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Journal of Mathematics Instruction, Social Research and Opinion Vol. 5, No. 1, March 2026, pp. 97 – 104, https://doi.org/10.58421/misro.v5i1.1022 ISSN 2962-7842 97 Journal homepage: https://journal-gehu.com/index.php/misro Profile of Students' Mathematical Creative Thinking Ability in Solving Open-Ended Problems

Wina1, Neneng Tita Rosita2, Lia Yuliawati3 1,2,3Universitas Sebelas April, Sumedang, Indonesia Article Info ABSTRACT Article history: Received 2025-12-20 Revised 2026-01-13 Accepted 2026-01-15

This study aimed to describe the profile of students' mathematical creative thinking skills in solving open-ended problems on data presentation. Mathematical creative thinking was analysed based on four creativity indicators proposed by Torrance: fluency, flexibility, originality, and elaboration. The research employed a descriptive qualitative approach and was conducted at SMP Negeri 2 Pamulihan. The research subjects consisted of 32 seventh-grade students selected through purposive sampling to represent four categories of creative thinking ability: highly creative, creative, moderately creative, and less creative. Data were collected using a mathematical creative thinking skills test, task-based interviews, and observations of students' problem-solving processes. Data analysis was conducted through data reduction, data display, and conclusion drawing, supported by the triangulation of techniques and data sources to ensure validity. The results indicated that students' mathematical creative thinking skills varied across categories. Students in the highly creative category achieved an overall score of 34.375% across all creativity indicators, demonstrating the ability to generate diverse ideas, apply multiple problem-solving strategies, produce original solutions, and present detailed and systematic explanations. Students in the creative category achieved the highest percentage, 37.5%, showing strong performance particularly in fluency and flexibility, although originality and elaboration were not consistently demonstrated. Students in the moderately creative category obtained a score of 9.375%, indicating limited creative thinking skills that were mostly confined to fundamental indicators, with minimal originality and elaboration. Meanwhile, students in the less creative category achieved 18.75%, characterised by reliance on a single strategy and brief, superficial explanations.

Keywords: Ability Profile Data Presentation Mathematical Creative Thinking Open-Ended

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1. INTRODUCTION The advancement of science and technology in the era of Industry 4.0 and Society 5.0 demands that education develop students’ higher-order thinking skills, including creative thinking [1]. In mathematics learning, mathematical creative thinking is an essential competence because it is not only oriented towards achieving correct answers but also on the ability to generate various ideas, strategies, and representations in solving non-routine problems [2], [3]. This ability is necessary for students to tackle complex and dynamic contextual problems [4]. Mathematical creative thinking is a form of divergent thinking that involves several key indicators, namely fluency in generating ideas, flexibility in applying different approaches, originality of solutions, and the ability to elaborate and explain ideas systematically [5], [6]. Students with strong mathematical creative thinking skills tend to be able to connect concepts, select appropriate strategies, and communicate their thought processes logically and systematically [7]. One effective approach to foster and reveal mathematical creative thinking skills is the use of open-ended problems [8]. Open-ended problems provide students the opportunity to produce more than one correct answer and employ diverse problem-solving strategies, thus allowing differences in individual thinking to emerge [3], [9]. Several studies have shown that solving open-ended problems can help identify variations in students’ mathematical creativity based on their fluency, flexibility, and originality of ideas [10]. Recent research indicates that the use of open-ended problems can not only develop but also more comprehensively reveal students’ mathematical creative thinking skills in junior high school, particularly in the indicators of fluency, flexibility, originality, and elaboration [11], [12]. However, mathematics learning in schools is still dominated by routine, procedural problems that require a single correct answer [13]. This situation causes students to be less trained in flexible and creative thinking because

they are accustomed to following existing solution examples [14], [15]. As a result, mathematical creative thinking skills, especially in terms of originality and elaboration, have not developed optimally [16]. Previous studies generally focus on the influence of specific learning models or approaches on the improvement of mathematical creative thinking skills. However, research that thoroughly describes the profile of students' mathematical creative thinking abilities based on creativity indicators through solving open-ended problems, particularly on the topic of data presentation in junior high school, remains limited. Moreover, some studies tend to emphasise test results without integrating qualitative analyses of students' thinking processes through interviews and observations. Therefore, this study offers novelty in the form of a comprehensive analysis of students' mathematical creative thinking profiles, examined through an integration of open-ended problem tests, task-based interviews, and problem-solving observation. This study aims to describe the profile of students' mathematical creative thinking skills in solving open-ended problems on data presentation material, viewed from the indicators of fluency, flexibility, originality, and elaboration.

