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Analysis of Students' Creative Thinking Skills in Solving Scatter Plot Problems in Terms of Self-Efficacy

Dinda Anggraeni[1], Agus Prasetyo Kurniawan[1*], Luluk Mahmuda[2]
[*] 06040422070@student.uinsby.ac.id
[1]*Program Studi Pendidikan Matematika UIN Sunan Ampel Surabaya, Surabaya 60237, Indonesia*
[2]*SMA Al Falah Ketintang Surabaya, Surabaya, 60232, Indonesia*

Abstract

The ability of students to think creatively in solving mathematical problems, especially scatterplot problems, is significantly influenced by various factors, one of which is self-efficacy or students' belief in their abilities. Students with high levels of self-efficacy are usually more capable of overcoming challenges in learning, while students with low self-efficacy often feel hindered and less motivated to find creative solutions. This study aims to investigate the impact of self-efficacy on students' creative thinking abilities in solving scatterplot problems. The study involved students from varying levels of self-efficacy, categorized into three groups: high, moderate, and low. Data were collected through a questionnaire to measure self-efficacy, a creative thinking test, and in-depth interviews to gain insights into students' approaches to solving problems. The results of the study showed that students with high self-efficacy tended to be more creative, confident, and flexible in solving problems, while students with low self-efficacy experienced difficulties in creative thinking, felt uncertain, and avoided challenges. This study highlights the importance of developing self-efficacy in mathematics education, especially in enhancing students' creative thinking abilities. Therefore, teaching strategies that support the improvement of students' self-efficacy can strengthen their creativity and performance in solving more complex problems.

Keywords: self-efficacy, creative thinking, scatterplot, mathematics education

1. Introduction

Creative thinking skills hold a vital role in 21st-century mathematics education in order to produce a generation capable of solving problems flexibly and innovatively. The topic of statistics, particularly scatter plot material, provides ample space for developing this competency through the process of identifying patterns of relationships between variables based on deep logical reasoning (Sugihartini et al., 2025). The use of scatter plots aims to visually map data trends so that students are challenged to critically interpret the relationship between two different variables through accurate pattern analysis.

Phenomena in the field actually show that many students still struggle when trying to interpret data in these diagrams, which hinders the emergence of their creative ideas in finding solutions. This obstacle indicates a significant gap in the development of students'

innovative thinking power, which is actually very much needed to overcome complex statistical problems (Susilawati et al., 2020). An internal factor in the form of self-efficacy, or an individual's belief in their own capacity, emerges as a determining variable that influences students' success in effectively achieving certain learning objectives (Ananda & Wandini, 2022).

Students who have a high level of confidence in their competence will show strong motivation and remarkable resilience even when facing difficult mathematics problems (Rozi & Afriansyah, 2022). Conversely, low self-esteem regarding one's own ability often triggers avoidance behavior toward academic challenges, which ultimately hinders the growth of students' creative potential. This mental condition positions self-belief as a fundamental element in the mathematics learning ecosystem to encourage students to produce original answers without fear of failure (Arista & Mahmudi, 2020).

Strong self-belief functions as an internal driver that motivates students to explore various new alternative solutions when facing the complexity of statistical data. Self-efficacy enables students to maintain focus and sharpness of thought when they must integrate logical reasoning with visual interpretation skills in scatter plot problems (Tuzzahra et al., 2023). This psychological drive is highly effective in helping students go beyond standard thinking boundaries so that they are able to formulate fresher and more innovative mathematical conclusions (Arifin et al., 2024).

The definition of self-efficacy refers to a person's specific belief in successfully completing a particular task, and it has a fundamental difference from the concept of self-esteem, which is a general personal judgment. Bandura (2001) explains that the level of efficacy influences an individual's defense mechanisms when facing obstacles, where those with high self-belief tend to work harder compared to those who feel pessimistic. In classroom practice, this determines how students dissect scatter plot problems that require the integration of visual intelligence and data analysis sharpness to reach valid conclusions.

