The research found that the general structure of problem posing is similar across countries: the teacher presents a situation, students pose a problem, and then solve it. However, international practices often include additional steps, such as identifying problem elements and designing problem structures, before formulation. Indonesia's approach tends to focus more on textbook-based activities and exercises. This study highlights the differences and similarities in problem-posing methods, suggesting that while there are shared principles, international practices often incorporate a more structured and comprehensive approach than those in Indonesia.

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1. INTRODUCTION

Mathematics is one of the important disciplines in education worldwide, especially in problem-solving and logical thinking. One approach that can improve understanding of mathematical concepts is problem-posing, which is a learning process carried out by students who not only solve problems, but also compose, modify, or reformulate mathematical problems [1], [2]. Problem-posing is one of the approaches to mathematics education that has received increasing attention in the world of education [3], [1]. Research on problem-posing has been applied in several countries, such as Australia [4], Spain [5], Turkey [6], Taiwan [7], Germany [8], Thailand [9], Ireland [10], Hungary [11], and Romania [11].

Problem posing is the process of formulating mathematical problems derived from a given context, information, or situation, where the problem is developed through modification in accordance with given conditions [3], [12]. From this perspective, problem-posing serves as a powerful pedagogical tool that compels students to engage deeply with mathematical concepts, fostering a robust understanding through the act of creation. In this context, problem-solving is inherently linked to problem-posing: while problem-posing involves formulating mathematical problems, problem-solving is the subsequent process of devising and executing strategies to arrive at a solution. Both processes are symbiotic, with the ability to pose a problem often enhancing one's capacity to solve it effectively, and vice versa [13]. This practice is grounded in the theoretical premise that active construction of knowledge is paramount for meaningful learning, aligning with constructivist learning theories.

Implementing problem posing is one of the most important aspects of education, as it can foster international collaboration in raising educational standards, particularly in mathematics. Through the exchange of best practices, ideas, and knowledge from various educational contexts and systems, researchers and educators can gain a deeper understanding of the effective strategies and challenges involved in this approach.

Numerous studies have investigated the use of problem-posing in other countries to enhance various aspects and have identified strategies that can be used. Research in various countries has shown that problem-posing can improve logical reasoning, creativity in mathematical modelling, learning motivation, learning achievement, problem-solving, and posing performance, and positive attitudes toward mathematics [13], [14], [8], [15], [6], [16], [17]. Furthermore, the literature review, which compiles findings from numerous studies, highlights the trends in aspects that can be improved through the implementation of problem-posing in mathematics learning. Kull et al. [18], through a meta-analysis, found that the problem-posing strategy can significantly improve mathematics learning achievement, problem-solving skills, problem-posing skills, and attitudes toward mathematics. Another systematic study by Kaur and Rosli [19], using a Systematic Literature Review (SLR) approach, concluded that problem posing has a positive impact on learning achievement, critical thinking, creative thinking, and learning motivation. Meanwhile, Aktas [20], in a bibliometric study, revealed that problem posing contributes to the improvement of problem-posing and problem-solving skills, learning outcomes, attitudes toward mathematics, and conceptual understanding among prospective teachers. However, further studies are needed to extend previous work by identifying additional benefits of problem posing that have not been described.

Although its benefits have been recognized, implementing problem posing in classroom learning practices still faces various challenges. There are difficulties that prospective mathematics teachers face in problem-posing activities, such as creating problems related to students' daily lives [21]. Rochaminah [22] found that teachers rarely give problem-posing tasks to students, and many of them misinterpret problem-posing in mathematics learning. Therefore, many studies are needed to discuss how problem posing is implemented in the classroom. According to Baumanns and Rott [23], the process of problem posing involves several key stages: (1) choosing a starting point; (2) listing attributes or registering properties; (3) applying the "What-If-Not" strategy by posing the question "what if not?"; (4) asking questions or generating problems; and (5) analyzing the problem. After this analytical stage, students are expected to proceed with solving the problem. Baumanns and Rott [23] have proposed a phase model of problem posing that includes situation analysis, variation, generation, problem-solving, and evaluation. Nevertheless, it cannot be denied that slightly different or even additional phases of the model may emerge.

This study has two main points to discuss: the benefits derived from problem posing (i.e., the aspects that can be improved through its implementation) and its procedural steps. Although these two points have been discussed frequently, further studies are needed to examine how far the benefits of problem posing and the steps in problem posing have advanced across various researchers' perspectives. Additionally, this study will compare these two aspects among researchers in Indonesia and abroad. The lack of comparative analysis between national and international research highlights the importance of this study. By bridging this gap, the benefits and procedural steps of problem posing, which are often developed outside Indonesia, can be critically examined and contextualized within the Indonesian educational landscape. Furthermore, this study may serve as a model for researchers in other countries to conduct comparative analyses of their national practices and international developments in problem-posing implementation.

Through a comprehensive literature review, it is hoped that insights will be gained to improve the quality of mathematics education. The specifics of the Research Questions (RQ) to assist in obtaining pertinent data, such as: (1) What aspects can be improved in mathematics learning through the application of problem posing? (2) How is the application of problem posing in mathematics learning in Indonesia and abroad in terms of aspects that can be improved? Furthermore, (3) How is the application of problem posing in mathematics learning in Indonesia and abroad in terms of the steps of problem posing?

2. METHOD

2.1 Research Design

This study used a Systematic Literature Review (SLR) with a qualitative descriptive approach to examine the application of problem posing in mathematics learning, both in Indonesia and internationally. According to Higgins [24], conducting an SLR is essential, as it clarifies research priorities, informs the development of a conceptual framework for future investigations, and deepens one's understanding of authoritative decisions within the field. Furthermore, the SLR approach sharpens the information gathered by systematically filtering, organizing, and synthesizing relevant research findings.

