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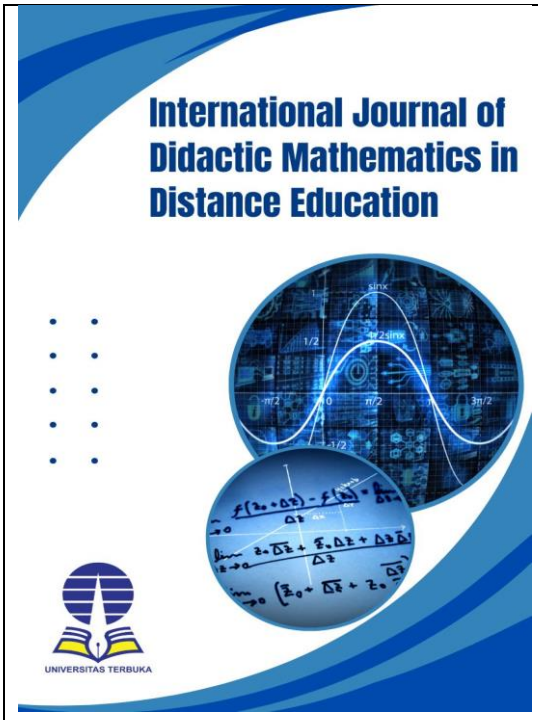

The level of students' mathematical creative thinking skills as measured by their self-confidence

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The level of students' mathematical creative thinking skills as measured by their self-confidence

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Abstract

High self-confidence and creative mathematical thinking skills will change students from having difficulty with mathematics to active learners who can solve mathematical problems. But the facts show that the achievement of both abilities is still quite low. The purpose of this research is to analyze how students' creative mathematical thinking skills are viewed from the perspective of self-confidence in social arithmetic material. Social arithmetic material is used because it allows them to abstract mathematical processes into their daily lives, thereby developing their creativity. The research method is descriptive qualitative. The sample was 3 people, namely 1 person for each level of self-confidence (high, medium, and low). They are selected through purposive sampling. The data collection techniques used include questionnaires, tests, interviews, and field notes. The data analysis techniques employed are data reduction, data presentation, and conclusion drawing. The results indicate that students' self-confidence levels in social arithmetic material affect their creative mathematical thinking skills. It was found that students with high self-confidence were able to meet three indicators of creative mathematical thinking skills: fluency, flexibility, and elaboration. However, students with high self-confidence were not able to meet the originality indicator. Students with moderate self-confidence were able to meet one indicator of creative mathematical thinking skills, namely fluency, but were not able to meet the flexibility and elaboration indicators. Meanwhile, students with low self-confidence were not able to meet any indicators of creative mathematical thinking skills. Thus, self-confidence can be increased to improve mathematical creative thinking skills.

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1. Introduction

Technology is developing rapidly. Various types of technology are widely applied in life, including in learning activities. Currently, students can find various information needed in the learning process from various sources so the information obtained is increasingly varied and abundant (Luritawaty, et al. 2024). It was further stated that this condition can stimulate students to increase opportunities for creative thinking. However, this condition also makes the problems faced in learning mathematics increasingly complex and must be directed at the goals of 21st-century education that emphasize creativity. Therefore, in learning, it is very important to develop mathematical understanding and creative thinking skills to solve mathematical problems and make learning activities fun (Jackson & Messick, 1965; Zubaidah et al., 2023;). Therefore,

mathematics education should not only focus on educators and delivering materials but also on training and developing the skills of each student, including their mathematical creative thinking skills.

The skill to think creatively in mathematics is the skill to think to create or discover new, different, uncommon, and original ideas that yield definite and accurate results (Andiyana et al., 2018). The creative mathematical thinking skill in question is the skill to propose ideas in solving mathematical problems (Amidi & Zahid, 2016; Faturohman & Afriansyah, 2020). To foster creative mathematical thinking, an important component that students must have is confidence and belief in their skills, to avoid feelings of worry and doubt (Melyana & Pujiastuti, 2020; Hidayah et al., 2022). Based on the results of interviews with several junior high school students in Cibiuk Village, it is known that students lack confidence in learning mathematics. They consider mathematics to be full of formulas so when they do not memorize them, they are not confident in learning. They also find it difficult to show their creativity because they already consider mathematics difficult (Dalilan & Sofyan, 2022). In the process of learning mathematics, self-confidence is crucial as it is a mental or psychological condition that provides strong assurance to students to create or take mathematical actions. High self-confidence and creative mathematical thinking skills will transform students from struggling with mathematics into active learners capable of solving mathematical problems. This underscores the importance of having the skill to think creatively in mathematics.

