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PROFILE OF STUDENTS' CREATIVE THINKING ABILITY ON FLAT BUILDING MATERIAL BASED ON LEARNING STYLE

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ABSTRACT
Mathematics education requires students to have creative thinking skills, which are indispensable in solving problems, adapting to change, and creating new ideas. In this study, students' creative thinking abilities in learning mathematics, especially in plane material, were assessed based on their learning style. This research aims to reveal students' creative thinking intelligence in plane material by considering their learning styles. The approach used in this research is qualitative, with the subjects consisting of three class VIII students at MTs Sunan Dalem Gumeno, who were selected based on filling out a questionnaire regarding learning styles. To collect data, the methods used include written tests, questionnaires and interviews. In analyzing data, the steps taken are data reduction, data presentation, and drawing conclusions. The research results show that each subject has a different creative thinking process including: (i) Students with a visual learning style based on indicators of fluency, flexibility and novelty show the creative category by producing four different and correct answers. (ii) Students with an auditory learning style show a fairly creative category, producing three different and correct answers. (iii) Students with a kinesthetic learning style show a less creative category by only producing two answers.
Keywords: creative thinking; flat shape; learning styles

ABSTRAK
Pendidikan matematika mengharuskan siswa untuk memiliki kemampuan berpikir kreatif, yang sangat krusial dalam pemecahan masalah, beradaptasi dengan perubahan, dan menciptakan ide-ide baru. Dalam kajian ini, kemampuan berpikir kreatif siswa yang ditinjau pada pembelajaran matematika, khususnya pada konsep bangun datar, dinilai berdasarkan gaya belajar yang mereka miliki. Penelitian ini memiliki tujuan untuk mengungkap kecerdasan berpikir kreatif siswa dalam konsep bangun datar dengan mempertimbangkan gaya belajar mereka. Pendekatan yang digunakan pada penelitian ini adalah kualitatif, dengan subjek yang terdiri dari tiga siswa kelas VIII di MTs Sunan Dalem Gumeno, yang dipilih berdasarkan pengisian angket terkait gaya belajar. Untuk mengumpulkan data, metode yang digunakan meliputi tes tulis, angket, dan wawancara. Dalam menganalisis data, langkah-langkah yang diambil adalah reduksi data, penyajian data, dan penarikan kesimpulan. Hasil temuan pada penelitian ini mengungkapkan bahwa setiap subjek memiliki proses berpikir kreatif yang berbeda-beda diantaranya: (i) Siswa dengan gaya belajar visual berdasarkan indikator kemampuan berpikir kreatif menunjukkan kategori kreatif dengan menghasilkan empat jawaban yang berbeda dan benar. (ii) Siswa dengan gaya belajar auditori menunjukkan kategori cukup kreatif, menghasilkan tiga jawaban yang berbeda dan benar. (iii) Siswa dengan gaya belajar kinestetik menunjukkan kategori kurang kreatif dengan hanya menghasilkan dua jawaban.
Kata kunci*: bangun datar; berpikir kreatif; gaya belajar*

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Introduction

Education is a means of ijtihad to uphold humanitarian values using easy-to-understand language, so that we can understand ourselves and our environment (Subaidi, 2017) . Therefore, education is the most basic need for every individual. Education is the process of changing behavior and mindset to shape human character and abilities (Inanna, 2018) . Education plays a crucial role in the development and self-actualization of individuals, as well as the progress of the nation and state as expressed by (Wijaya et al., 2016) . One of the scopes of education that is very essential in daily activities is mathematics. So it is not surprising that mathematics is a parameter for the success of the implementation of education in Indonesia (Sofiyah et al., 2025). During the implementation of the mathematics learning process, the main focus is not only related to learning outcomes, but also to efforts to develop mathematical skills, reasoning abilities, problem solving, mathematical representation and connecting ideas (Saniyyah & Winiati, 2020) .