Previous research has proven the significant contribution of self-efficacy to increasing students' creativity and mental persistence when working on complex tasks. Bandura (2001) confirmed that high self-belief is directly proportional to increased motivation and individual persistence in solving challenging problems. Research by Ananda & Wandini (2022) also shows that students with high levels of creativity tend to

have strong self-efficacy, making them more courageous in exploring solutions when facing mathematical problems. Given that scatter plot material requires the integration of logical reasoning and visual interpretation, it is important to further examine how the relationship between self-efficacy and mathematical creativity applies specifically in the context of this material.

The development of students' creative thinking skills in understanding scatter plots needs more attention, considering that this material demands complex cognitive abilities in the form of integrating logical reasoning and visual interpretation. Understanding how belief in one's own ability can change the way students view statistical data through a more innovative approach is important to examine further.

This research aims to examine the influence of self-efficacy levels on the quality of students' creativity when they grapple with statistical problems that require in-depth visual data interpretation. The results of this analysis are expected to become a valuable reference for educators in designing learning scenarios that can boost students' mental courage and sharpness of creative thinking simultaneously in statistics material.

2. Research Methods

This research employs a descriptive qualitative approach. The research subjects were 6 students from class XI-B at SMA Al Falah Ketintang, who were selected purposively from a population of 25 students based on the results of a self-efficacy questionnaire. Students were grouped into three categories, namely high, moderate, and low, and then 2 students whose questionnaire scores were most representative of their group were selected from each category, resulting in 6 research subjects. The selection of these subjects aims to understand the differences in creative thinking abilities between students with different levels of self-efficacy.

The instruments used in this research consist of:

a. Creative Thinking Ability Test

   This test consists of 4 open-ended questions about scatter plots, which ask students to create a scatter plot based on the data provided and interpret the patterns that emerge. The questions were developed based on indicators of creative thinking ability according to Munandar and Torrance, which include fluency, flexibility, originality, and elaboration.

b. Self-Efficacy Questionnaire

This questionnaire uses a 1–5 Likert scale consisting of 20 statement items to measure students' level of self-efficacy in solving statistics and scatter plot problems. The questionnaire was developed based on three dimensions of self-efficacy according to Bandura (2001), namely magnitude, strength, and generality.

c. In-Depth Interviewer Guide

Interviews were conducted to explore in greater depth students' experiences, perceptions, and strategies in solving scatter plot problems, as well as how their level of self-efficacy influences their creative thinking abilities.

Data were collected through:

a. Creative Thinking Ability Test

Students were asked to complete the scatter plot questions provided in the test to measure their creative thinking abilities.

b. Self-Efficacy Questionnaire

This questionnaire was used to measure students' level of self-efficacy regarding their ability to solve mathematical problems.

c. In-Depth Interviews

Interviews were conducted to further explore how students' self-efficacy influences the way they think and solve problems.

The data analysis technique used is the qualitative data analysis model of Miles and Huberman (2014), which consists of three main stages:

a. Data Reduction

The process of filtering and selecting relevant data from the test results, questionnaires, and interviews.

b. Data Presentation

Organizing the reduced data in the form of narratives or tables to facilitate understanding.

c. Conclusion Drawing

Drawing conclusions based on the presented data to answer the research questions regarding the relationship between self-efficacy and students' creative thinking abilities in solving scatter plot problems.

3. Results and Discussion

3.1 Results

3.1.1 Self-Efficacy Questionnaire Results

The results of the self-efficacy questionnaire show clear variation among students with high, moderate, and low self-efficacy (Bandura, 2001). Most students with high self-efficacy had average scores above 4.0, reflecting their confidence in their ability to solve scatter plot problems. They felt more confident and motivated when facing more complex mathematics problems.

Students with moderate self-efficacy had average scores between 3.0 and 4.0, indicating a more moderate level of confidence. They tended to feel hesitant and less certain when facing problems, although they attempted to solve them in a more structured manner and followed the examples that had been given.

Students with low self-efficacy showed average scores below 3.0. They felt unable to solve the problems and often avoided more difficult questions. This was reflected in the interviews, where they expressed confusion and fear of failure when working on the problems.

Table 1. Summary of Self-Efficacy Questionnaire Results

Student	Self-Efficacy Category	Average Self-Efficacy Score
A	High	4,6
B	High	4,4
C	Moderate	3,7
D	Hight	3,5
E	Hight	4,2
F	Low	2,8

Based on Table 1, students with high self-efficacy (A, B, and E) tended to feel more confident in solving scatter plot problems, while the student with low self-efficacy (F) felt less confident and tended to avoid more difficult problems.