However, in reality, mathematical creative thinking skills are still low (Setiana & Purwoko, 2021; Suherman & Vidákovich, 2022; Sari & Afriansyah, 2022; Wannapiroon & Pimdee, 2022), as evidenced by several previous studies. For instance, Hasanah and Haerudin (2021) stated that students' mathematical creative thinking skills remain low. This is evident from their research results, which showed that the creative thinking skill test scores of three students mostly fell into the medium category at 62.5%, with the least mastered indicator being originality. Additionally, Andiyana et al. (2018) reported that students' mathematical creative thinking skills are still very low, as indicated by their research results, which showed an average percentage of 51%, with the least mastered indicator also being originality. In addition, based on preliminary research data, it is known that low critical thinking skills also occur in one of the junior high schools in Cibiuk Village, Garut Regency.

Mathematical creative thinking skill is influenced by self-confidence (Yaniawati et al., 2020; Kharisudin, 2022). This is evidenced by research conducted by Eviliasani et al. (2018), which states that students with high self-confidence (HSC) will have high creative thinking skills. Meanwhile, students with moderate self-confidence (MSC) will have moderate creative thinking skills. Students with low self-confidence (LSC) will have low creative thinking skills. Therefore, it can be concluded that self-confidence influences students' mathematical creative thinking skills.

Students' creative thinking skills can improve by using social arithmetic materials, as these can create a process of mathematical abstraction in their daily lives, enabling students to develop their creativity (Suprapti, 2019; Febrianingsih, 2022; Daniatun et al., 2022). Additionally, the research by Sitorus & Priyanda (2021) indicated that most students lack confidence or courage in making independent decisions, resulting in low problem-solving skills in social arithmetic material at Mahardika Junior High School. Social arithmetic is a part of mathematics that explains how to calculate finances in buying and selling or business activities (Isnawati & Rosyana, 2021). There are various ways to handle contextual problems; individuals can become skilled in thinking by analyzing the appropriate methods to apply in their buying and selling or business activities. Therefore, social arithmetic in mathematics is a subject that can be used to train students in the process of developing creative thinking skills.

Based on the description, there is an interesting problem to be researched. Therefore, the researcher aims to analyze students' mathematical creative thinking skills about their confidence in social arithmetic material. The researcher hopes that the students' mathematical creative thinking skills can be analyzed in depth based on their self-confidence, specifically in social arithmetic material.

2. Method

In this study, the method used is a case study descriptive research design. Qualitative descriptive research is a study to understand and comprehend the conditions of what is possessed by the research subjects, described based on observations by elaborating in the form of words (Creswell, 2016). The results of this

research are presented in the form of written text or facts from the researched subjects, field notes, and other supporting materials that facilitate the research process. The researcher's objective in choosing qualitative descriptive research is to describe the results of the analysis of mathematical creative thinking skills in terms of self-confidence.

This research was conducted in 2023 at one of the Junior High Schools in Cibiuk, Garut Regency. The subject of this research is a 44 student in 7th-grade student, selected using a purposive sampling technique to test mathematical creative thinking skills, with 1 student chosen from each category of self-confidence. They were selected because they are willing to volunteer to be involved in this research. The researcher selected subjects based on their characteristic traits, namely students categorized as having high, moderate, and low self-confidence. The reason for choosing this sampling technique is to assess the creative thinking skills among students with varying levels of self-confidence.