Mathematics is often perceived as a complicated and stressful (Amanda et al., 2024). This is due to the lack of application of mathematics that is relevant to everyday life, making it seem like an abstract science, limited to formulas and numbers only (Andini et al., 2023). In addition, a passive learning atmosphere also contributes to the lack of student interest. These problems make mathematics often seen as challenging teaching materials. The teaching methods taught by teachers limit the space for students to explore innovative thinking in finding solutions to mathematical problem subjects (Ayu et al.,2021). Thus, it is important to change the learning approach to prioritize students' creative thinking processes. (Aprilyani & Hakim, 2020) . It should also be noted that mathematics has a very crucial role in the development of other disciplines, such as those related to mathematical concepts (Aprilyani & Hakim, 2020) .

Effective mathematics learning is not only centered on theory and formulas, but also requires the development of creative thinking skills in solving relevant problems (Astria & Kusuma, 2023). Creative thinking is none other than a critical skill that everyone should have in responding to changes in the global era filled with competition and challenges (Utami et al., 2020) . Creative thinking is a pattern of thinking that can be honed by stimulating imagination, opening up to new opportunities, presenting unique perspectives (Aisy & Ismah, 2021). Thus, we can produce unpredictable innovations (Astria & Kusuma, 2023) . To spur students' creative thinking in mathematics, we can use problem ideas in the form of flat shape questions. Questions about flat shapes have a way of solving, so that students can implement their creative mathematical thinking skills in identifying answers related to the topic (Hikmatulloh et al., 2023).

One of the topics in mathematics that can be used to evaluate students' creative thinking through concepts and methods is plane figures (Kholili et al., 2021). This is in line with the results of the study by Eviliasani et al. (2018) which revealed that students' creative thinking potential can be identified through the application of tests on the topic of plane figures, because students appear to be able to present new solutions in solving problems. The arrangement of relevant and complementary plane figures requires expertise in observing the complete picture of each existing element (Muhsetyo, 2016).

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Flat shapes have the potential to trigger students to think creatively, especially when they face problems in determining the area of a combination of flat shapes (Putri & Ratu, 2018). Thus, researchers conducted an in-depth analysis of students' innovative thinking skills in solving problems related to the topic of flat shapes at the junior high school level. This is an important reference for teachers to know and understand the characteristics of each student. Because the success or failure of the student's learning process can be influenced by the ability to understand these characteristics and the individual learning style of students (Isnawan & Wicaksono, 2018).

A person's success in developing a skill, especially creative thinking skills, is usually influenced by various elements, both internal and external. One of the several internal or internal aspects that can influence creative thinking skills is the individual's learning style (Purnomo, 2015). During the learning process, each student has a different approach in receiving, processing, and remembering information, as well as in solving problems. The difference in this approach reflects the learning style of each student, which plays a role in reducing obstacles to achieving success in the learning process (Wijayanti & Nalurita, 2024) . Generally, each student has a variety of learning methods, namely visual, auditory, and kinesthetic (Apipah & Kartono, 2017). Visual learning style involves the ability of the sense of sight, while the auditory learning method depends on the sense of hearing. On the other hand, the kinesthetic learning style is characterized by physical potential, activity, or touch. Among these three learning styles, each student must have varying preferences, although some may have similarities according to (Hakim & Nirwana, 2022) .

In this case, it is proven that learning style is also an important element in exploring the profile of students' creative thinking abilities. However, in reality, previous studies have discussed more about the effectiveness of learning methods by teachers without reviewing students' learning styles (Wijaya et al., 2016) . Based on this, this study is intended to fill the research gap related to the relationship between learning styles and students' creative thinking abilities and describe the process . With this study, it is expected that learning strategies can be applied more appropriately and optimally to develop students' creativity in mathematics.

Research Methods

This type of research is descriptive with a qualitative approach. The purpose of this study is to describe the potential for students' innovative thinking in dealing with mathematics problems, especially flat shape material, reviewed based on learning styles. The stages of this research include; (1) introduction, (2) preparation of instruments, (3) Validation, (4) Determination of research subjects, (5) implementation, (6) triangulation, (7) data analysis, (8) preparation of reports. This research was conducted at MTs Sunan Dalem Gumeno in the even semester of the 2024/2025 academic year with research subjects consisting of 18 grade VIII students. Sampling was carried out by identifying students' learning styles using questionnaires and considerations with subject teachers. The sample in this study consisted of 3 students. Each student represents one type of learning style, namely visual, auditory, and kinesthetic. The instruments applied to support this research

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process include; (1) questionnaires as a method of identifying students' learning styles, (2) written tests used to determine students' creative thinking abilities, (3) interviews to explore students' thinking patterns in solving problems. For data analysis techniques are carried out through data reduction, data presentation, and drawing conclusions. This study applies time triangulation, which involves the implementation of two tests and interviews at different times. Analysis of students' creative thinking abilities through learning styles can be reviewed in the creative thinking indicators shown in Table 1.