2. METHOD

This study employed a descriptive qualitative approach. The descriptive qualitative approach is employed to understand and portray the phenomenon under study in depth, based on natural conditions without the manipulation of variables. Qualitative research emphasises meaning, processes, and understanding the social context from the perspective of research participants [17]. Furthermore, descriptive qualitative research aims to provide a systematic, factual, and accurate depiction of the facts and characteristics of a particular phenomenon as it exists [18]. This approach is suitable for educational research because it can provide in-depth insights into learning processes, interactions, and students' responses [19]. Therefore, the descriptive qualitative approach was chosen as it enables the researcher to gain a comprehensive understanding of the phenomenon through the collection of data in the form of words, actions, and relevant documents. This study aimed to describe the profile of students' mathematical creative thinking skills in solving open-ended problems related to data presentation. The research was conducted at SMP Negeri 2 Pamulihan, Sumedang Regency. The subjects consisted of 32 seventh-grade students who participated in the mathematical creative thinking skills test. 1 Based on the test results, four students were selected as the primary research subjects using purposive sampling, each representing the categories of highly creative, creative, moderately creative, and less creative. The selection was based on the consideration that these students could represent the characteristics of each category and provide relevant information for the study's objectives. This aligns with Patton [20], who stated that purposive sampling emphasises the selection of information-rich cases, and Creswell and Poth [17], who stressed that this technique is used to choose subjects who best understand the phenomenon under investigation. Based on this grouping, one student from each category was selected as the main subject for in-depth analysis. Table 1. Assessment Criteria for Mathematical Creative Thinking Skills Test Criteria Score Range Number of Students Highly Creative 13 – 16 11 Creative 9 – 12 12 Moderately Creative 5 – 8 3 Less Creative 0 – 4 6 Source: Guilford [5], Torrance [6] The research instruments consisted of a mathematical creative thinking skills test, in the form of four open-ended essay questions, developed based on Torrance's indicators of creative thinking: fluency, flexibility, originality, and elaboration. Each question was designed to measure one specific indicator, as presented in the Indicator and Instrument Table. Assessment of mathematical creative thinking skills referred to a scoring rubric used to classify students into four ability categories, as shown in the Assessment Criteria Table. Supporting instruments included task-based interview guidelines and observation sheets to uncover students' thinking processes while solving the problems.

https://doi.org/10.58421/misro.v5i1.1022 100 Table 2. Descriptive Statistics of Mathematical Creative Thinking Skills Test Scores Statistic Value Mean 10.4 Standard Deviation 4.1 Minimum 2.0 Maximum 16.0 Data were collected through written tests, interviews, and observations of the problemsolving process. Data analysis was conducted using the interactive analysis model of Miles, Huberman, and Saldaña, which includes data reduction, data display, and conclusion drawing. The analysis linked test results and interview data for each indicator of mathematical creative thinking. Data validity was ensured through source and technique triangulation, as well as member checking to confirm the consistency and credibility of the research findings. 3. RESULTS AND DISCUSSION 3.1. Results The research results were obtained through the analysis of the mathematical creative thinking skills test, task-based interviews, and observation of the problem-solving process in response to open-ended questions related to data presentation. The analysed data were processed and classified based on the indicators of mathematical creative thinking, namely fluency, flexibility, originality, and elaboration. 1 Based on the test results from 32 students, variations in mathematical creative thinking abilities were identified and classified into four categories: highly creative, creative, moderately creative, and less creative. The distribution of students' abilities was varied. Eleven students were classified as highly creative, 12 students as creative, 3 students as moderately creative, and 6 students as less creative. The distribution of students' mathematical creative thinking ability categories is presented in Table 1. Table 1. Profile of Students' Mathematical Creative Thinking Skills Subject Fluence Flexibility Originality Elaboration Category S1 High High High High Highly Creative S2 High High Medium Medium Creative S3 Medium Medium Medium Low Moderately Creative S4 Low Low Low Low Less Creative Based on the analysis of the mathematical creative thinking skills test and task-based interviews, a varied profile of students' mathematical creative thinking abilities was obtained for each research subject. A summary of the achievement of the indicators—fluency, flexibility, originality, and elaboration—for each subject is presented in Table 3. This variation highlights differences in the characteristics of students' mathematical creative thinking processes when solving open-ended problems related to data presentation. Below is a table of the responses from four students to support the analysis of the mathematical creative thinking skills test and interviews.

