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The Creative Thinking Process of Elementary School Students in Solving Mathematics Story Problems Reviewed from Learning Styles

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ABSTRACT

Current elementary school mathematics instruction tends to be procedural and homogenous, thus under-facilitating diverse learning styles and impacting students' low mathematical creative thinking skills in solving word problems. This study aims to in-depth describe elementary school students' creative thinking processes in solving math word problems, considering their visual, auditory, and kinesthetic learning styles. Using a qualitative approach with a phenomenological design, this study involved sixth-grade students at Pamuruyan 9 Elementary School, Sukabumi Regency. The sample was selected using a snowball sampling technique based on a learning style questionnaire, resulting in six students representing the three dominant learning modalities. Data analysis applied Moustakas' phenomenological model (epoche, horizontalizing, categorization, textual-structural description, and conclusion drawing). The results showed that elaboration was the most dominant indicator across all subjects, while fluency and flexibility showed the greatest variation across learning style groups. The novelty of this study lies in its comprehensive mechanistic mapping of the navigation of creative components based on learning modalities at the elementary school level. The implication emphasizes the importance of implementing differentiated learning based on learning styles to optimize students' potential and mathematical creative thinking abilities.

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1. INTRODUCTION

Education in the 21st century requires students to master higher order thinking skills, including creative thinking, as an essential part of developing competitive human resources [1], [2]. In mathematics, this demand is reflected in the need for students to solve contextual story problems creatively, not merely by following procedural formulas [5], [7]. However, elementary mathematics learning still tends to be procedural, homogeneous, and less exploratory, which limits students' fluency, flexibility, originality, and elaboration in solving mathematical story problems [10], [11].

This problem is reinforced by the diversity of students' learning styles. Visual, auditory, and kinesthetic learners process mathematical information differently, yet classroom practices often use one general approach and provide limited differentiated support [14]–[18]. As a result, students whose learning modalities are not accommodated may find it difficult to express creative ideas and solution strategies optimally.

Previous studies have discussed creative thinking, problem solving, and learning styles, but research that maps the creative thinking process of elementary students in solving mathematical story problems based on visual, auditory, and kinesthetic learning styles remains limited [23], [29], [38]. This gap is important because elementary school students are still in a concrete operational stage and need learning experiences that match the way they receive and process information [19].

The novelty of this study lies in its detailed mapping of how each learning style navigates the four creative thinking indicators: fluency, flexibility, originality, and elaboration. Therefore, this study aims to describe in depth the creative thinking process of elementary school students in solving mathematical story problems reviewed from their learning styles, so that the findings can support more responsive and differentiated mathematics learning.

2. LITERATURE REVIEW

2.1 *Learning Style*

Learning style refers to an individual's learning style or characteristics that affect how students receive, process, and store information [24]. Based on previous research on the influence of learning style on learning outcomes, several studies concluded that there was no significant difference in thematic learning outcomes between students with visual, auditory, and kinesthetic learning styles [25].

In addition, Rokhimah & Rejeki (2018) stated that learning style does not have a significant effect on the critical thinking ability of elementary school students. However, certain learning styles can affect students' tendency to do academic procrastination, especially in math subjects [27]. Efforts to adapt learning methods to students' learning styles can increase the effectiveness of the teaching and learning process, one of which is the application of a Problem-Based Learning approach that is suitable for students with an accommodating learning style [28].

Based on the preliminary study, the description of students' mathematical problem-solving abilities is reviewed from the following learning styles: (1) visual students can understand problems well, draw up appropriate solution plans, execute the plan correctly, and re-examine the answers that have been made. (2) Auditor students can understand the problem well, prepare the right solution plan, implement the plan correctly, but do not carry out the stage of rechecking the answers. (3) Auditory students can understand the problem well, are not able to write a solution plan correctly, are not able to carry out the steps of the solution plan, and re-check the answers that have been made. This means reinforcing the theory that learning styles affect students' ability to solve math problems [29].

2.2 *Creative Thinking*

Creative thinking is the ability to generate new ideas, innovative solutions, and different approaches to solving problems. These skills are essential in facing the challenges of the 21st century and the era of the industrial revolution 4.0, where students are required to be able to adapt, innovate, and think outside the box [30], [31]. The creative thinking process can be analyzed through the stages of Wallas, namely: preparation, incubation, illumination, and verification. Each individual can show differences in this process depending on the personality type, where the rational type tends to be quicker in understanding problems and developing new ideas [32].