3.1.2 Creative Thinking Ability Test Results

The categorization of creative thinking ability levels refers to the percentage of scores achieved relative to the maximum score of 16 (4 indicators × maximum score of 4 per indicator), with the following criteria: a score of ≥ 66% is categorized as high, a score of 34%–65% is categorized as moderate, and a score of ≤ 33% is categorized as low

(Arikunto, 2016).

$$Value\ (\%) = \frac{Score\ obtained}{Maximum\ score} \times 100\%$$

Table 2. Creative Thinking Test Scores

Student	Fluency	Fleksibilitas	Originality	Elaboration	Skor Total	Nilai (%)	Kategori Berpikir Kreatif
A	4	4	4	4	16	100%	Tinggi
B	4	4	3	4	15	94%	Tinggi
C	3	2	2	2	9	56%	Sedang
D	2	2	2	2	8	50%	Sedang
E	3	3	3	3	12	75%	Tinggi
F	1	1	1	1	4	25%	Rendah

Based on Table 2, students with high self-efficacy (A, B, and E) demonstrated high creative thinking ability, with percentage scores of 100%, 94%, and 75% respectively. Students with moderate self-efficacy (C and D) fell into the moderate creative thinking category, with scores of 56% and 50%. Meanwhile, the student with low self-efficacy (F) obtained the lowest score of 25% and fell into the low category. This pattern indicates a tendency toward a positive relationship between the level of self-efficacy and students' creative thinking ability in solving scatter plot problems.

3.1.3 In-Depth Interview Results

From the interviews conducted with the students, several interesting patterns emerged related to their level of self-efficacy. Students with high self-efficacy, such as Student A and Student B, revealed that they felt more confident in working on scatter plot problems, even when faced with difficult questions. They felt that although the problem was challenging, they could approach it in a more structured way and with the belief that they were able to find a solution.

Student A, for example, described how they approached a scatter plot problem that initially left them confused. They explained that although they were initially confused, they believed that if they tried, they would be able to succeed; they went ahead and experimented until they found the right pattern, after which they became more confident and continued with self-assurance.

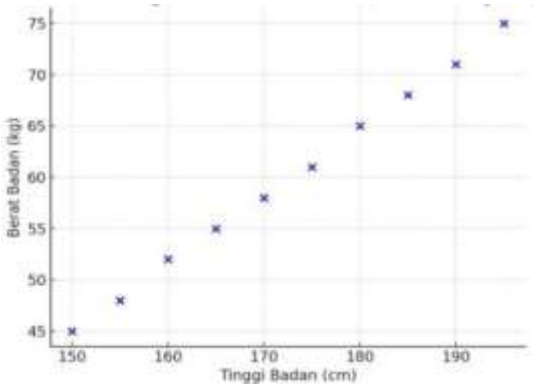

Figure 1. Scatter Plot of Student A's Sample Answer

Student B expressed a similar level of confidence. They explained that they usually did not worry too much about problems like this, that they would immediately try to visualize the data and observe the patterns that emerged, and that if they did not understand right away, they would look for another approach until they found the solution, stating that they were confident they could do it. Both students believed that they were capable of overcoming difficult problems and felt that their efforts would definitely produce good results.

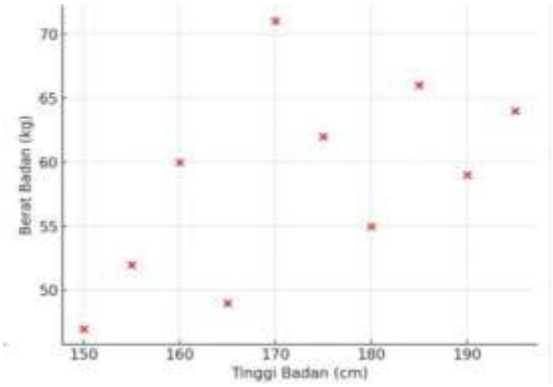

Figure 2. Scatter Plot of Student B's Sample Answer

Students with high self-efficacy tended to be more willing to experiment and seek different solutions without fear of making mistakes. They were more flexible in their approach and felt that every mistake was part of the learning process that needed to be undergone.

