

Creativity Pattern of Problem Posing in Mathematics for Moderately Capable Students in Cross-Situations

Ahyani Mirah Liani¹

¹Departement of Mathematics Education, Makassar State University, Indonesia

Nurdin Arsyad²

²Departement of Mathematics Education, Makassar State University, Indonesia

Awil³

³Departement of Mathematics Education, Makassar State University, Indonesia

Corresponding Author: ahyani.mirah.liani@unm.ac.id

Abstract

This study aims to describe the pattern of creativity in mathematical problem posing among students with moderate mathematical ability across different situations. Creativity is analyzed through three indicators: fluency, flexibility, and novelty. This qualitative descriptive study involved students of the Primary School Teacher Education Program (PGSD) at Universitas Negeri Makassar, selected using purposive sampling based on moderate mathematical ability test results. Data were collected through mathematical problem-posing tasks involving free, semi structured, and structured situations, supported by semi-structured interviews. The findings indicate that students with moderate mathematical ability demonstrate relatively consistent fluency across situations, as they are able to generate several relevant mathematical problems. However, flexibility and novelty are limited and fluctuate depending on the characteristics of the situation. Free and semi-structured situations provide more opportunities for idea variation, while structured situations tend to restrict creativity, resulting in routine and procedural problems. These results highlight the importance of designing adaptive problem posing situations to support the development of students' mathematical creativity. These results suggest that instructional designs incorporating adaptive and balanced problem posing situations are essential to support the development of flexibility and novelty in students' mathematical creativity.

Keywords: Mathematical Creativity; Problem Posing; Moderate Mathematical Ability; Fluency; Flexibility; Novelty; Problem Situations.

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INTRODUCTION

Creativity is one of the essential competencies in 21st century mathematics learning because it relates to the ability to think at a higher level, solve problems, and develop ideas flexibly. In mathematics education, creativity is not only reflected in the ability to solve the given problems, but also in the ability to formulate and propose mathematical problems independently. Problem posing activities are seen as an effective means to uncover students' mathematical creativity because they place them as active subjects in building mathematical structure and meaning (Silver, 1994; Brown & Walter, 2005).

Problem posing is a complex mathematical activity because it requires the ability to understand situations, identify relevant information, and formulate meaningful and solvable mathematical questions. Through this activity, students not only reproduce knowledge, but also construct new ideas based on their understanding of the given context (Findell et al., 2001). Therefore, problem posing is often used as an approach to examine mathematical creativity more authentically compared to routine problem solving tasks (Silver & Cai, 2005).

Creativity in submitting mathematical problems is generally analyzed through three main aspects, namely fluency, flexibility, and novelty. Fluency refers to the ability to produce a number of problems from a situation, flexibility is related to the variety of ideas or approaches used in the problem posed, while novelty is related to the level of uniqueness or non-routine of the problem (Silver, 1997); Runco & Jaeger, 2012). These three aspects are interrelated and form an individual's mathematical creativity profile.

However, creativity in problem solving does not appear uniformly in every individual. A number of studies show that mathematical ability affects the quality of the problem posing produced. Students with high math ability tend to show higher variety and novelty, while students with low abilities often have difficulty formulating meaningful problems (Leung & Silver, 1997; Siswono, 2008). In this context, students with the ability are in a unique position because they have a sufficient understanding of basic concepts, but are not yet fully able to develop ideas flexibly and originally.

In addition to mathematical skills, the characteristics of the situations used in problem posing also affect the creativity displayed. Free, semi-structured, and structured situations provide different levels of freedom in exploring mathematical ideas (Stoyanova & Ellerton, 1996). Therefore, the study of creativity in problem posing needs to be carried out cross-situation in order to obtain a more complete and comprehensive picture of creativity patterns.

Based on this description, this study aims to describe the pattern of creativity in submitting



mathematics problems of students with moderate abilities across situations. The focus of the research is directed at how students with medium abilities show aspects of fluency, flexibility, and novelty in asking mathematical problems in various different situations. The results of this study are expected to make a theoretical contribution to the study of mathematical creativity as well as practical implications for the design of mathematics learning oriented to the development of creativity.