Based on preliminary studies, the application of various problem-based, project, and contextual learning models has been shown to significantly improve creative thinking skills [30], [33], [34], [35], [36], [37]. Research by Ishabu [38] Aims to describe the creative thinking process of elementary school students in solving mathematical problems. The subjects of this study are female students who have a visual learning style with the consideration that the subject can produce flexible products, but not exceptional products that meet the aspects of fluency and novelty. Data collection was carried out through in-depth tests and interviews. Data validity is carried out by data triangulation technique. The collected data is analyzed by transcription, categorization, reduction, interpretation and conclusion. The results of the study show that the creative thinking process of elementary school students in solving mathematical problems is realized through the generation of ideas (reading and observing pictures in the problem) to identify information that is already known, using different approaches to plan problem-solving, and producing creative products that meet the flexibility aspect. However, the product has not yet met the aspects of smoothness and novelty. This research supports the urgency of the topics raised in this thesis and becomes a similar study that underlies the direction of further research.

2.3 *Math Story Questions*

Solving math problems involves a creative thinking process that consists of several stages: preparation (gathering information and translating problems), incubation (building ideas and connecting concepts), illumination (designing and implementing ideas), and verification (testing solutions and drawing conclusions). This process utilizes symbolic and visual representations, as well as students' visual-spatial intelligence [39]. The use of story problems in mathematics learning can improve numeracy literacy and relate mathematics to real life. However, teachers need to pay attention to students' reading and comprehension skills and provide structured exercises so that students get used to translating stories into proper mathematical models [40], [41]. Mathematics story problems are an important tool to measure students' problem-solving skills and understanding of mathematical concepts. However, the success of students in solving this problem is greatly influenced by the ability to read, understand concepts, and solve strategies used.

3. METHODS

This study uses a qualitative approach to phenomenological design. The phenomenological design was chosen to try to reveal the meaning formed by students during the process of solving mathematical story problems. This approach not only traces what students do, but also how and why they choose certain strategies, as well as how their learning styles affect that thought process. Qualitative research is a research method that is carried out in natural settings because social reality is seen as something holistic, whole, complex, dynamic, and meaningful. In the process, the researcher acts as a human instrument that collects data through observation, interviews, and documentation, and uses triangulation to ensure the validity of the data [42]. Thus, this research does not emphasize on generalization, but on the meaning of the phenomenon being studied. This approach was chosen to examine in depth how elementary school students experience and interpret the creative thinking process when solving math story problems, as well as how this process is influenced by each student's learning style in a real learning context.

The research was carried out at SD Negeri 9 Pamuruyan, Sukabumi Regency, West Java with criteria that have been determined and selected *purposively.* The subject of this study is grade VI students selected using *snowball sampling*, which is the deliberate selection of research subjects based on certain characteristics. The data collection technique used a written test with a think tank and observation protocol, task-based in-depth interviews, documentation studies, and learning style questionnaires, Data analysis refers to the Moustakas phenomenological model which includes the stages of *epoche* (removing prejudices), *horizontaling* (identification of meaningful statements), thematic categorization/coding, preparation of textual-structural descriptions, and drawing essential conclusions. The validity of the data is guaranteed through triangulation (sources, techniques, time), *member checking*, *trail audits*, and *prolonged engagement*.

4. RESULTS AND DISCUSSION

4.1 *Results*

The creative thinking test used in this study aims to identify students' creative thinking processes when solving math story problems. Before carrying out the test of students' creative thinking processes, the researcher carried out an initial test to determine the main subject of the study. The initial test was tested on all grade VI students of SD Negeri 9 Pamuruyan which amounted to 27 students. The test questions are in the form of 4 open-ended description questions.

Based on the results of the test given to 27 students in the form of 4 mathematical story questions to measure students' creative thinking skills in solving Mathematics problems. Question material about constructing cubes and blocks. From the results of the test conducted, an overview was obtained that all have the potential for creative thinking skills because all students meet all creative thinking indicators. But if observed based on the answers given by students, there are various levels in each indicator. The assessment is carried out based on four main indicators, namely:

a. Fluency: the ability to come up with a variety of ideas or solutions strategies.
b. Flexibility: the ability to use a variety of approaches to solve problems.
c. Originality: the ability to come up with unique and unusual ideas.
d. Elaboration: the ability to detail and expand an idea into a complete and in-depth solution.