Table 1. Creative Thinking Indicators

Components of Creative Thinking	Student Abilities
Fluency	Students are able to solve problems using a variety of alternative solutions and answers.
Flexibility	Students are able to solve problems, which then use other alternative solutions.
Novelty	Students are able to correct answers with various alternative solutions or answers, which then create new alternatives.

Silver (in Purwandini et al., 2020)

Based on the Table 1., the indicators of creative thinking ability are used as a reference by researchers in designing questions that are arranged to explore the extent to which students can demonstrate fluency, flexibility and novelty in solving problems. These questions can be used as a benchmark for students' creative thinking ability as shown in Figure 1.

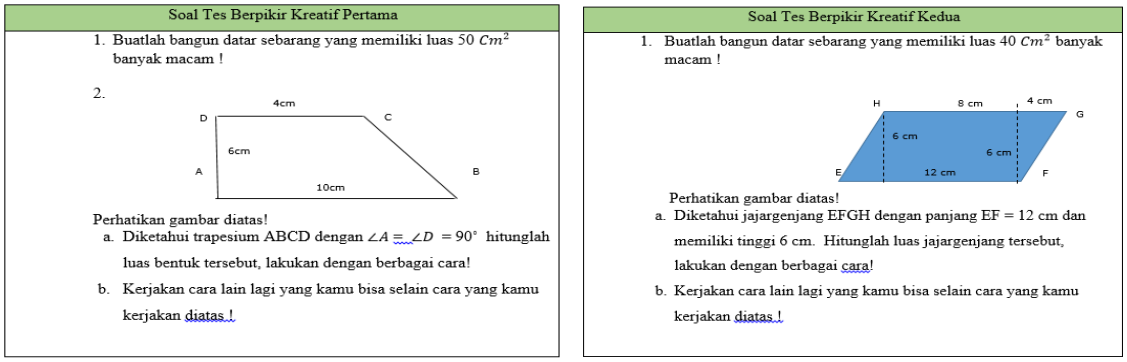

Figure 1. Creative Thinking Questions

Figure 1. Shows a right trapezoid and a parallelogram with the length, height and angles presented in a flat figure with various questions. These questions are intended to test students' creative thinking skills in calculating the area of a trapezoid and a parallelogram through various methods.

Results and Discussion

In class VIII MTs. Sunan Dalem Gumeno, there are 18 students who will be identified to be selected into three students based on learning styles and considerations from subject teachers. In general, the three students show creative thinking skills with different indicators through tests that have been distributed.

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Students with visual learning styles are included in the creative category because they are able to answer questions with various answers and provide four different answer solutions. Meanwhile, students with auditory learning styles are classified as quite creative because they are able to answer various types of questions with three different ways of solving. On the other hand, students with kinesthetic learning styles, can also provide various answers to the same question. Although their creativity is more limited, they can work with two ways of solving. The results of this finding state that students' creative thinking skills vary based on their learning styles. The following is the research subject data in Table 2. to provide a clearer picture of the differences in students' creative thinking based on learning styles.

Table 2. Research Subject Data

No	Subject	Fluency	Flexibility	Novelty	Category
1	V1	√	√	√	Creative
2	V2	√	√	√	Creative
3	A1	√	√	√	Quite Creative
4	A2	√	√	√	Quite Creative
5	K1	√	√	×	Lack of creativity
6	K2	√	√	×	Lack of creativity

With the following table description,

V1, V2 : Students who have a visual learning style
A1, A2 : Students who have auditory learning
K1. K2 : Students who have a kinesthetic learning style

Table 2. shows the category of students in providing the number of variations of solutions to the questions or problems given. Students who have a visual learning style have higher flexibility and novelty than students who have an auditory and kinesthetic learning style. This categorization is based on indicators of creative thinking skills. For more details, a discussion is presented regarding the correlation of students' creative thinking skills presented through the test questions worked on and their categories as follows.