https://doi.org/10.58421/misro.v5i1.1022 101 Figure 1. Responses of Student 1 Subject S1, who is classified as highly creative, demonstrated fulfilment of all indicators of mathematical creative thinking. S1 [1] was able to generate various problemsolving ideas (fluency), apply diverse data presentation strategies flexibly (flexibility), produce uncommon solutions (originality), and explain the problem-solving process in a detailed and systematic manner (elaboration). Figure 2. Responses of Student 2 Subject S2, who is categorised as creative, demonstrated strong abilities in the fluency and flexibility indicators but showed limited performance in originality and elaboration. S2 [1] was able to generate more than one problem-solving strategy; however, the ideas presented tended to be general, and the explanations provided were not yet detailed. Figure 3. Responses of Student 3

https://doi.org/10.58421/misro.v5i1.1022 102 Subject S3, who is in the moderately creative category, showed relatively balanced but not yet optimal achievement across the indicators of mathematical creative thinking. S3 [1] was able to generate basic ideas and strategies for problem-solving, but did not demonstrate significant originality and still experienced difficulties in detailing the problem-solving steps. This condition indicates that students with moderate creativity tend to be in a transitional stage in developing mathematical creative thinking skills, where fluency and flexibility are beginning to develop, but originality and elaboration have not yet been fully formed. Overall, the fluency indicator was relatively easier for students to achieve compared to flexibility, originality, and elaboration. The most noticeable differences were observed in originality and elaboration. These findings highlight the importance of using open-ended problems continuously to encourage students to explore ideas and fully develop their mathematical creative thinking skills. 3.2. Discussion The results of this study indicate variations in students' mathematical creative thinking skills when solving open-ended problems on data presentation. From the 32 students who participated in the test, the distribution of abilities varied, with 11 students classified as highly creative, 12 as creative, 3 as moderately creative, and 6 as less creative. A more detailed analysis of the four main subjects (S1, S2, S3, and S4) revealed diverse profiles in each of the four indicators: fluency, flexibility, originality, and elaboration. Subject S1, categorised as highly creative, demonstrated high achievement across all indicators. S1 [1] was able to generate multiple ideas (fluency), apply various data presentation strategies flexibly (flexibility), produce original solutions (originality), and explain the problem-solving process in a detailed and systematic manner (elaboration). These findings align with previous studies showing that students with high mathematical creativity tend to integrate all four creative thinking indicators simultaneously in problem-solving [9], [11]. Moreover, this supports the view that mathematical creativity is reflected in the ability to generate diverse solutions and alternative strategies with meaningful explanations [3], [5], [6]. Subject S2, categorised as creative, showed strong skills in fluency and flexibility but had limited originality and elaboration. This student could produce more than one strategy; however, the ideas were still general, and the explanations were not detailed. This finding is consistent with prior research indicating that students at a moderate level of creativity tend to exhibit fluency and flexibility more easily than originality and detailed explanations [3], [7]. Flexibility in problem-solving usually develops earlier, whereas originality and elaboration require more experience and conceptual depth. Subject S3, categorised as moderately creative, demonstrated relatively balanced achievement across indicators, but performance was not yet optimal. This student could generate basic ideas and strategies, yet originality was limited, and detailing the problemsolving steps was challenging. These results indicate that students in this category are in a transitional stage of developing mathematical creative thinking, where fluency and flexibility begin to develop, but originality and elaboration are not yet fully formed [7], [11].

 Students in this category generally require scaffolding to develop their originality and elaboration optimally. Subject S4, categorised as less creative, showed limitations across all indicators. This student relied on a single strategy, did not produce new ideas, and provided brief and unsystematic explanations. This finding supports previous research indicating that students whose learning experience is dominated by routine and procedural problems tend to have low mathematical creative thinking skills [9], [21]. Limited exposure to non-routine and open-ended problems results in insufficient training in fluency, flexibility, originality, and elaboration. Overall, the fluency indicator was relatively easier for students to achieve compared to flexibility, originality, and elaboration, with the most noticeable differences observed in originality and elaboration. This suggests that the continuous use of open-ended problems is essential to encourage students to explore ideas and develop comprehensive mathematical creative reasoning. These findings align with those of Rahayuningsih et al. [11] and Darmawijoyo [22], who stated that differences in students' mathematical creative thinking profiles become more apparent when open-ended problems are used, particularly in terms of originality and elaboration, which tend to be more challenging for students than other indicators. 4. CONCLUSION In line with the research objectives, the results indicate that students' mathematical creative thinking skills in solving open-ended problems on data presentation exhibit clear variations across each creativity indicator. Students in the highly creative category were able to optimally fulfil all indicators of mathematical creative thinking, namely fluency, flexibility, originality, and elaboration. Students in the creative and moderately creative categories showed uneven achievement across indicators, particularly in originality and elaboration, while students in the less creative category had not yet demonstrated developed creative thinking skills. These findings confirm that the use of open-ended problems is effective in both revealing and fostering students' mathematical creative thinking, especially by providing opportunities for exploring diverse ideas and problem-solving strategies. Therefore, mathematics instruction should consistently integrate open-ended problems so that students' mathematical creative thinking skills can develop more optimally and evenly. REFERENCES [1] H. Meissner, 'Creativity in Mathematics Education', in The Proceedings of the 12th International Congress on

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