LITERATURE REVIEW

Creativity in Math Learning

Creativity in mathematics learning is seen as the ability of individuals to generate diverse, meaningful, and valuable mathematical ideas in a given context. Creativity does not only focus on the final product in the form of an answer or solution, but also on a thought process that involves exploration, imagination, and mathematical decision-making (Runco & Jaeger, 2012). In mathematics education, creativity is an important part of efforts to develop high-level thinking skills and readiness to face complex problems.

A number of studies confirm that mathematical creativity is closely related to the ability to understand concepts, connect ideas, and use knowledge flexibly in different situations (Findell et al., 2001). Thus, creativity does not stand alone, but rather grows from adequate conceptual understanding and learning experiences that encourage the exploration of ideas. Therefore, mathematics learning needs to be designed in such a way as to provide space for students to think divergently and develop their mathematical ideas.

In the context of higher education, mathematical creativity is an increasingly important competency because students are required not only to master procedures, but also to be able to think critically and creatively in solving and formulating problems. Students' mathematical creativity can be developed and revealed through challenging activities, one of which is through problem posing in mathematics.

Problem Posing in Mathematics

Problem Posing in mathematics is defined as the activity of formulating or asking mathematical questions based on a situation, both contextual and abstract. This activity can be done before, during, or after the problem-solving process, and is seen as an integral part of meaningful math learning (Silver, 1994). Through problem posing, students are encouraged to play an active role in building mathematical knowledge.



Problem posing requires the ability to understand situations, identify relevant information, and construct mathematical relationships that can be expressed in the form of problems. Brown & Walter (2005) emphasizing that this activity not only trains mathematical thinking skills, but also encourages the emergence of new ideas and diverse perspectives on a situation. Thus, problem posing serves as a means to develop creativity as well as understanding mathematical concepts.

Previous research has shown that problem posing has great potential in revealing students' mathematical creativity because it provides freedom in determining the form and direction of the problem posed (Silver & Cai, 2005). Therefore, problem posing is often used as a research approach to examine how students think creatively in mathematics, including at the higher education level.

Creativity Aspects in Problem Posing

Creativity in problem posing in mathematical is generally analyzed through three main aspects, namely fluency, flexibility, and novelty. Fluency refers to an individual's ability to generate a number of problems from a similar situation. The more problems that are relevant and can be solved, the higher the level of fluency shown (Silver, 1997).

Flexibility has to do with the ability to generate variations of ideas or approaches in a proposed problem. This aspect is reflected in the diversity of concepts, strategies, or representations used in formulating problems. Flexible individuals are able to move from one idea to another and not get stuck on one particular thought pattern (Leung, 1997).

Meanwhile, novelty is related to the level of uniqueness or non-routine of the problem being asked. A problem is said to be new if it has a structure or idea that is different from common or previously known problems. Runco & Jaeger (2012) affirming that novelty is the most challenging aspect of creativity because it requires individuals to go beyond conventional thinking habits.

Math Skills and Creativity

Mathematical ability is one of the factors that affect creativity in problem posing. Students with high mathematical abilities generally have a strong mastery of concepts so that they are able to produce varied and original problems. In contrast, students with low abilities often have difficulty understanding situations and formulating meaningful problems (Leung & Silver, 1997).

Capable students are occupying positions between the two groups. They already have enough understanding of basic concepts to propose mathematical problems, but still show



limitations in developing ideas flexibly and originally. This condition causes the creativity displayed to be often fluctuating and highly dependent on the characteristics of the given situation (Siswono, 2008).

Thus, the study of moderately gifted students is important because it can provide an idea of how mathematical creativity develops in groups that often dominate the classroom in numbers. The results of this study can be the basis for designing learning that is more targeted in developing student creativity.

Situation in Mathematical Problem Posing

The situation used in mathematical problem posing plays an important role in influencing the creativity displayed by students. Stoyanova & Ellerton (1996) stated that problem posing situations can be classified into free, semi-structured, and structured situations. Each situation provides a different level of freedom in exploring mathematical ideas.

Situations that are too open can provide a wide space for exploration, but they also have the potential to cause confusion, especially for moderately gifted students. On the other hand, overly structured situations tend to limit the variety and novelty of ideas because learners are more geared towards specific procedures. Therefore, the balance between openness and clarity of information is an important factor in encouraging creativity (Leung, 1997).