2.2 Population and Sampling

The sample in this study consists of 21 articles published between 2020 and 2024 in the field of mathematics education. These articles were selected from reputable databases, including Scopus, ERIC, and ScienceDirect. The search was conducted using the keywords: ("Problem-Posing" OR "Problem Posing") AND ("Mathematics" OR "Math" OR "Mathematical"). The selection process aimed to capture recent and relevant studies that discuss the application of problem posing in mathematics learning.

2.3 Data Collection Tools

The systematic literature review procedure in this study adapts the data selection stages from [25] and [26], following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework.

2.4 Data Collection

The stages of the review process include the following steps:

1. Data Selection, this stage involves:
   1) Formulating research questions and identifying relevant articles;
   2) Determining inclusion criteria (Table 1); and
   3) Filtering articles from various databases, namely Scopus, ERIC, and ScienceDirect.

   Articles were reduced according to predefined criteria. A total of 21 articles were selected for in-depth analysis through abstract review and full-text reading.
2. The coding instrument used was adapted from the Paper Classification Form (PCF) developed by Kizilaslan et al. [27], which meets the requirements for validity and reliability. The indicators analyzed in the PCF include the article title, author(s), author's country, journal name, year of publication, journal type, language, indexing status, main discipline, research method, data collection technique, sample, and data analysis approach. In addition, the researchers created a data matrix comprising research objectives, integrated learning models, themes, and key findings. The data collected were analyzed using percentage calculations.
3. This stage focuses on identifying key patterns in the articles, including major findings, forms of problem-posing integration, and aspects of mathematics learning that can be further developed.
4. Finally, the identified patterns were synthesized to answer the formulated research questions (Figure 1).

2.5 Data Analysis

In this step, we calculated the percentage distribution of each finding and investigated the underlying causes by referring to relevant supporting research (Table 1).

Table 1. Inclusion and Exclusion Criteria

No	Inclusion Criteria	Exclusion criteria
1	Published Year: 2020 – 2024	Published year < 2020
2	Includes research articles	Includes article review
3	Indexed in Scopus, ERIC, ScienceDirect	Not indexed in Scopus, Eric, ScienceDirect
4	Contains aspects that are improved with problem posing OR problem posing steps	Does not contain aspects that are enhanced by problem posing OR problem posing steps
5	Problem posing as a model/approach (not as an aspect)	Problem posing as an improved aspect

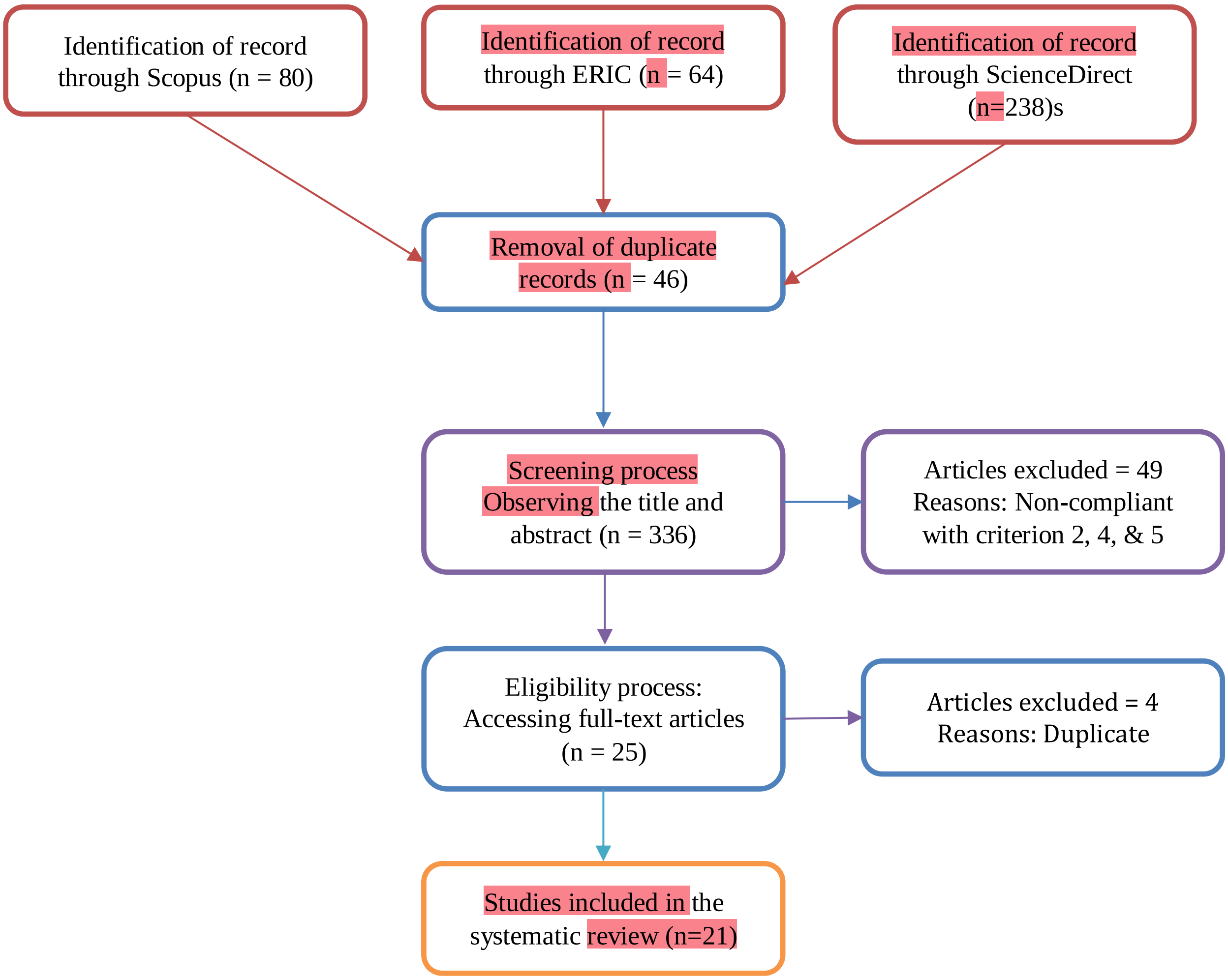

Figure 1. Flowchart of the article selection procedure

3. RESULTS AND DISCUSSION

3.1 Results

This systematic literature review examines articles published between 2020 and 2024. The review includes international articles indexed in Scopus, ERIC, and Science Direct that focus on the implementation of problem posing in mathematics education. The distribution of articles identifying the country of origin of the research conducted is shown in Figure 2.