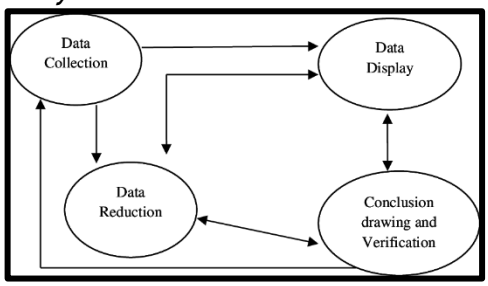
The research instruments used in this study are as follows: questionnaire, test, interview guideline, and field notes. The questionnaire sheet was created to determine the self-confidence category of each student. The test sheet contains questions that include indicators of mathematical creative thinking skills, namely fluency, flexibility, and elaboration. The interview guideline sheet is prepared to serve as a guide when exploring information about mathematical creative thinking skills in social arithmetic materials. Field notes are used to observe and directly study the research subject, allowing researchers to record and compile data that occur in the field.

The questionnaire used is a pre-prepared questionnaire with provided answers, allowing students to choose directly. The purpose of this questionnaire is to determine the level of self-confidence that students possess. The questionnaire contains a total of 20 statements. The test given to students consists of social arithmetic material questions. The purpose of this test is to assess students' mathematical creative thinking skills. The test comprises three essay questions that must be completed within a predetermined time. The interviews used in this research employed a semi-structured interview format. Conducted by the researcher with 3 students from class VIIA as research subjects, these interviews aimed to understand the students' mathematical creative thinking skills. Field notes are made by the researcher in this study to reinforce the data from results, interviews, and questionnaires. In these field notes, the researcher writes about the observations made during the research.

The research data were analyzed qualitatively using the Miles and Huberman qualitative descriptive data analysis method in Figure 1, which consists of the stages of data reduction, data presentation, and concluding (Rijali, 2019).

Figure 1

Qualitative Descriptive Data Analysis Method



The data reduction stage in this research includes a) Analyzing the test results completed by students to understand their mathematical creative thinking skills; b) Transcribing the interviews of participating students, each subject coded differently: P for Researcher, S1 for Subject 1, S2 for Subject 2, and S3 for Subject 3; and c) Analyzing field notes obtained while students were solving problems. The data presentation stage is the activity of gathering selected information that is then organized, allowing for the possibility of concluding. The presented data includes test results, interview outcomes, and field notes that have been reduced and formatted into tables and graphs. In the concluding stage, conclusions are drawn based on data reduction and presentation to determine how students' mathematical creative thinking skills are perceived in terms of self-confidence.

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The validity of the data in this research uses triangulation, specifically technique triangulation, which involves cross-checking data from the same source using different techniques. In this case, data obtained from the test results of the three participant students are then cross-checked with data obtained from interviews and field notes. This research does not cause any negative impact, either physically or non-physically, on the subjects under study. The confidentiality of the subjects' names is maintained to uphold the ethical code of the subjects under study.

3. Results and Discussion

3.1 Results

This research begins by assigning three students who have been grouped based on their confidence levels to measure students' mathematical creative thinking skills. The questions given are in the form of three essay questions on social arithmetic, structured according to indicators of mathematical creative thinking skills: fluency, flexibility, originality, and elaboration. The results of these questions are presented in the following Table 1.

Table 1

The score of Mathematical Creative Thinking Skill

Student	Self Confidence Level	Score			Total Score
		Question 1	Question 2	Question 3	
S1	High	4	2	4	10
S2	Medium	2	1	1	4
S3	Low	2	1	1	4

Based on Table 1, it is known that students with high self-confidence get the highest scores on all questions. Meanwhile, students with medium and low self-confidence get the same scores.

Data Reduction Stage

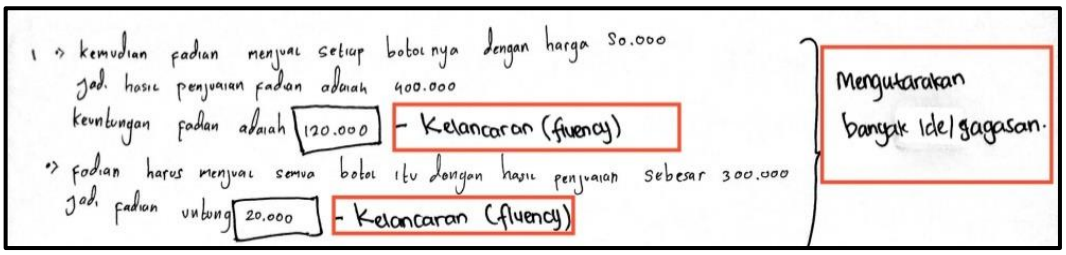
On this occasion, the data results of each student are not displayed in their entirety. Each question is represented by only one student, as an illustration of the data reduction stage that the researcher has conducted. The conclusions drawn later will encompass conclusions from all students.