Table 1. Results of the Initial Test of Students' Creative Thinking Ability

No.	Student Code	Analysis Results			
		Fluency	*Flexibility*	*Originality*	*Fluency*
1	S1	√	√	√	√
2	S2	√	√	√	√
3	S3	√	√	√	√
4	S4	√	√	√	√
5	S5	√	√	√	√
6	S6	√	√	√	√
7	S7	√	√	√	√
8	S8	√	√	√	√
9	S9	√	√	√	√
10	S10	√	√	√	√
11	S11	√	√	√	√
12	S12	√	√	√	√
13	S13	√	√	√	√
14	S14	√	√	√	√
15	S15	√	√	√	√

No.	Student Code	Analysis Results			
		Fluency	*Flexibility*	*Originality*	*Fluency*
16	S16	√	√	√	√
17	S17	√	√	√	√
18	S18	√	√	√	√
19	S19	√	√	√	√
20	S20	√	√	√	√
21	S21	√	√	√	√
22	S22	√	√	√	√
23	S23	√	√	√	√
24	S24	√	√	√	√
25	S25	√	√	√	√
26	S26	√	√	√	√
27	S27	√	√	√	√

Source: Researcher Data Processing (2026)

Based on the results of the learning style questionnaire, the learning style tendency of students of SDN Pamuruyan wa obtained as presented in the following table:

Table 2. Learning Style Questionnaire Results

No.	Student Code	Score			Learning Styles
		Visual	Auditory	Kinesthetic	
1	S1	28	27	32	Kinesthetic
2	S2	24	25	29	Kinesthetic
3	S3	29	28	26	Visual
4	S4	30	27	31	Kinesthetic
5	S5	31	25	30	Visual
6	S6	29	36	21	Auditory
7	S7	34	27	21	Visual
8	S8	31	23	22	Visual
9	S9	25	26	28	Kinesthetic
10	S10	28	30	29	Auditory
11	S11	27	30	35	Kinesthetic
12	S12	26	32	31	Auditory
13	S13	31	32	31	Auditory
14	S14	32	19	30	Visual
15	S15	31	25	28	Visual
16	S16	28	29	29	Auditory
17	S17	23	21	26	Kinesthetic
18	S18	29	26	28	Visual
19	S19	27	21	29	Kinesthetic
20	S20	24	24	25	Kinesthetic
21	S21	23	26	25	Auditory
22	S22	34	28	31	Visual
23	S23	30	25	31	Kinesthetic
24	S24	32	34	32	Auditory
25	S25	24	24	27	Kinesthetic
26	S26	22	27	34	Kinesthetic
27	S27	26	24	22	Visual

Source: Researcher Data Processing (2026)

From these results, it is known that most students have a tendency towards kinesthetic learning styles, which means they understand information more easily through hands-on practice and concrete experiences. However, the visual learning style is quite prominent and there are some students who have an auditory learning style, this shows that the variety of learning styles is quite diverse in one class. Based on the results of the creative thinking test and learning style questionnaire, 6 students were selected as the main subjects of the research. This selection considers three main learning styles, (Visual 2 people, Auditory 2 people and Kinesthetic 2 people). The researcher encoded the subject as listed in the following table.

Table 3. Research Subject

No	Student Code	Subject Code	Learning Style
1	S5	*SV1*	Visual
2	S14	*SV2*	Visual
3	S10	*SA1*	Auditory
4	S13	*SA2*	Auditory
5	S17	*SK1*	Kinesthetic
6	S25	*SK2*	Kinesthetic

Based on the analysis of the results *of the think tank test* and in-depth interviews on 6 main subjects, the pattern of the creative thinking process was obtained as follows:

a. Students with Visual Learning Styles *(SV1 & SV2)*

In the *Fluency and Flexibility* indicators, students are able to produce 3 forms of logical building nets/constructions. Understanding a problem relies heavily on visual representations (redrawing information or sketching out a scribble on an answer sheet). *An indicator of Originality & Elaboration* is that the resulting ideas are quite original and spatially detailed, although *SV1* is still at a moderate level of fluency due to the limitations of form variations in complex problems.

b. Students with Auditory Learning Styles *(SA1 & SA2)*

In the *indicators of Fluency and Flexibility*, students have fulfilled all indicators well. The process of coming up with ideas is carried out by reading story problems repeatedly (whispering or sounding) to understand the structure of mathematical sentences. The *student's Originality & Elaboration indicator* is able to explain the solution argument in a concise and logical manner during the interview, even though the draft of the visual scribble is not as dense as the visual learner.

c. Students with Kinesthetic Learning Styles *(SK1 & SK2)*

The *Fluency and Flexibility* indicators SK1 meet all aspects well, while SK2 tends to be weak in the flexibility aspect. Students with kinesthetic learning styles have a distinctive characteristic that students process information by making physical movements (*the hands-on simulation* method of shadow), such as moving their hands or tapping a table to illustrate the folding of the dimensions of cubes/blocks before being poured into writing.