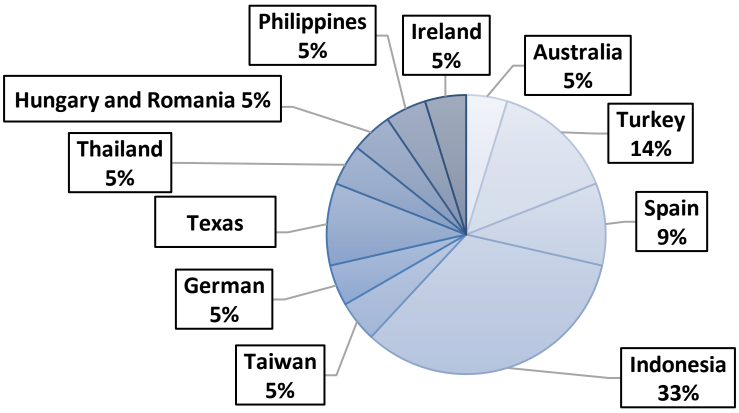

Figure 2. Distribution of Articles by Country of Study

The article review was conducted by dividing the research objectives' focus into the effects of applying problem posing on cognitive and affective aspects, as shown in Figures 3 and 4. The cognitive aspects include creativity, problem-solving performance, problem-posing performance, critical thinking, learning achievement, mathematical thinking, modelling performance, pedagogical content knowledge, written mathematical communication skills, and adaptive reasoning. Affective aspects influenced by problem posing include Interest, Value, Enjoyment, Boredom, Acceptance, Motivation, Curiosity, Hard Work, and Responsibility.

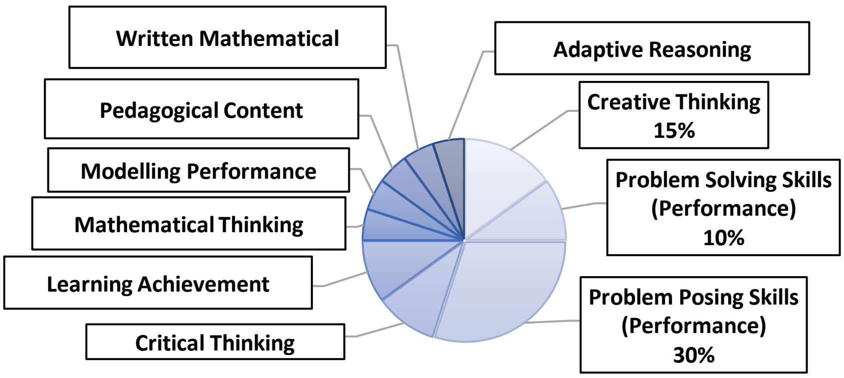

Figure 3. Distribution of Articles by Enhanced Cognitive Aspects

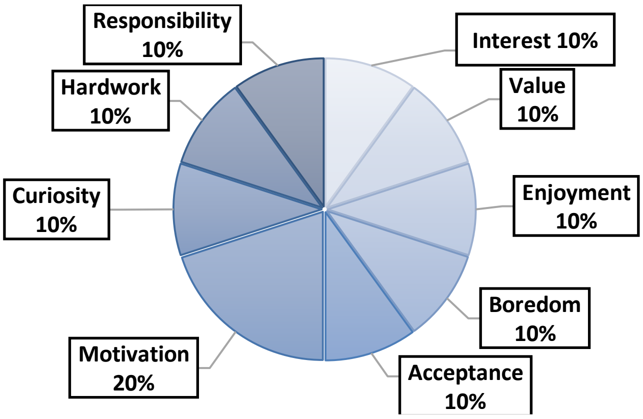

Figure 4. Distribution of Articles by Enhanced Affective Aspects

A review of articles highlighting improvements in problem posing, both in Indonesia and abroad, is presented in Tables 2 and 3.

Table 2. Enhanced Aspects through the Implementation of Problem Posing in Indonesia

Enhanced Aspects	**Researcher**
Creativity	[28], [29]
Mathematical Thinking	[30]
Critical thinking	[28] [31]
Curiosity	[29]
Hard work	[29]
Responsibility	[29]
Motivation	[17]
Adaptive reasoning	[32]
Written Mathematical Communication Skills	[33]

Table 3. Enhanced Aspects through the Implementation of Problem Posing Abroad

Enhanced	**Country**	**Researcher**
Creativity	Australia	[4]
Problem-solving skills (performance)	Turkey, Hungary, Romania, Ireland	[6], [11]
Problem posing skills (performance)	Turkey, Hungary, and Romania	[6], [11], [34], [35], [10], [36]
Learning achievement	Taiwan	[7], [9]
Interest	Spain	[37]
Value	Spain	[37]
Enjoyment	Spain	[37]
Motivation	Taiwan	[7]
Acceptance	Taiwan	[7]
Boredom	Spain	[37]
Modelling Performance	German	[8]
Pedagogical content knowledge	Texas	[38]

Furthermore, the review of articles was carried out according to the steps of problem posing in learning, as briefly shown in Tables 4 and 5.