Analysis of Students' Creative Thinking Skills with High Self-Confidence Levels

At this stage, the results of the undergraduate research for question number 1 are presented. The S1 responses to question number 1 on mathematical creative thinking skills were analyzed by the researcher. The results of the analysis of student responses are presented in Figure 2 below.

Figure 2

Analysis of Answer S1 Number 1



Based on Figure 1, the researcher analyzed that S1 provided 2 answers in different ways. Based on the answers, S1 could give 2 examples of advantages. Firstly, S1 determined the price per bottle and sold it at a higher price than the cost per bottle. Secondly, S1 sold all the bottles at a higher price than the initial price. S1 is considered capable of expressing ideas and providing many thoughts or answers in solving problem number 1 because S1 could provide different answers. However, in working on problem number 1, S1 could not provide new ideas, so the initial assumption is that S1 has achieved the fluency indicator but has not met the originality indicator. This was observed directly by the researcher and documented in the field notes. Here are the results of the field note research on question number 1 are presented in Figure 3 below.

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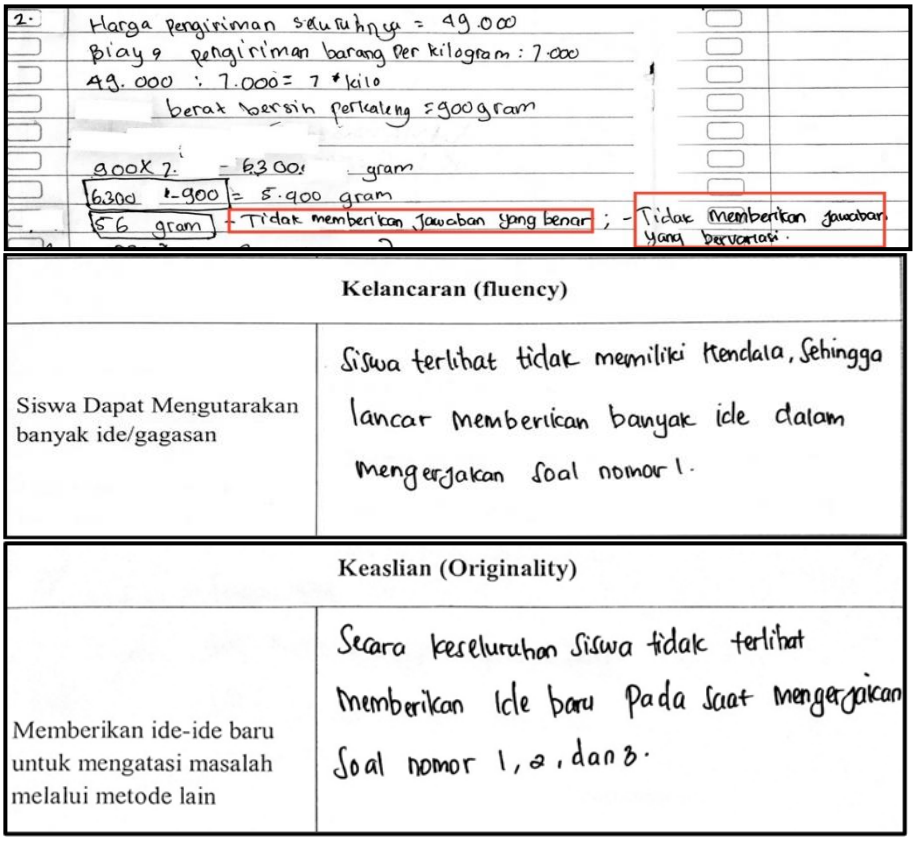
Figure 3
Field Notes Result S1 Number 1



Based on Figure 3, the field notes show that S1 generated many ideas while working on question number 1, indicating that S1 meets the fluency indicator. However, S1 did not appear to generate new ideas while working on question number 1, meaning that S1 does not meet the originality indicator.