Cross-situational studies are needed to understand how problem-solving creativity develops in various contexts. By comparing student responses to different situations, it was possible to identify typical patterns of creativity, especially in moderately gifted students, as the focus of this study.

METHOD

Research Design

This research is a Qualitative Research using a descriptive approach. This research relates psychology to mathematical skills which aims to see the mathematical creativity ability of students with moderate ability in asking problems. This research was carried out with the help of problem posing test instruments, mathematical ability tests and interview guidelines.

Participants and Research Setting

This research was carried out at the State University of Makassar, Faculty of Education (FIP), Elementary School Teacher Education Study Program (PGSD). The selection of subjects was



carried out by *purposive sampling* technique by considering that PGSD students may be able to communicate their thoughts orally and in writing well so that efforts to investigate students' creative abilities can be carried out, and students selected by *purposive sampling* are assumed to meet the variety of creative thinking processes in submitting mathematical problems.

Students are given a mathematical ability test as a consideration to determine the right research subject. The results of the PGSD students' math ability test will be categorized as moderate with a score interval of $65 \leq x \leq 80$.

Research Procedure

The research procedure consisted of three main stages:

Table 1. Research Procedure

1. Preparation Stage This research begins with the determination of the research subject in accordance with the criteria that have been set. Data collection is carried out through tests and interviews. The test is used to obtain written data related to the subject's work, while the interview aims to explore the subject's explanation and thought process in more depth.
2. Implementation Stage The data obtained is then analyzed through data reduction by selecting and focusing data that is relevant to the research objectives. After that, data validation is carried out to ensure consistency between test results and interview results.
3. Data Collection Stage Based on the validation results, the data is classified into valid data and invalid data. Valid data is further analyzed to obtain the main findings of the study, while invalid data is analyzed as supporting findings. The final stage of the research is the drawing of conclusions based on the results of the analysis of the data that has been validated.

Research Instruments

The main instrument in this study is the researcher as a human instrument, which plays a role in designing research, collecting data, analyzing, interpreting, and reporting research results. To support the data collection process, three supporting instruments were used, namely the math ability test, the problem posing mathematical test, and the interview guidelines.

The math ability test is used as an initial instrument to group students based on their math



proficiency level. This test is in the form of a description of the problem submission of problems in flat building materials, and the results are used to determine research subjects in the medium ability category.

The main instrument of the research is the problem posing mathematical test, which is designed to reveal the pattern of students' creativity in asking math problems. This test consists of three different situations, namely free, semi-structured, and structured situations. Students are asked to submit as many math problems as possible based on the information provided without being asked to solve them. This instrument was prepared by adapting the development of problem posing from previous research and aimed to identify aspects of creativity, such as variations in problem types and the emergence of new information.

To deepen and validate the written test data, semi-structured interview guidelines were used. The interview was conducted to explore students' explanations related to the thinking process, the reasons for asking the problem, and considerations in forming mathematical questions. Interview questions are flexible and can evolve according to the subject's response, but still refer to the focus of the research. The validity of the interview guidelines is carried out through expert assessment before being used in data collection. The three instruments were used in an integrated manner to obtain rich and in-depth data on the creativity patterns of mathematics problem posing of moderately gifted students in various situations.

RESULTS

The results of the study showed that the pattern of creativity in mathematics problem posing for students with medium abilities varied according to the characteristics of the given situation, namely free, semi-structured, and structured situations. Creativity is analyzed based on three main indicators, namely fluency, flexibility, and novelty.

In a free situation, students with moderate abilities show fairly good fluency, characterized by the ability to ask more than three relevant math problems from a single context. However, most of the problems posed still have similar mathematical goals and are routine. Flexibility is beginning to appear, but it is limited to variations in calculations that are still in a familiar context. Novelty only appears in a limited and inconsistent manner, because students tend to avoid developing context or adding new information.