Table 4. Problem Posing Steps in Indonesia

Problem Posing's Steps	Researcher
Situation Orientation, Creating Problems, Solving Problems, Class Discussion, and Practice	[28]
Follow the information closely from the teacher, read/review information in the student book, Formulate the problem or question based on the information obtained, Formulate and solve problems in LKPD (Student's worksheet), Discuss/ask friends or teachers, Conclude the subject matter based on teacher guidance, and Pay attention to the feedback given by the teacher.	[29]
Informing learning goals, Group formation, Presenting Problems, Posing problems, Solving the problems	[17]

Table 5. Problem Posing's Steps Abroad

Problem Posing's Steps	Country	Researcher
The students pose a problem. The posed problem is solved, and the data are then changed so that the students can pose a different problem.	Turkiye	[6]
Understanding the Situation, Identifying Problem Elements, Designing the Problem, Articulating the Problem, Checking the Problem	Spain	[5]
Problem Construction, Problem Solving, Peer Assessment, Group-Achievement Visualization	Taiwan	[7]
Students are given real-world situations; Students are asked to formulate mathematical problems based on those situations; Students are asked to solve the problems they created.	German	[8]
Modeling, practice, problem posing, problem solving	Hungary and Romania	[11]
Grouping the students provides information, situations, charts, and pictures, and encourages students to use mathematical knowledge. The teacher asks each group to exchange problems; students present their problems and the problems they receive, and students upload their assignments.	Thailand	[9]
Analyze the mathematical problem, use problem hints to create problems, Formulate problems, then Reflection and consolidation.	Ireland	[10]

3.2 Discussion

3.2.1 Aspects That Can Be Improved in Mathematics Learning Through the Implementation of Problem Posing

This study found several articles that explain aspects that can be improved through the implementation of problem posing. The articles are divided into several kinds, including quantitative-experimental research, qualitative research, R&D, and action research. In quantitative research, eight articles (38,09%) of them are experimental research which shows that problem posing activity can effectively improve learning achievement (Utami & Hwang, 2024; Sangpom & Sangpom, 2024), critical thinking [28], [31], creative thinking [28], Written Communication skills [33], adaptive reasoning [32], and motivation [17]. Experimental research allows researchers to control variables, enabling them to accurately identify the influence of strategies or activities related to problem posing. Two articles in this study (0,09%) used a mixed-methods design that included an experimental design, in which it was found that problem posing can improve problem posing skills [34] and pedagogical content knowledge [38]. Other findings in this study include nine qualitative research articles (42, 85%), one research and development (R&D) article, and one action research article, which produced various findings. These findings strengthen the results of quantitative-experimental and mixed-method research and generate new hypotheses that can be further explored or tested through a quantitative-experimental approach.

The implementation of problem posing in mathematics learning has been proven to increase students' learning achievement [7], [9]. The increase in learning achievement is supported by constructivist theory, which emphasizes students' active engagement in the learning process. In this context, problem posing enables students to construct problems actively, thereby making the knowledge gained more meaningful and in-depth. In addition, the contribution of problem posing to learning achievement is supported by Kurniasih et al. [30], who found that how teachers stimulate learning through problem posing (as well as Poetry and Singing) can improve mathematical thinking skills. This skill is an important component in supporting students' learning achievement.

Regarding the improvement in student achievement through the implementation of problem posing, this study highlights the importance of integrating technology into problem-solving activities, as demonstrated in [7]. Furthermore, as demonstrated in [9], problem posing can also be applied in online learning, not just in offline learning. This suggests that implementing problem posing will be more effective when supported by technology and combined with a problem-solving approach. Furthermore, problem posing can be an effective alternative in online learning contexts, especially when face-to-face learning is not possible, such as during the COVID-19 pandemic.

In addition to influencing overall mathematics learning achievement, the findings in this study also indicate that problem-solving activities can improve students' critical and creative thinking skills [28], [31]. These studies revealed that problem posing is more effective in enhancing students' critical and creative thinking than expository and conventional learning. This supports [39] argument that problem posing is a way to make students become critical thinkers. According to [28], problem posing plays a very important role in improving students' creative and critical thinking, as does the use of the contextual learning model. Their findings reveal that, from a critical thinking perspective, contextual learning has a greater influence than problem posing. Conversely, when viewed from the perspective of creative thinking, problem posing has a greater influence than contextual learning. However, in general, both critical thinking and creative thinking can be improved through both problem posing and contextual learning. This highlights the importance of applying problem posing in mathematics learning, as well as the importance of contextual learning in improving students' critical thinking and creative thinking skills. Another finding in [31] reveals that the implementation of problem posing can improve students' critical thinking skills, as can the application of problem-based learning. This finding shows the difference in critical thinking skills when using problem posing and problem-based learning compared to conventional learning. These findings reveal that, in addition to having the same role as contextual learning in improving critical thinking, problem posing also has the same role as problem-based learning in improving students' critical thinking skills. Thus, it can be understood that problem posing is as effective as contextual learning and problem-based learning in improving students' critical and creative thinking skills. Regarding creative thinking, the qualitative research conducted by [4] also supports the above findings, namely that problem-posing activities support students' creative thinking skills. Additionally, the research emphasizes the aesthetic aspects of mathematics, such as figural quadratic patterns, which can capture students' attention and enhance their engagement in learning.

In addition, problem posing is effective in improving problem-posing and problem-solving performance. This result was evident in the differences between pre-test and post-test scores in the class that participated in problem-solving learning, although there was no significant difference between the experimental and control classes [6]. These findings were also confirmed by [34], who reported that mathematics teaching using problem-posing strategies could enhance problem-solving skills, and by [11], who found that problem-solving ability is predicted by the quality of problem posing.

Another finding shows that problem posing combined with the Realistic Mathematics Education (RME) approach can improve written mathematical communication skills [33]. The study showed that problem posing with the RME approach was more effective in improving students’ written communication skills than problem posing alone. However, problem posing without RME was still more effective than Direct Instruction (DI) in enhancing students' written mathematical communication abilities. This means that Problem Posing, when taught using the RME approach, will be more beneficial for mathematical written communication skills.

The next aspect that can be improved through problem posing activities is adaptive reasoning skills, as in the study by [32]. Interestingly, in that study, problem posing with a scientific approach was more effective at improving adaptive reasoning than problem-solving activities. This also indicates that problem posing can be effectively utilized to enhance students' adaptive reasoning skills when combined with a scientific approach.