1. Subjects *With Visual Learning Styles*

Students who have a visual learning style tend to have the ability to answer questions in a structured and systematic way through visual representations such as pictures, diagrams or certain patterns. The following are the results of the answers of the visual learning style subjects presented in Figure 2.

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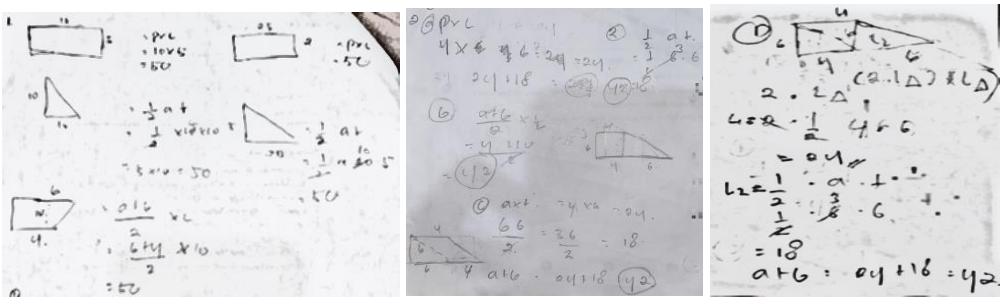

Figure 2. Results of Visual Learning Style Subject Work on the First Test

Figure 2 shows the results of the subject's work with a visual learning style in the first test (V1). Based on Figure 1, we can see that this subject has met the indicators of creative thinking, namely fluency, flexibility, and novelty. In Figure 2, it can be seen that subject V1 is able to solve problems using various solutions and methods of completion. The benchmark for ability can be seen from the various solutions found, using various flat shapes, such as rectangles, triangles, and trapezoids. The resulting answers reflect that subject V1 is able to solve problems well and provide various solutions. This subject successfully demonstrated the first solution with one method, then continued with three alternative solutions, namely applying the area formula for rectangles and triangles combined. In the second solution, the subject used the trapezoid area formula, while in the third solution, he combined the triangle area formula with the trapezoid area formula. Thus, subject V1 is indicated to have met the flexibility indicator. In addition, the innovative and unusual way applied by the subject in dividing the image using three combined triangles shows that V1 also meets the novelty indicator.

Based on the written results, it is proven that V1 can solve problems with various alternative answers and correct solutions. Therefore, V1 with the creative category has four solutions. After being given the first test, students with a visual learning style were given a second test to measure consistency in solving problems. The following are the results of the performance of visual learning style subjects on the second test in Figure 3.

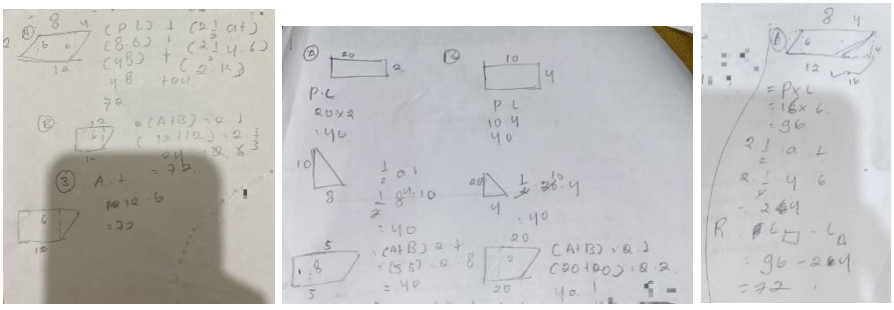

Figure 3. Visual Learning Style Subject Performance Results in the Second Test

Figure 3. shows the results of students' work using visual learning methods in the second test (V2). In the figure, it can be seen that the subject has met the benchmarks for creative thinking, namely fluency, adaptability, and

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innovation. Based on Figure 3, subject V2 can solve problems with more than one answer choice or solution method. The fluency indicator is reflected in the diversity of solutions and answers that use various geometric shapes, such as rectangles, triangles, and trapezoids. Subject V2's success in solving problems well and providing various solutions shows that he meets the fluency indicator. This subject is also able to show one solution, and put forward three other alternatives by applying the area formula for a rectangle and two triangles combined. This solution indicates that subject V2 also meets the flexibility indicator. Students' expertise in flexibility is seen when they evaluate the results with various solution approaches which then produce different answers. In addition, this subject uses a new or unusual approach, as seen in the figure, where he uses a combination of a rectangle and two triangles. This indicates that V2 meets the element of novelty, where they can present new solutions based on the answers they have given previously. All these results show that students' answers have been equipped with the understanding taught by the mathematics subject teacher.