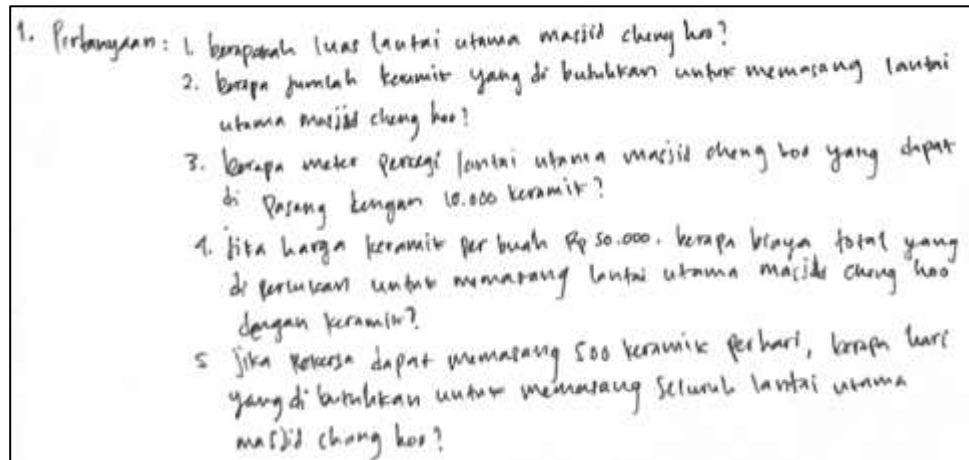
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1. Perbandingan: 1. berapakah luas lantai utama masjid cheng hoo?
 2. berapa jumlah keramik yang dibutuhkan untuk memasang lantai utama masjid cheng hoo?
 3. berapa meter persegi lantai utama masjid cheng hoo yang dapat di pasang dengan 10.000 keramik?
 4. jika harga keramik per buah Rp 50.000, berapa biaya total yang diperlukan untuk memasang lantai utama masjid cheng hoo dengan keramik?
 5. jika pekerja dapat memasang 500 keramik per hari, berapa hari yang dibutuhkan untuk memasang seluruh lantai utama masjid cheng hoo?

Figure 1. Student Formulation of Problems in Free Situations

In a semi-structured situation, the creativity in posed mathematics problems for students with abilities is in the transition stage. Fluency is maintained, with some relevant and solvable math problems. Flexibility is starting to develop, as seen from the use of more than one mathematical point of view, although the variation has not yet stabilized. Novelty is still limited, as most of the issues raised still rely on explicit information and rarely modify the initial conditions of the situation.

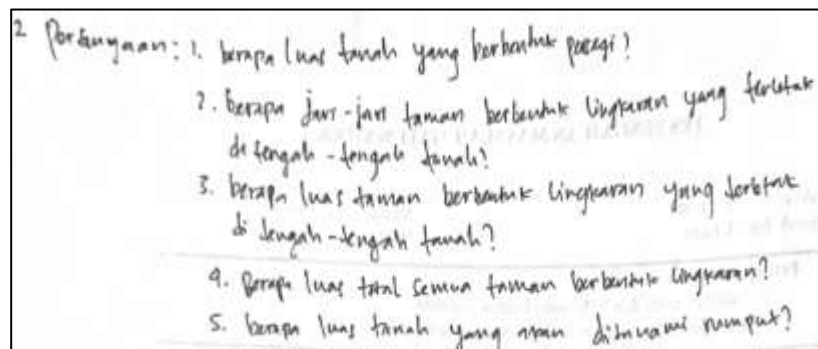
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2. Perbandingan: 1. berapa luas tanah yang berbentuk persegi?
 2. berapa jarak-jarak taman berbentuk lingkaran yang terletak di tengah-tengah tanah?
 3. berapa luas taman berbentuk lingkaran yang terletak di tengah-tengah tanah?
 4. berapa luas total semua taman berbentuk lingkaran?
 5. berapa luas tanah yang akan ditanami rumput?

Figure 2. Student Formulation of Problems in Semi-Structured Situation

On the other hand, in structured situations, the creativity of problem posing students with medium abilities shows a fairly clear decline, especially in the aspects of flexibility and novelty. Fluency still emerges, but it is limited to the direct use of available information. The problems posed tend to be procedural and follow a pattern of routine questions, without the development of new ideas or contexts. This condition shows that a strict structure limits the space for the

exploration of ideas and encourages students to choose safe strategies.