Furthermore, another aspect that can be improved through problem posing activities is motivation [17]. The study found that students' learning motivation increased significantly through problem posing. This finding is also supported by [7] who applied Collaborative Problem Posing and Solving (CPPS) in mathematics learning, where a questionnaire revealed that it resulted in high motivation.

Apart from students, problem posing is also applied to prospective teachers. The study by [38] showed the success of problem posing in improving the pedagogical content knowledge of prospective teachers. This increase was measured through closed-ended items, which indicated that both content knowledge and pedagogical content knowledge of prospective teachers increased during the learning process.

In principle, these findings were obtained from experimental research that controlled various variables, thereby allowing the causal relationship between the independent and dependent variables to be accurately identified. This approach allows researchers to ensure that the variables studied truly influence the aspects under observation. On the other hand, other types of research, such as qualitative research, research and development (R&D), and action research, also make important contributions by generating new hypotheses. These hypotheses can be tested more systematically through quantitative-experimental approaches in subsequent research, thereby enriching scientific understanding.

Based on the results of [37], mathematical problem posing in real-world contexts can foster value and reduce boredom. Moreover, the same study found that problem posing on visual poetry can increase interest and enjoyment. This finding is very interesting because it can be extended to quantitative experimental research to answer whether problem posing in real-world contexts and visual poems can truly encourage value, minimize boredom, increase interest, and increase enjoyment in mathematics learning. To answer this, further research is needed, using quantitative experiments or mixed-methods designs, to convince practitioners in the field actually to apply problem posing. Additionally, based on [7] research, the application of Collaborative Problem Posing and Solving (CPPS) showed high acceptance from students. Through a Research and Development (R&D) study, Arif et al. [29] developed a Mathematics Learning Device with a Scaffolding-assisted Problem-Posing approach by lesson plans, teacher books, student books, student worksheets, and learning outcome assessment instruments. They found that these learning tools effectively improved students' characters, including curiosity, hard work, and responsibility. These findings are also worth further exploration through quantitative-experimental research to test the extent to which problem posing influences curiosity, hard work, and responsibility.

The findings above make valuable contributions to practitioners and researchers in mathematics education, particularly in implementing the problem-posing approach. For practitioners, the application of problem-posing in the classroom has been proven to enhance various aspects of learning, including learning achievement, problem-posing skills, critical thinking, creativity, mathematics, written communication skills, adaptive reasoning, pedagogical content knowledge for both teachers and prospective teachers, and learning motivation. These findings expand the evidence for the benefits of the problem-posing approach, as previously reported in the literature. Kul et al. [18], through a meta-analysis study, found that the problem posing strategy can significantly improve mathematics learning achievement, problem-solving skills, problem-posing skills, and attitudes toward mathematics. Another systematic study [19] using a Systematic Literature Review (SLR) approach concluded that problem posing has a positive impact on learning achievement, critical thinking, creative thinking, and learning motivation.

Meanwhile, Aktas [20], in a bibliometric study, revealed that problem posing contributes to the improvement of problem-posing and problem-solving skills, learning outcomes, attitudes toward mathematics, and conceptual understanding among prospective teachers. This study expands on previous research while reinforcing earlier findings by adding new benefits of problem posing that have not been extensively explained before: written mathematical communication skills, adaptive reasoning, and pedagogical content knowledge. Additionally, for researchers, this study opens the door to further research exploring the Influence of problem posing on important learning characteristics, such as curiosity, work ethic, and responsibility, through an experimental research approach.

3.2.2 Comparison of Aspects that Can Be Improved in Mathematics Learning through the Implementation of Problem Posing Between Indonesia and Abroad

The aspects that are improved through problem Posing consisting of cognitive and affective aspects, are as follows: Critical & Creative thinking, problem posing performance, problem solving performance, Mathematical thinking skill, Learning achievement, Modelling performance, Pedagogical content knowledge, Written mathematical communication skills, and Adaptive reasoning, as well as Interest, Value, Enjoyment, Boredom, Student acceptance, Motivation, Curiosity, Hard work, and Responsibility. In Indonesia itself, the aspects that are enhanced include critical and creative thinking, students' mathematical thinking skills, adaptive reasoning, written mathematical communication skills, student motivation, curiosity, hard work, creativity, and responsibility. Meanwhile, abroad, the aspects that are enhanced include Creativity, Problem Posing & Solving Performance, Learning Achievement, Student Modelling Performance, Pedagogical Content Knowledge, Students' Acceptance, Motivation, Interest, Value, Enjoyment, and Boredom.

Aspects that are developed in Indonesia but not found abroad include critical thinking, students' mathematical thinking skills, adaptive reasoning, written mathematical communication skills, curiosity, hard work, and responsibility. Conversely, aspects developed abroad but not found in Indonesia include Problem Posing and Solving Performance, Learning Achievement, Student Modelling Performance, Pedagogical Content Knowledge, Students' Acceptance, Interest, Value, Enjoyment, and Boredom. Among these aspects, there are two commonalities between Indonesia and abroad: Creativity and Motivation, which are developed in both places.

3.2.3 Comparison of Problem-Posing Learning Steps Between Indonesia and Abroad

In Indonesia, there are various steps in implementing problem posing. Toheri et al. [28] outline the learning steps starting with Situation Orientation, Creating Problems, Solving Problems, Class Discussion, and Practice. Arif et al. [29] did something different. He conducted learning where students did the following things: Follow the information closely from the teacher, Read/review information in the student book, Formulate the problem or question based on the information obtained, Formulate and solve problems in LKPD (Student's worksheet), Discuss/ask friends or teachers, Conclude the subject matter based on teacher guidance, and Pay attention to the feedback given by the teacher. Christidamayani and Kristanto [17] also compiled the learning steps as follows: Informing Learning Goals – Delivering learning objectives to students, Groups Formation – Forming study groups, Presenting Problems – Presenting problems to students, Posing Problems – Students are asked to create or modify problems based on given information, Solving the Problems – Students solve problems that they have created themselves.