Based on the research data on subject V2, it shows that V2 has solved challenges with various answers. The integration of various solution methods and accurate answers can indicate that V2 is classified as creative with four alternative solutions. These findings are also in line with research (Hikmatulloh et al., 2023) which states that students can be classified as creative in solving mathematics problems including students who use a visual learning style in their learning process and students who are able to show significant achievements in fluency indicators. Other studies also reveal that students are said to have creative thinking skills if they are able to solve problems in various ways based on student perceptions (Utami et al., 2020) .

To ensure the validity of the data on the subject of visual learning styles, triangulation was conducted to find the suitability between students' answers and the measured indicators. The following is table 3 regarding the triangulation data of the subject of visual learning styles.

Table 3. Triangulation Results Data of Visual Learning Style Subjects

Components of Creative Thinking	**Student Abilities**	**Subject V1**	**Subject V2**
Fluency	Students are able to solve problems using a variety of alternative solutions and answers.	Think creatively	Think creatively
Flexibility	Students are able to solve problems, which then use other alternative solutions.	Think creatively	Think creatively
Novelty	Students are able to correct answers with various alternative solutions or answers, which then create new alternatives.	Think creatively	Think creatively

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Table 3. shows that the triangulation method is able to show the suitability between data sources that support each other. This is shown through the work of the test answers and interviews by subjects who have met all indicators of creative thinking.

2. *Subjects with Auditory Learning Style*

Students with auditory learning styles tend to use oral explanation methods, discussions, and verbal thinking in understanding a question. The following are the results of the auditory learning style subjects' answers presented in Figure 4.

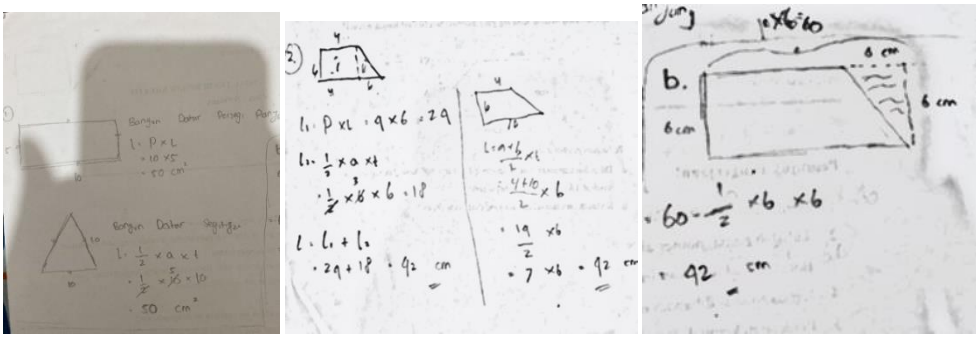

Figure 4. Results of Auditory Learning Style Subject Work on the First Test

Figure 4. shows the results of the subject's work with an auditory learning style in the first test (A1). From the picture, it can be seen that the subject has met the indicators of creative thinking, namely fluency, flexibility, and novelty. Subject A1 is able to solve problems with more than one answer and alternative solutions. This answer illustrates that subject A1 meets the fluency indicator, because he is able to find solutions well and produce various answer choices using rectangular and triangular plane shapes. Subject A1 successfully completed the problem with one approach, then provided two alternative solutions. The first alternative uses the equations for the area of a rectangle and a triangle combined, while the second alternative uses the trapezoid formula. This indicates that subject A1 also achieved the flexibility indicator. In addition, the method used in the picture is a new or unusual approach, by applying the formula for the area of a rectangle and subtracting the area of a triangle which shows that A1 meets the parameters of novelty.