Overall, the results of this study indicate that the creativity in posing mathematics problems of students with medium abilities is partial and fluctuating. Relative fluency consistently appears in all three situations, while flexibility and novelty are strongly influenced by the level of openness of the situation.

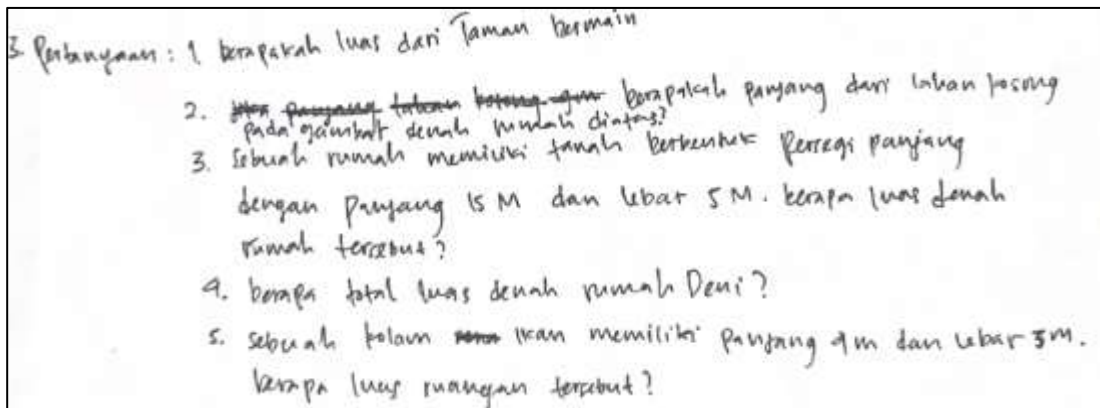


Figure 2. Student Formulation of Problems in Structured Situation

Table 2. Creativity Pattern of Problem Posing Mathematics for Moderately Capable Students in Cross-Situations

Problem Situation	Fluency	Flexibility	Novelty	General Patterns of Creativity
Free	Good; Able to posed ≥ 3 relevant issues	It is starting to appear, but it is still limited to calculation variations	Low; rarely contains new ideas or data	Creativity is quite developed, but not yet intact
Semi-Structured	Good and relatively stable	Starting developed, but not consistent	Low-medium; still relying on explicit information	Creativity is in transition
Structured	Enough; Limited to explicit information	Low; One dominant point of view	Very low; Problems are routine	The most limited creativity

Narrative Summary of Findings

This study revealed that the creativity of problem submission of moderately capable



students showed a non-linear pattern and was greatly influenced by the characteristics of the problem situation. In the three situations given free, semi-structured, and structured, creativity does not develop uniformly, but rather shows variations in the aspects of fluency, flexibility, and novelty.

In a free situation, students are able to ask a number of relevant mathematical problems, indicating the emergence of good fluency. However, the exploration of ideas is still within safe limits, with a tendency to repeat familiar calculation patterns. As a result, flexibility and novelty have not been optimally developed, although this situation theoretically provides ample room for exploration.

In a semi-structured situation, the creativity of problem submission is in the transition stage. Students are able to take advantage of the information and limitations available to propose several problems that can be solved. Flexibility begins to appear through the use of more than one mathematical point of view, although it is not yet consistent. Novelty is still limited, as most problems remain based on explicit information without the development of a broader context.

On the other hand, in structured situations, the creativity of problem solving of students with abilities is experiencing the most noticeable decline. Strict structures and boundaries encourage students to rely on strategies that are considered safe, so the problems posed tend to be procedural and routine. Fluency still appears in basic form, but flexibility and novelty are hardly seen consistently.

Overall, the findings of this study show that the creativity in submitting mathematics problems of students with medium abilities is partial and fluctuating. Fluency is relatively stable in various situations, while flexibility and novelty are highly dependent on the level of openness of the situation. This pattern indicates that moderately capable students have real creative potential, but need learning support that is deliberately designed to encourage the exploration of ideas, the courage to think, and reflection on the quality of the problems posed in order for creativity to develop more fully.