Although the implementation of Problem Posing in Indonesia differs in its steps, there are three main steps in common: first, situation orientation. In this step, the teacher provides a situation to the students, which in another sense can be viewed as "Choosing a starting point." The second step is problem formulation. Here, students are asked to create problems from the given situation, either by creating new ones or modifying existing ones. The third step is for students to solve the problems they have created themselves. Toheri et al. [28] designed discussions and exercises for learning through problem posing. Arif et al. [29] also designed discussions, but explicitly used the LKPD (Student Worksheet) for the exercises.

Abroad, there are also various steps in implementing problem posing. Polat and Özkaya [6] describe their learning steps as follows: students pose a problem, the problem is solved, and finally, the data in the posed problem are modified so that students can pose a different problem. Martín-Díaz [5] implements problem posing with the following steps: First, Understanding the Situation – The teacher ensures that students understand the context of the given scenario. Second, Identifying Problem Elements – The teacher helps students recognize the data, context, and other elements needed for the problem. Third, Designing the Problem – Students are given time to organize relationships between these elements and build the problem. Fourth, Articulating the Problem – Students thoroughly articulate the problem, including the question to be answered. Fifth, Checking the Problem – Students attempt to solve the problem they created to ensure its coherence and meaning. Utami and Hwang [7] describe the following steps: First, Problem Construction – Students and the teacher design questions related to decimals in an authentic context. Students may use text, audio, and images to explain their questions. Second, problem-solving – Students choose and answer questions designed by other students or the teacher. They may also provide explanations using multimedia. Third, Peer Assessment – Students provide feedback on their peers' answers. Fourth, Group-Achievement Visualization – The system visualizes group achievement based on the number of questions posed, answers given, and peer assessments. Hartmann et al. [8] outline the following general steps: Students are given real-world situations; Students are asked to formulate mathematical problems based on those situations; Students are asked to solve the problems they created. Kovács et al. [11] describe the problem-posing steps as follows: First, Modeling – Processing new material; the teacher models examples and draws attention to the textbook. Second, Practice – Students find examples and solve problems based on the model. Third, problem posing – Students create problems with the same structure as the model. Fourth, problem Solving – The class discusses and solves the problems posed by the students. Sangpom and Sangpom [9] outline the following steps: First, grouping the students into 6 groups (for 30 participants). Second, the teacher provides information, situations, charts, and pictures, and encourages students to use mathematical knowledge to analyze and find relationships between the information in a given context, create problems or questions, and then solve the problems. Third, the teacher asks each group to exchange the problems they have formulated with other groups and to solve them. Fourth, three selected groups present their problems and the problems received from another group. Fifth, Students upload their assignments to Google Classroom, and the teacher gives feedback. Sixth, Q & A and discussion. Leavy and Hourigan [10] outline the following learning steps: Analyze the mathematical problem, Use problem hints to create problems, Formulate problems, then Reflection and consolidation.

In general, problem posing learning abroad involves three main steps: The teacher provides the situation (students understand the given situation), Students pose the problem, and students solve the posed problem. However, Martín-Díaz [5] in designing problem posing learning, introduced a step, "Identifying Problem Elements," where the teacher helps students recognize data, context, and other elements. Similarly, Sangpom and Sangpom [9] include a step that encourages students to use mathematical knowledge to analyze and identify relationships among the information in the given context. This suggests that before students pose questions or problems, the teacher guides students in analyzing the situation. This is not simply asking students to pose problems, which may seem unusual. After providing the situation, identifying the problem elements, and before asking students to formulate the problem completely, Martín-Díaz et al. [5] introduce a further step, "Designing the Problem". Students are given time to organize relationships between the elements and construct the problem.

The implementation of problem posing abroad, which is not seen in Indonesia, includes the steps "Identifying Problem Elements" and "Designing the Problem (before posing the problem)." Identifying problem elements, as seen in the problem-posing steps proposed by [40], corresponds to the steps "listing attributes" or "registering properties." In the "Designing the Problem" step, students begin formulating questions about the situation, but have not yet finalized the problem to be posed. Many questions may arise from analyzing the situation, but the students have not yet determined the final problem to be answered. In this case, students are considered to have posed a problem once they can articulate the problem clearly. On the other hand, the implementation of problem posing in Indonesia, which is not seen abroad, is the step "Exercise" in the research by [28], and the step "Read/review information in the student book" in the research by [29].

This study shows that there are differences in the steps taken to implement problem posing, both in Indonesia and abroad. These differences reflect the diversity of pedagogical approaches, curriculum contexts, and learning objectives sought by each researcher or practitioner. In Indonesia, the implementation of problem posing generally follows three main stages, namely situation orientation, problem formulation, and problem solving. However, in practice, each study designs its own unique learning steps. For example, Toheri et al. [28] added stages of class discussion and problem-solving exercises, while [29] incorporated the steps of reading textbook information and using worksheets as student work guides. Christidamayani and Kristanto [17] emphasize the formation of learning groups and teacher feedback as part of the learning structure.

On the other hand, international studies show a more exploratory tendency and a focus on in-depth context analysis. The steps for implementing problem posing in foreign studies, as described by [5] and [11], include additional cognitive stages such as "Identifying Problem Elements" and "Designing the Problem" before students are asked to formulate the problem completely. These stages are designed to help students understand the key elements in the given situation, organize relationships between pieces of information, and design problems that are more structured and meaningful. This approach demonstrates that problem posing is not merely a creative activity but also a systematic thinking process that can be enhanced through cognitive scaffolding.

4. CONCLUSION

The application of problem posing in mathematics learning demonstrates a wide range of positive impacts, particularly in enhancing both cognitive and affective domains.

12 Empirical evidence indicates that problem posing significantly improves students' critical thinking, creativity, problem-solving abilities, mathematical reasoning, academic achievement, and written mathematical communication. Simultaneously, it fosters the development of affective aspects such as motivation, interest, value orientation, enjoyment of learning, and a sense of responsibility. These findings underscore the strategic value of problem posing as a holistic and impactful instructional approach in mathematics education.