On the other hand, students with low self-efficacy, such as Student F, expressed deep confusion and fear when looking at scatter plot problems. Student F admitted to feeling great difficulty in getting started, explaining that upon seeing a scatter plot

problem, they immediately felt confused, did not know where to begin, and felt very afraid of making mistakes, which ultimately led them to give up trying and instead choose easier problems.

Student D also spoke about the doubt they felt while working on the problems, explaining that with problems like this, they felt unsure, did not know which method to use, and were confused about whether the method they used was correct, so they often preferred to simply follow the steps that had already been provided in order to feel safer.

From these interviews, it is evident that students with high self-efficacy tend to feel more confident and are more willing to face greater challenges. They not only tried to find the correct answer but also felt more flexible and comfortable trying various methods to solve the problem.

In contrast, students with low self-efficacy more often felt confused and hesitant. They tended to avoid more difficult problems and felt hindered by their fear of failure. They did not feel confident enough to seek different solutions or try new approaches.

Overall, these interviews reveal a close relationship between self-efficacy and students' creative thinking ability. Students with high self-efficacy were more inclined to think creatively and find various alternative solutions when solving problems, while students with low self-efficacy were more limited in their creativity and felt hindered by a lack of self-confidence.

3.2 Discussion

3.2.1 The Influence of Self-Efficacy on Creative Thinking Ability

Individuals with a high level of self-efficacy demonstrate mental openness and steady confidence when facing the challenges of solving scatter plot problems. They hold a strong belief that all forms of academic difficulty can be overcome through adequate effort and the right strategy. Findings from the interview process confirm that subjects with high self-efficacy were able to project various innovative alternative solutions because they fully trusted their own intellectual capacity. This phenomenon reinforces Bandura's (2001) theory, which states that a positive perception of one's own ability serves as the primary driving force for overcoming complex obstacles.

Research by Khoiriyah et al. (2024) further supports this finding through evidence that high self-efficacy is directly correlated with the sharpness of students' creative thinking in the classroom. Students' sense of capability triggers the courage to explore various problem-solving methodologies without being fixated on a single conventional approach. Creativity in this context includes cognitive flexibility that allows students to adapt quickly when facing uncertain mathematical situations. This adaptive capacity is the key distinguishing factor between students who merely memorize procedures and those who genuinely understand statistical concepts in depth.

Clear evidence can be seen in Student A and Student B, who were able to demonstrate originality in identifying patterns of relationships between variables, driven by their high level of confidence. They did not let the complexity of the data become a mental barrier; instead, they turned it into an opportunity to deepen their understanding of scatter plot structures. This proves that the psychological aspect of self-efficacy makes a significant contribution to expanding the horizons of creative thinking through experimentation with various problem-solving approaches. Their persistence in analyzing visual data reflects a harmonious integration between affective and cognitive aspects in mathematics learning.

However, a high level of self-efficacy does not automatically produce an identical degree of creativity in every individual, due to the presence of other intervening variables. External factors such as the quality of past learning experiences and support from the social environment also shape how creativity manifests in real action. Each student's unique internal motivation also plays a role in determining the extent to which they are willing to explore new and risky ideas. Therefore, educators need to recognize that self-efficacy is only one of the main pillars that must be combined with the facilitation of a conducive learning environment (Elanda et al., 2025).

3.2.2 Obstacles Faced by Students with Low Self-Efficacy

Students with a low level of confidence often become trapped in various mental obstacles that close off space for the growth of creative thinking (Rozi & Afriansyah, 2022). They tend to feel inferior when facing complex tasks and choose to avoid challenges that could potentially trigger personal failure. Interview data reveal that students such as Student F experienced acute confusion and paralyzing doubt when asked to analyze scatter plots independently. This feeling of helplessness ultimately stifles

imaginative capacity, causing them to fail to find alternative solutions that would actually have been achievable.