DISCUSSION

The results of the study show that the creativity of posed mathematics problems of students with abilities is forming a different pattern in each situation. These findings reinforce the view that creativity is contextual and influenced by the interaction between individual abilities and the characteristics of a given task (Maharani et al., 2018; Sa'dijah et al., 2019). Moderately gifted students do not always show the same level of creativity in every situation, but rather



fluctuate according to the level of openness and clarity of information in those situations.

Judging from the aspect of fluency, students with moderate abilities are relatively able to produce more than one mathematics problem, especially in free and semi-structured situations. This situation provides a clear initial stimulus that helps students identify data and mathematical concepts that can be developed into questions. These findings are in line with the research results of Dewi & Marsigit (2018) and Sesanti & Marsitin (2018) which stated that contexts that provide visual support and explicit information can increase the number of problems posed by students.

However, in more structured situations, the fluency of students who are sufficiently skilled tends to decrease. The issues raised are generally repetitive and are limited to similar procedural calculations. This condition suggests that even if students have an adequate understanding of concepts, they still tend to rely on previously known problem patterns. These findings are consistent with Amalina et al. (2018) and Siswono (2011) who stated that moderately gifted learners often show sufficient productivity of ideas, but have not been accompanied by wide variation.

In the aspect of flexibility, students with medium abilities show a limited variety of types of problems. Despite attempts to pose problems with different approaches, most problems still focus on one dominant concept and rarely involve shifting between concepts or representations. This indicates that the mathematical thinking flexibility of students with moderate abilities has not been developed optimally. These findings are in line with the research of Yayuk et al. (2020) and Daiana et al. (2021) which showed that the ability to move between mathematical ideas is a characteristic that is not yet strong in individuals with intermediate mathematical abilities.

The novelty aspect is the lowest aspect of creativity shown by students with moderate abilities. The problems posed are generally in the form of simple modifications of the given situation or adaptations of familiar problems. Novelty more often appears in the form of a change in context or numerical value, rather than in the structure of a substantively different problem. This reinforces the view of Sesanti & Marsitin (2018) and Azlina et al. (2018) that novelty is the most difficult dimension of creativity to achieve because it requires the ability to go beyond conventional thinking patterns.

When viewed across situations, the results show that students with moderate abilities tend to display better creativity in situations that provide a balance between openness and clarity of information. Situations that are too open actually make students hesitate in developing ideas, while situations that are too structured limit the opportunities for variation and novelty. These findings reinforce the problem posing framework stated by Stoyanova & Ellerton (1996) that the



design of the situation greatly determines the quality of the resulting problem submission. A balanced situation between openness and clarity of information provides the best opportunity for the emergence of variety and novelty of ideas (Dewi & Marsigit, 2018); Maharani et al., 2018).

Overall, the pattern of creativity in submitting mathematics problems for students with medium abilities is characterized by sufficient fluency, limited flexibility, and low novelty, with variations influenced by the characteristics of the situation. These findings are consistent with the results of previous studies, which affirm that the development of students' mathematical creativity requires the design of problem posing situations that are gradual, adaptive, and deliberately directed to encourage variation and novelty of ideas.

CONCLUSION

This study shows that the creativity of mathematical problem submission of students with the ability is forming a distinctive pattern across situations. In general, students with moderate abilities are able to ask mathematical problems that are relevant to the given situation, but the quality of creativity displayed is still at a moderate level. The fluency aspect is relatively more visible than other aspects, while flexibility and novelty still show limitations, especially in producing a variety of ideas and problems that are not routine.

The results of the study also revealed that the characteristics of the situation affect the emergence of creativity in problem solving. Moderately gifted students tend to show better creativity in situations that provide a balance between openness and clarity of information. Overly structured situations limit the variety of ideas, while overly open situations tend to create doubts in formulating problems. These findings confirm that creativity in problem solving is not only determined by individual abilities, but also by the design of learning situations.

Based on these findings, the development of mathematics learning needs to deliberately design a gradual and adaptive problem posing activity to encourage increased flexibility and novelty of ideas, especially for students with moderate abilities. By providing a varied and directed situation, mathematics learning is expected to be more optimal in developing students' mathematical creativity in a sustainable manner.