From a procedural standpoint, the structure of problem-posing practices in Indonesia and abroad is generally similar, typically involving: the teacher providing the situation (so students understand the given situation), students posing the problem, and students solving the posed problem. However, overseas implementations include additional steps, such as identifying problem elements and designing the problem structure before explicit formulation, steps not found in the problem-posing stages in Indonesia. Conversely, mathematics learning in Indonesia tends to rely more heavily on explicit textbook reading activities and structured, guided exercises.

The implications of these findings suggest the importance of adopting a more structured approach to problem posing, both in Indonesia and internationally, to improve students' creativity, problem-solving abilities, and conceptual understanding. However, the study has a limitation, as the literature review relied on a limited range of databases, namely Scopus, ERIC, and ScienceDirect, which may not encompass other, potentially broader databases that could offer a more comprehensive insight. To maximize the pedagogical impact of problem posing, future research and development should aim to synthesize diverse approaches by integrating the reflective emphasis and perseverance in learning observed in Indonesian practices with the explicit conceptual scaffolding and cognitive structuring prevalent in international contexts. Such cross-contextual collaboration holds significant potential to produce culturally adaptive and pedagogically enhanced learning models that are both effective and inclusive across diverse educational settings.

REFERENCES

[1] I. Pelczer and H. P. Osana, "A review on problem posing in teacher education," in *Mathematical Problem Posing: From Research to Effective Practice*, Psychology Press, 2015. https://doi.org/10.1007/978-1-4614-6258-3_23

[2] J. Cai and S. Hwang, "Teachers as redesigners of curriculum to teach mathematics through problem posing: Conceptualization and initial findings of a problem posing project," *ZDM - Mathematics Education*, vol. 53, no. 4, pp. 1403-1416, 2021. https://doi.org/10.1007/s11858-021-01252-3

[3] E. A. Silver, "On Mathematical Problem Posing," *For the Learning of Mathematics*, vol. 14, no. 1, pp. 19-28, 1994.

[4] K. J. Wilkie, "Creative thinking for learning algebra: Year 10 students' problem solving and problem posing with," *Thinking Skills and Creativity*, vol. 52, 2024. https://doi.org/10.1016/j.tsc.2024.101550

[5] J. P. Martín-Díaz, M. Montes, M. Codes and J. Carillo, "Characterisers of teaching in a mathematics problem posing lesson in preschool education," *Sustainability (Switzerland)*, vol. 12, 2020. https://doi.org/10.3390/su12156148

[6] H. Polat and M. Özkaya, "The effect of problem posing-based active learning activities on problem-solving and posing performance: The case of fractions," *Journal of Pedagogical Research*, vol. 7, no. 1, pp. 67-81, 2023. https://doi.org/10.33902/JPR.202317880

[7] I. Q. Utami and W. Y. Hwang, "The impact of collaborative problem posing and solving with ubiquitous-decimal app in authentic contexts on math," *Journal of Computers in Education*, vol. 9, no. 3, pp. 427-454, 2022. https://doi.org/10.1007/s40692-021-00209-5

[8] L. M. Hartmann, J. Krawitz and S. Schukajlow, "Create your own problem! When given descriptions of real," *ZDM - Mathematics Education,* vol. 53, no. 4, pp. 919-935, 2021. https://doi.org/10.1007/s11858-021-01224-7

[9] N. Sangpom and W. Sangpom, "Enhancing mathematics achievement through online problem-posing: a study during the covid-19," *Educational Planning,* vol. 31, no. 3, pp. 53-66, 2024.

[10] A. Leavy and M. Hourigan, ""Attending to task variables when engaging in group problem posing for elementary level mathematics," *Journal of Mathematical Behavior,* vol. 73, pp. 1-21, 2023. https://doi.org/10.1016/j.jmathb.2024.101128

[11] Z. Kovács and et al, "Incorporating Problem-Posing into Sixth-Grade Mathematics," *Education Sciences,* vol. 13, no. 2, 2023. https://doi.org/10.3390/educsci13020151

[12] L. D. English, "The development of 5th-grade problem-posing abilities," *Educational Studies in Mathematics,* vol. 34, pp. 183-217, 1997.

[13] J. Cai and S. Hwang, "Learning to teach through mathematical problem posing: Theoretical considerations, methodology, and directions for future research," *International Journal of Educational Research,* vol. 102, 2020. http://www.jstor.org/stable/45380372

[14] H. Elgrably and R. Leikin, "Creativity as a function of problem-solving expertise: Posing new problems through investigations," *ZDM - Mathematics Education,* vol. 53, no. 4, pp. 891-904, 2021. https://doi.org/10.1007/s11858-021-01228-3

[15] J. Stewart and L. Ball, "The Tension Between Allowing Student Struggle and Providing Support When Teaching Problem-Solving in Primary School Mathematics," *Canadian Journal of Science, Mathematics and Technology Education,* vol. 23, no. 4, pp. 791-817, 2023. https://doi.org/10.1007/s42330-024-00309-1

[16] L. Zhang and G. J. Stylianides, "Enhancing mathematical problem posing competence: A meta analysis of intervention studies," *International Journal of STEM Education,* vol. 11, no. 1, pp. 1-24, 2024. https://doi.org/10.1186/s40594-024-00507-1

[17] A. P. Christidamayani and Y. D. Kristanto, "The Effects of Problem Posing Learning Model on Students' Learning Achievement and Motivation," *Indonesian Journal on Learning and Advanced Education (IJOLAE),* vol. 2, no. 2, pp. 100-108, 2020. https://doi.org/10.23917/ijolae.v2i2.9981

[18] Ü. Kul, S. Çelik and Z. Aksu, "The Impact of Educational Material Use on Mathematics Achievement: A Meta-Analysis," *International Journal of Instruction* , vol. 11, no. 4, pp. 303-324, 2018.