Arista & Mahmudi (2020) underline that the tendency to avoid difficulty among students with low self-efficacy prevents them from improvising in learning. Their inability to think flexibly makes it difficult for them to adapt to changes in question patterns that require new or unusual logical thinking. Students such as Student F often felt pressured by a fear of making mistakes, which then extinguished their desire to experiment with different solving techniques. This defensive psychological condition turns the process of learning mathematics into a mere routine, devoid of discovery or creativity.

The rapid onset of feelings of hopelessness when facing technical obstacles is another characteristic feature of individuals who lack trust in their own abilities. Susilawati et al. (2020) affirm that low self-efficacy triggers a tendency to give up easily among students who feel they lack sufficient intellectual tools for success. Student D admitted in the interview to feeling more comfortable following rigid standard procedures rather than bearing the risk of failure when attempting a more creative approach. This persistent hesitancy ultimately limits their cognitive range of motion and distances students from the potential to develop patterns of thought beyond the ordinary.

This deficit in self-belief also has a systemic impact on the ongoing decline in motivation to keep trying to improve their work. Fear of failure becomes a barrier that reduces the intensity of students' efforts in completing intellectually challenging mathematics tasks. This provides a clear picture that low self-efficacy is a major inhibiting factor in the development of students' critical and creative thinking abilities, particularly in scatter plot material. Without appropriate intervention, students will continue to be trapped in a cycle of inability that hinders their overall academic achievement (Tuzzahra et al., 2023).

3.2.3 The Importance of Self-Efficacy in Mathematics Learning

The role of self-efficacy in mathematics education is highly crucial, particularly as a catalyst for the growth of the creative thinking ability needed to solve complex problems. Belief in one's own capacity makes students more courageous in exploring various mathematical strategies when facing data visualizations such as scatter plots. Tuzzahra et al. (2023) emphasize that steady self-efficacy will stimulate individuals to

work harder and to view failure as part of the learning process. Students who hold this mindset will see every complex problem as a challenge that sparks intellectual excitement rather than as a frightening threat.

Ananda and Wandini (2022), through their research, reinforce the argument that the level of self-efficacy has a very close functional relationship with academic achievement. Students who are optimistic about their abilities tend to achieve success in demanding tasks because they possess a driving force in the form of stable intrinsic motivation. Within the scope of scatter plot material, self-efficacy helps students not merely to answer questions correctly, but also to discover meaning or patterns that are not immediately visible to the naked eye. This ability to see beyond the numbers is at the core of mathematical creativity, which is highly valued in modern education.

Educators bear a great responsibility to integrate the reinforcement of self-efficacy into daily learning schemes in order to facilitate students' need for recognition of their competence. Providing measured challenges along with constructive positive feedback can help students build a stronger foundation of self-belief over time (Elanda et al., 2025). This mental transformation will subsequently have a direct impact on improving the quality of creative thinking, which serves as students' primary capital for achieving higher accomplishments. Creating a classroom climate that supports the growth of self-efficacy is a strategic step toward sustainably optimizing students' performance and creative capacity in mathematics.

4. Conclusion

This research shows that self-efficacy influences students' creative thinking ability in solving scatter plot problems. Students with high self-efficacy (Students A, B, and E) were able to optimally fulfill all four indicators of creative thinking. On the fluency indicator, they were able to generate many ideas and solving methods smoothly and correctly. On the flexibility indicator, they were able to view problems from various perspectives and use more than one approach to solving them. On the originality indicator, they were able to produce unique ideas rather than merely imitating previously taught procedures. On the elaboration indicator, they were able to detail and develop their answers thoroughly and systematically.

Students with moderate self-efficacy (Students C and D) fulfilled only some of these indicators, with their originality and elaboration abilities still limited. They tended to solve problems in a more structured manner, following the procedures that had been demonstrated, without much exploration. Meanwhile, the student with low self-efficacy (Student F) was unable to adequately fulfill all four indicators, being hindered by fear of failure and doubt about their own ability, which resulted in avoidance of more complex problems.

Based on these findings, it is important for educators to pay attention to and enhance students' self-efficacy in the mathematics learning process, particularly in material that demands visual interpretation skills such as scatter plots. Approaches that support the development of self-efficacy, such as providing measured challenges and constructive feedback, are essential for comprehensively improving students' creative thinking abilities.

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