Based on the results that have been presented, it states that A1 can solve problems with various answers and solutions, which are correct. So A1 can be categorized as quite creative with three alternative solutions. After being given the first test, students with an auditory learning style were also given a second test to measure consistency in solving problems. The following are the results of the auditory learning style subject's work on the second test presented in Figure 5.

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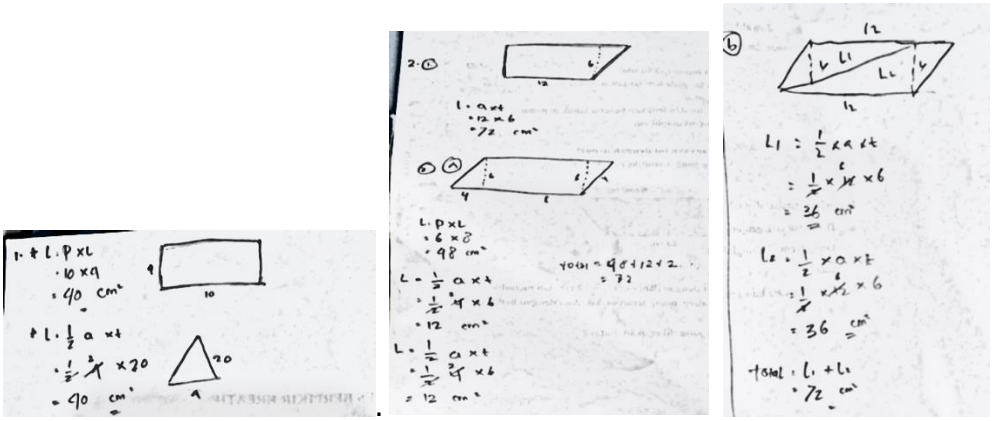

Figure 5. Results of Auditory Learning Style Subject Work on the Second Test

Figure 5. shows the performance results of subjects who have an auditory learning style in the first test (A2). In this figure, it can be seen that the subject has met the indicators of creative thinking, namely fluency, flexibility, and novelty. Specifically, subject A2 is able to solve problems with various alternative answers and solving methods. The fluency indicator can be seen from the presentation of various solutions and answers used, such as in rectangular and triangular plane shapes. In the process, subject A2 shows one way of solving, followed by two alternatives. The first method uses the parallelogram formula, while the second solution applies the area formula for a rectangle and two triangles combined. This indicates that subject A2 also meets the flexibility indicator as indicated by the subject's ability to check answers using several other solving methods, and create different alternatives. In addition, a new or unusual way is seen in the use of the area of two triangles combined, thus adding to the indication that A2 meets the novelty indicator because the subject completes the answer based on the previous answer . This is evidenced by the results of the students' answers which show that all of these answers have been taught by the mathematics subject teacher.

From the written results, it can be said that A2 has been able to solve problems with various answers and correct solutions. Thus, subject A2 is classified as quite creative by presenting three diverse alternative solutions. The findings are also similar to research (Hikmatulloh et al., 2023) that auditory subjects who are categorized as quite creative are students who still meet the fluency indicators. In addition, other studies have also revealed that creative thinking skills with a sufficient category are students who are still able to create other ways to solve problems from the previous method (Hanifah et al., 2024).

To ensure the validity of the data on the subject of auditory learning styles, triangulation was conducted to find the suitability between student answers and the measured indicators. The following is Table 4 regarding the triangulation data on the subject of auditory learning styles.

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Table 4. Triangulation Results Data for Auditory Learning Style Subjects

Components of Creative Thinking	Student Abilities	Subject A1	Subject A2
Fluency	Students are able to solve problems using a variety of alternative solutions and answers.	Think creatively	Think creatively
Flexibility	Students are able to solve problems, which then use other alternative solutions.	Think creatively	Think creatively
Novelty	Students are able to correct answers with various alternative solutions or answers, which then create new alternatives.	Think creatively	Think creatively

Table 4. shows that the triangulation method is able to show the suitability between data sources that support each other. This is shown through the work of the test answers and interviews by subjects who have met all indicators of creative thinking.

3. *Subjects with Kinesthetic Learning Style*

Students who use the kinesthetic learning method tend to use physical activity and direct practice methods in thinking. The following are the results of the answers of the kinesthetic learning style subjects presented in Figure 6.