Here are the interview results with undergraduate students related to working on question number 1.

P: Explain the meaning of this question.
S1: So, Fadlan has to sell again to make a profit.
P: Do you understand the problem being asked in this question?
S1: I understand.
P: If yes, how would you solve the problem with an idea or answer that fits?
S1: So, Fadlan needs to sell each bottle for Rp.50,000 because the original price is Rp.35,000 from Rp.280,000/8.
P: Can you solve this problem with a different idea or answer than what you wrote?
S1: Yes, because earlier Fadlan sold them for Rp.50,000, now he should sell each bottle for Rp.40,000.

From the results of the interview, S1 understood what is meant and what was asked in question number 1. S1 is capable of providing explanations based on the answers they have written. S1 is also able to provide alternative ideas or answers besides what they have written, however, S1 has not yet been able to generate new ideas. Therefore, based on the interview results, S1 is considered to have fulfilled the indicator of fluency but has not yet fulfilled the indicator of originality.

Analysis of Students' Creative Thinking Skills with Moderate Self-Confidence Levels

At this stage, the research results of S2 are presented for question number 2. The answer of student S2 to problem number 2 regarding mathematical creative thinking skills was analyzed by the researcher. The results of the analysis of the student's answer are presented in Figure 4 below.

Figure 4
Analysis of Answer S2 Number 2

Based on Figure 4, S2 was able to attempt problem number 2 in one way but still made a mistake. S2 made a mistake in determining the maximum weight of one can in problem number 2. Besides working on problem number 2 incorrectly, S2 also could not yet solve problem number 2 with varied ideas or answers. S2 was assessed as unable to solve problem number 2 because they couldn't provide varied ideas or answers. S2 couldn't generate new ideas for solving problem number 2, thus initially indicating that S2 hasn't achieved flexibility and originality indicators. This was observed directly by the researcher and documented in field notes. The results from the field notes study on problem number 2 are presented in Figure 5.

Figure 5
Field Notes Result in S2 Number 2

Keluwesan (flexibility)	
Siswa Dapat Menghasilkan banyak jawaban	Pada Soal nomor 2 siswa terlihat mengerjakan Soal dengan langkah/cara yang benar namun langkah/cara mengerjakan selanjutnya terlihat salah sehingga mengakibatkan Jawaban yang diberikan kurang tepat. Siswa juga terlihat hanya mengerjakan Soal nomor 2 dengan satu jawaban saja.
Keaslian (Originality)	
Memberikan ide-ide baru untuk mengatasi masalah melalui metode lain	Secara keseluruhan Siswa tidak terlihat memberikan Ide baru Pada saat mengerjakan Soal nomor 1, 2, dan 3.

Based on Figure 4, the field notes indicate that S2 has started solving the problem with the correct initial steps, but S2's completion is still incorrect. S2 also answered only one question or did not provide varied answers, and appeared unable to generate new ideas while working, indicating that S2 has not fulfilled the flexibility and originality indicators.

Here are the interview results with S2 regarding the completion of question number 2.

P: How many solutions did you find to solve this problem?
S2: One.
P: Do you think there are any other ways besides the one you used?
S2: There are, but I don't know them.

Based on the interview results, S2 can work on problem number 2 but still makes mistakes. S2 believes there is another way, but is not yet aware of that method. S2 cannot yet understand problem number 2 from another perspective. S2 cannot provide new ideas. It is concluded that based on the interview results, S2 is assessed as not having achieved the flexibility indicator and originality indicator.

Analysis of Students' Creative Thinking Skills with Low Self-Confidence Levels

At this stage, the research results of S3 are presented for question number 3. The answer of student S3 to problem number 3 regarding mathematical creative thinking skills was analyzed by the researcher. The results of the analysis of the student's answer are presented in Figure 6 below.