[19] A. Kaur and R. Rosli, "Problem Posing in Mathematics Education Research: A Systematic Review," *International Journal of Academic Research in Progressive Education and Development,* vol. 10, no. 1, pp. 438-456, 2021. https://doi.org/10.6007/IJARPED%2FV10-I1%2F8641

[20] M. C. Aktas, "Problem-posing research in mathematics education: A bibliometric analysis,," *Journal of Pedagogical Research,* vol. 6, no. 4, 2022. https://doi.org/10.33902/JPR.202217414

[21] A. Mallart, V. Font and J. Diez, "Case study on mathematics preservice teachers' difficulties in problem posing," *Eurasia Journal of Mathematics, Science and Technology Education,* vol. 14, no. 4, pp. 1465-1481, 2018. https://doi.org/ 10.29333/ejmste/83682

[22] S. Rochaminah and et al, "Needs Assessment for the Development of Learning Models Based on Mathematical Problem Posing to Improve Critical Thinking Skills," *KnE Social Sciences,* vol. 7, no. 1, pp. 67-81, 2024. https://doi.org/10.18502/kss.v9i13.15966

[23] L. Baumanns and B. Rott, "Metacognitive Behaviour in Problem Posing-a Case Study," *Proceedings of the 44th Conference of the International Group for the Psychology of Mathematics Education,* vol. 2, pp. 47-55, 2021.

[24] J. P. T. Higgins and et al, Cochrane Handbook for Systematic Reviews of Interventions, 2nd ed. Wiley-Blackwell, 2019.

[25] R. Sharif, "The relations between acculturation and creativity and innovation in higher education: A systematic literature review," *Educational Research Review,* vol. 28, pp. 1-26, 2022. https://doi.org/10.1016/j.edurev.2019.100287

[26] D. Moher and et al, "Preferred reporting items for systematic review and meta analysis protocols (PRISMA-P) 2015 statement," *Japanese Pharmacology and Therapeutics,* vol. 47, no. 8, pp. 1177-1185, 2019. https://doi.org/ 10.1136/bmj.g7647

[27] A. Kizilaslan and et al, "Inquiry based teaching in Turkey: A content analysis of research reports," *International Journal of Environmental and Science Education,* vol. 7, no. 4, pp. 599-617, 2012.

[28] Toheri, W. Winarso and A. A. Haqq, "Where Exactly for Enhance Critical and Creative Thinking: The Use of Problem Posing or Contextual Learning," *Europan Journal of Educational Research*, vol. 9, no. 2, pp. 877-887, 2020. https://doi.org/ 10.5220/0009914806980705

[29] P. Arif, B. Bundu and N. Arsyad, "Development of mathematics learning device with scaffolding-assisted problem approach to improve character learners," *Universal Journal of Educational Research,* vol. 8, no. 7, pp. 3236-3243, 2020. http://dx.doi.org/10.13189/ujer.2020.080753

[30] A. Kurniasih, I. Hidayah and M. Asikin, "Teacher Support for Eliciting Students Mathematical Thinking: Problem Posing, Asking Questions, and Song," *International Journal of Learning Teaching and Educational Research,* vol. 19, no. 10, pp. 265-285, 2020. https://doi.org/10.26803/ijlter.19.10.15

[31] D. Darhim, S. Prabawanto and B. E. Susilo, "The effect of problem-based learning and mathematical problem posing in improving student's critical thinking skills," *International Journal of Instruction*, vol. 13, no. 4, pp. 103-116, 2020. https://doi.org/10.29333/iji.2020.1347a

[32] F. Andika, I. Pramudya and S. Subanti, "Problem Posing and Problem Solving With Scientific," *International Online Journal of Education and Teaching (IOJET),* vol. 7, no. 4, 2020. http://iojet.org/index.php/IOJET/article/view/1037

[33] C. Chasanah, Riyadi and B. Usodo, "The Effectiveness of Learning Models on Written Mathematical Communication Skills Viewed from Students' Cognitive Styles," *European Journal of Educational Research,* vol. 9, no. 3, pp. 979-994, 2020. https://doi.org/10.12973/eu-jer.9.3.979

[34] R. Divrik, "Effect of Teaching Mathematics Supported by Problem-posing Strategies on Problem-posing Skills," *International Journal of Modern Education Studies,* vol. 7, no. 2, pp. 371-408, 2023. https://doi.org/10.51383/ijonmes.2023.308

[35] K. G. Yiğ and Z. Ay, "An Analysis of the Qualities of the Problems Posed by the Students in a Seventh Grade Mathematics Course Assisted by the Problem Posing Approach," *International Journal of Contemporary Educational Research,* vol. 8, no. 2, pp. 13-30, 2022. https://doi.org/10.33200/ijcer.795390

[36] A. J. V. Patac, L. P. Patac and N. E. Crispo, "Students' understanding of a geometric theorem: A case of grade 9 problem posing," *JRAMathEdu (Journal of Research and Advances in Mathematics Education),* vol. 7, no. 2, pp. 105-115, 2022. https://doi.org/10.23917/jramathedu.v7i2.16394

[37] A. Bataller, I. Ferrando and A. Reyes-Tores, "Visual Poetry and Real Context Situations in Mathematical Problem Posing and Solving: A Study of the Affective Impact," *Mathematics,* vol. 10, no. 10, 2022. https://doi.org/10.3390/math10101647

[38] R. Rosli and et al, "Elementary preservice teachers' knowledge, perceptions and attitudes towards fractions: A mixed analysis," *Journal on Mathematics Education,* vol. 11, no. 1, pp. 59-76, 2020. https://doi.org/10.22342/jme.11.1.9482.59-76

[39] P. Freire, Pedagogy of the Oppressed, 30th anniversary, New York: NY: Continuum, 2000.

[40] S. I. Brown and M. I. Walter, The Art of Problem Posing, 3rd ed, Lawrence Erlbaum Associates, 2005.