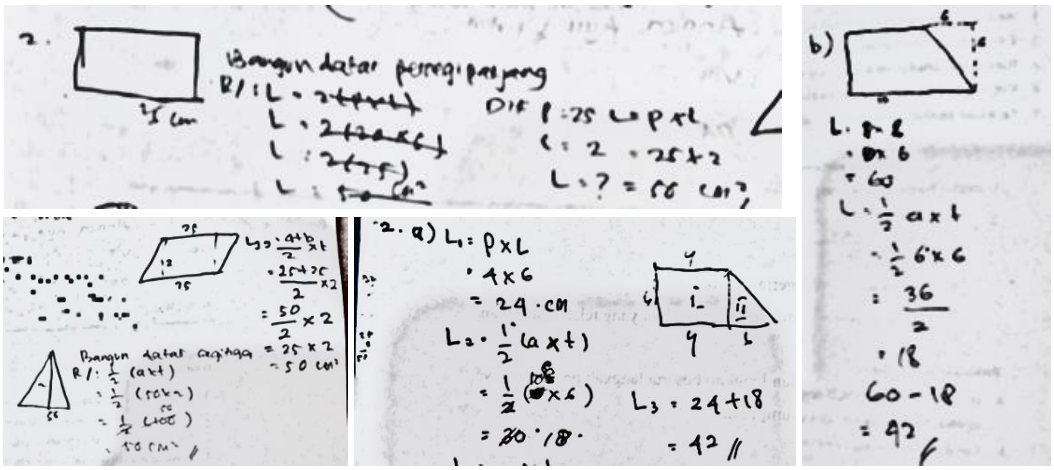

Figure 6. Results of Subjects with Kinesthetic Learning Style in the First Test

Figure 6. is the result of the performance of the kinesthetic learning style subject in the first test (K1). As shown in Figure 6, it is known that the subject meets the parameters of creative thinking, namely fluency, flexibility without novelty. Based on Figure 6, it can be seen that subject K1 in solving problems has several answers or solving methods. In this case, the variation of solutions and answers given by students is to integrate three flat shapes, namely rectangles, triangles and trapezoids. This answer shows that subject K1 meets the fluency indicator because he can solve the problem well and with varied solutions. Subject K1 successfully used 2 alternative solutions in solving the problem. The first solution uses the equation of the area of a rectangle and a triangle that are combined. The second alternative solution uses the formula for

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the area of a triangle and the total result is reduced. This shows that subject K1 meets the flexibility indicator. However, subject K1 could not complete the solution again or use an alternative that had novelty. Thus, K1 has not met the novelty indicator.

Based on the written results, it shows that K1 has been able to solve problems with various alternative answers and solutions but has not yet completed a new answer or solution, so that K1 is in the less creative category with a total of two alternative solutions. After being given the first test, students with kinesthetic learning styles were also given a second test to measure consistency in solving the questions. The following are the results of the performance of kinesthetic learning style subjects in the second test presented in Figure 7.

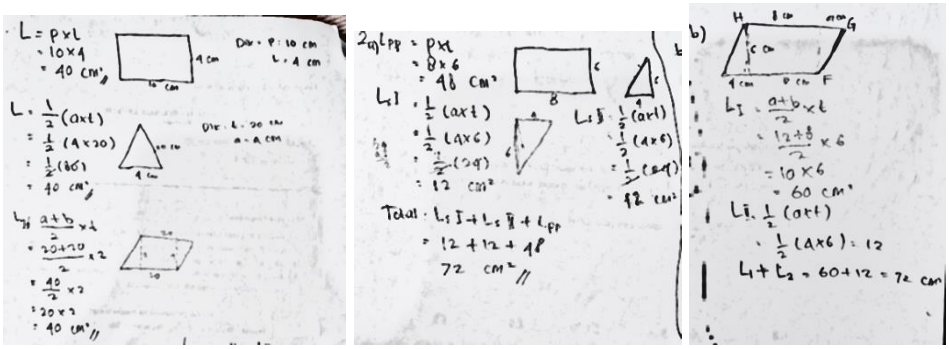

Figure 7. Results of Subject Performance with Kinesthetic Learning Style in the Second Test