REFERENCES

Amalina, I., Amirudin, M., & Budiarto, M. (2018). Students' Creativity: Problem Posing in Structured Situation. *Journal of Physics: Conference Series*, 947. <https://doi.org/10.1088/1742-6596/947/1/012012>



- Azlina, N., Amin, S., & Lukito, A. (2018). Creativity of Field-dependent and Field-independent Students in Posing Mathematical Problems. *Journal of Physics: Conference Series*, 947. <https://doi.org/10.1088/1742-6596/947/1/012031>
- Brown, S. I., & Walter, M. I. (2005). *The Art of Problem Posing* (3rd Edition). Psychology Press. <https://doi.org/10.4324/9781410611833>
- Daiana, P., Surahmat, S., & Fathani, A. H. (2021). Profile of Students' Mathematical Creative Thinking Ability in Solving Mathematical Problem. *Formatif: Jurnal Ilmiah Pendidikan MIPA*. <https://doi.org/10.30998/formatif.v11i1.7810>
- Dewi, H., & Marsigit. (2018). Mathematical creative thinking and problem posing: an analysis of vocational high school students' problem posing. *Journal of Physics: Conference Series*, 1097. <https://doi.org/10.1088/1742-6596/1097/1/012134>
- Findell, B., Swafford, J., & Kilpatrick, J. (2001). *Adding it up: Helping children learn mathematics*. National Academies Press.
- Leung, S. S. (1997). On the role of creative thinking in problem posing. *ZDM*, 29(3), 81–85. <https://doi.org/10.1007/s11858-997-0004-9>
- Leung, S. S., & Silver, E. A. (1997). The role of task format, mathematics knowledge, and creative thinking on the arithmetic problem posing of prospective elementary school teachers. *Mathematics Education Research Journal*, 9(1), 5–24.
- Maharani, R., Siswono, T., & Rahaju, E. B. (2018). Studentsr Creative Thinking in Posing Mathematical Problem with Different Context. <https://doi.org/10.2991/miseic-18.2018.13>
- Runco, M. A., & Jaeger, G. J. (2012). The Standard Definition of Creativity. *Creativity Research Journal*, 24(1), 92–96. <https://doi.org/10.1080/10400419.2012.650092>
- Sa'dijah, C., Handayani, U. F., Sisworo, Sudirman, Susiswo, Cahyowati, E. T. D., & Sa'diyah, M. (2019). The Profile of Junior High School Students' Mathematical Creative Thinking Skills in Solving Problem through Contextual Teaching. *Journal of Physics: Conference Series*, 1397. <https://doi.org/10.1088/1742-6596/1397/1/012081>
- Sesanti, N., & Marsitin, R. (2018). Analysis of Creative Thinking Ability of Primary School Department Student on Proposing Mathematics Problem. 49–53. <https://doi.org/10.2991/incomed-17.2018.11>
- Silver, E. A. (1994). On mathematical problem posing. *For the Learning of Mathematics*, 14(1), 19–28.
- Silver, E. A. (1997). Fostering creativity through instruction rich in mathematical problem solving and problem posing. *ZDM*, 29(3), 75–80. <https://doi.org/10.1007/s11858-997-0003-x>



- Silver, E. A., & Cai, J. (2005). Assessing students' mathematical problem posing. *Teaching Children Mathematics*, 12(3), 129–135.
- Siswono, T. Y. E. (2008). Model pembelajaran matematika berbasis pengajuan dan pemecahan masalah untuk meningkatkan kemampuan berpikir kreatif. Surabaya: Unesa university press.
- Siswono, T. Y. E. (2011). Level of student's creative thinking in classroom mathematics. *Educational Research and Reviews*, 6(7), 548.
- Stoyanova, E., & Ellerton, N. F. (1996). A framework for research into students' problem posing in school mathematics. *Technology in Mathematics Education*, 4(7), 518–525.
- Yayuk, E., Purwanto, As'ari, A., & Subanji. (2020). Primary School Students' Creative Thinking Skills in Mathematics Problem Solving. *European Journal of Educational Research*, 9, 1281–1295. <https://doi.org/10.12973/eu-jer.9.3.1281>