4.2 Discussion

Based on the results of research on the creative thinking process of six subjects in solving mathematical story problems, it was found that the characteristics of students' learning methods have an important role in influencing how the creative thinking process is formed during the completion of mathematical story problems. Each visual, auditory, and kinesthetic learning styles showed a different tendency of thinking patterns towards four creative thinking indicators, namely fluency, flexibility, originality, and elaboration. Thus, learning style is one of the factors that affect how students' mathematical creativity is manifested. There are significant mechanistic differences in how students navigate the creative thinking component based on their learning modalities. Visual students excel in transforming story problems into pictorial/geometric representations. Auditory students rely on the power of internal linguistics through verbal reading to find math keywords. Meanwhile, kinesthetic students require motor involvement or physical action-based spatial visualization to break the deadlock (*stuck*) thought.

This study found that *elaboration* is the most prominent indicator of creative thinking because most students are able to explain problem solving sequentially, in detail, and logically as a form of their cognitive reflection. On the other hand, *the fluency* and *flexibility indicators* show the greatest variability between students; *Fluency* is more influenced by confidence than pure mathematical ability, while *flexibility* and courage to switch strategies are highly dependent on the student's level of metacognition and self-regulation. Furthermore, the *originality* of ideas does not appear evenly but is strongly tied to the dominant learning style of each student, where kinesthetic students rely on spatial intuition and concrete experience, auditory students on verbal-argumentative reflection, and visual students on graphic representations and procedural generalizations. Overall, these findings confirm that mathematical creativity is not universal, so its development will run optimally if the learning process provides space for students to access the thinking strategies that best suit their characteristics and learning modalities. All of these findings show that students' creative thinking process in solving mathematical story problems develops through the interaction between reasoning skills, learning styles, and thinking experiences during learning, not solely influenced by aspects of mathematical ability alone.

The findings of this study show a strong alignment with previous studies while making a deeper contribution to mathematical creativity and the influence of learning style on problem solving. The results of this study are consistent with Siswono's [43] about the importance of space for exploring ideas according to learning characteristics, and supporting the findings of Ishabu et al. [38] where visual students have distinctive cognitive traits in the form of excellence in aspects *elaboration* and step collapse although not always optimal in *fluency* and *originality*. In addition, this study expands the perspective of Wardhani et al. [44] and Zulnaidi & Zakaria [45] which previously focused on learning outcomes by proving that visual, auditory, and kinesthetic learning styles significantly affect every stage of the creative thinking process of students in solving story problems. Lastly, when compared to Firmansyah & Syarifah [29] The Just examining problem solving in general, this study makes a more comprehensive contribution because it manages to describe in detail how each learning style affects the way students build ideas based on indicators *fluency*, *flexibility*, *originality*, and *elaboration*. However, this research makes a new contribution by mapping the creative thinking process of elementary school students based on learning styles more comprehensively, especially in the context of solving mathematical story problems. By revealing the peculiarities of creative thinking patterns in visual, auditory, and kinesthetic students, this study succeeded in filling the study gap that had not been widely researched at the elementary school level.

5. CONCLUSION

This study confirms that elementary students' creative thinking in solving mathematical story problems shows distinct patterns across learning styles. Visual learners are strongest in elaboration through systematic visual representations, auditory learners show strength in explaining solution flows verbally but are less consistent in calculation procedures, while kinesthetic learners display more original ideas through concrete and movement-based representations. Across all subjects, elaboration is the most dominant indicator, whereas fluency and flexibility vary most across learning style groups. These findings imply that mathematics teachers need to design differentiated activities that provide visual sketches, verbal explanation space, and concrete manipulation opportunities according to students' learning modalities. The limitation of this study is the small number of subjects and its focus on one elementary school; therefore, future research should involve broader participants and test differentiated learning strategies to strengthen students' mathematical creative thinking.

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