Figure 7. is the result of the subject's performance using the kinesthetic learning method in the second test (K2) which reveals that the subject meets the indicators of creative thinking, namely fluency, flexibility without novelty. Based on Figure 7, it can be seen that subject K2 in solving the problem, presents several answers and alternative solutions. The answer shows that subject K2 meets the fluency indicator because he can solve the problem well and various solutions using rectangular, triangular and trapezoidal flat shapes. Subject K2 successfully shows 2 alternative solutions. The first solution uses the equation of the area of a rectangle and two triangles that are combined. The second solution uses the formula for the area of a triangle and the total result is subtracted. This shows that subject K2 meets the flexibility indicator. As for novelty, subject K2 is still unable to use this method in solving the problem.

Based on the written results, it states that K2 has been able to solve problems with alternative answers and solutions but has not completed a new answer or solution. This is evident from the results of students' answers which reveal that the answer has not been taught by the mathematics subject teacher . So that K2 is in the less creative category with two alternative solutions.

From the written results, it can be said that K2 has been able to solve problems with various answers and correct solutions. Thus, subject K2 is classified as less creative by presenting two alternative solutions. The results of this study are also similar to researchers (Hikmatulloh et al., 2023) that kinesthetic subjects who are categorized as less creative are students who still

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meet the fluency indicators. In addition, other studies also state that students who do not meet one of the creative thinking indicators are included in the moderate or less creative category (Nufus et al., 2018).

To ensure the validity of the data on the subject of kinesthetic learning styles, triangulation was conducted to find the suitability between student answers and the measured indicators. The following is Table 5. regarding the triangulation data on the subject of kinesthetic learning styles.

Table 5. Triangulation Results Data of Kinesthetic Learning Style Subjects

Components of Creative Thinking	Student Abilities	Subject K1	Subject K2
Fluency	Students are able to solve problems with a variety of solutions and answers.	Think creatively	Think creatively
Flexibility	Students are able to solve problems in one way, then use other alternative solutions.	Think creatively	Think creatively
Novelty	Students are able to check answers with several alternative solutions or answers, then create different alternatives.		

Table 5. shows that the triangulation method is able to show the suitability between data sources that support each other. This is shown through the work of the test answers and interviews by subjects who have met all indicators of creative thinking.

Based on the results of this study, it was found that students with visual learning styles tend to be able to think creatively higher than students with auditory and kinesthetic learning styles. These findings are in line with previous studies that students with visual learning styles will easily understand the concept of questions referring to pictures or diagrams (Fadilah, 2023). Meanwhile, students with auditory learning styles can still respond to questions with limited solutions compared to visual students. This is because the visual method is able to support the ability of flexibility and novelty, while auditory and kinesthetic have limitations in visual representation, thus inhibiting the flexibility of students' thinking. So that the thinking ability of auditory students is classified as quite creative criteria. On the other hand, kinesthetic students meet the criteria of being less creative.

In addition to the advantages of this study which are able to provide a deeper understanding of the correlation between learning styles and students' creative thinking abilities, there are also shortcomings that create limitations in this study. These shortcomings lie in the limitations of the research sample, so that the results of the study cannot be generalized widely. In addition, motivation and learning environment as external factors have not been analyzed in depth. Therefore, further research can consider aspects of the researcher's recommendations to obtain complete and in-depth results.

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With this research, it is expected to be a reference for further research in developing student creativity. In addition, the implications of this research can be used by educators in designing effective learning strategies to support students' creative thinking skills based on their learning styles.

Conclusion and Suggestions

Based on the description of the data analysis that has been done, this study concludes that the profile of students' creative thinking abilities in flat geometry material varies based on their learning styles. Students who have a visual learning style show good creative abilities, while students with an auditory learning style are in the fairly creative category, and students who are kinesthetic are classified as less creative. This category is caused by several factors, namely differences in the way they process information, problem-solving methods, and students' abilities in connecting new information with previous knowledge. The researcher's suggestions after conducting this study are: (1) for teachers or educators, it is advisable to implement learning strategies that are suitable for students' learning styles such as the use of visual media, discussions, and field practice. (2) for further research, it is advisable to expand the scope of the research by considering external factors and adding research samples so that the data obtained is more accurate.

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