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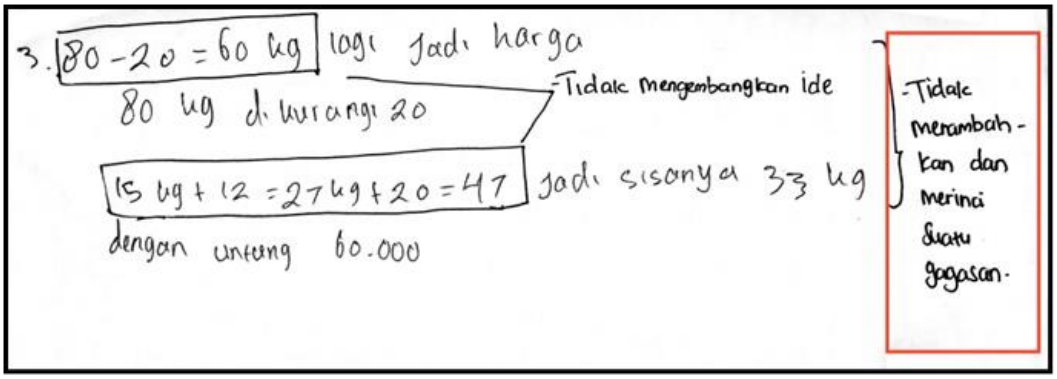
Figure 6
Analysis of Answer S3 Number 3



Based on Figure 5, S3 cannot correctly solve problem number 3 yet, and S3 cannot use the correct method to determine the profit in problem number 3. Because S3 cannot work in detail and cannot provide new ideas while working on the initial suspicion S3 has not yet reached the elaboration indicator and originality indicator. This was observed directly by the researcher and documented in field notes. The results of the field note research on question number 3 are presented in Figure 7 below.

Figure 7
Field Notes Result S3 Number 3

Elaborasi (Elaboration)	
Mengembangkan suatu ide/gagasan	Siswa terlihat kurang memahami maksud dari soal nomor 3 sehingga menyebabkan siswa tidak dapat mengembangkan ide pada soal tersebut.
Menambahkan atau merinci suatu gagasan	Siswa hanya menanyakan angka yang ada pada soal untuk dijumlahkan. Siswa terlihat tidak dapat mengerjakan soal dengan rinci.
Keaslian (Originality)	
Memberikan ide-ide baru untuk mengatasi masalah melalui metode lain	Secara keseluruhan siswa tidak terlihat memberikan ide baru pada saat mengerjakan soal nomor 1, 2, dan 3.

Based on Figure 6, the field notes from S3 appear unable to develop, add, and detail ideas thoroughly. S3 seems to only include the numbers from the question, indicating a lack of understanding of the intent of question number 3. S3 does not seem able to provide new ideas. This means that S3 has not yet met the indicators for elaboration and originality.

Here are the results of the interview with the PhD holder related to the completion of question number 3.

P: Can you solve this problem in detail?
S3: No, I can't.
P: What information did you get from this problem?
S3: Mrs. Synta bought 80 kg of sugar at Rp. 15,000, the rest at Rp. 12,000.
P: How did you develop the idea on the issue?
S3: 15kg plus 12 then 27kg plus another 20 then 47, the rest 33 kg with a profit of Rp. 60,000.

From the interview results, S3 could not solve problem number 3 in detail, and S3 has not been able to develop ideas on problem number 3 correctly. S3 has not been able to provide new ideas. Therefore, based on the interview results, S3 is assessed as not yet achieving the indicators of elaboration and originality.

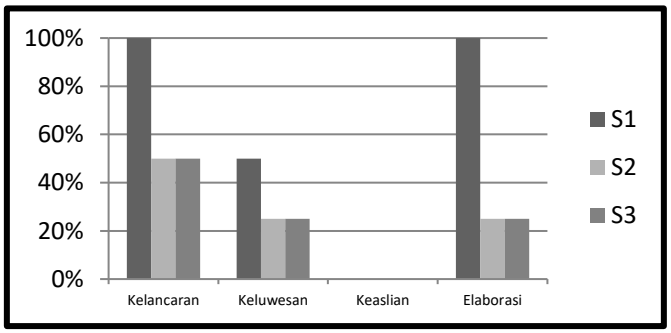
Data Presentation Stage

At this stage, the data is presented in three visual parts based on the data collection technique.

Analysis of Mathematical Creative Thinking Skill Based on Test Questions

Figure 8

Classification of Achievement of Mathematical Creative Thinking Skills Based on Test Questions

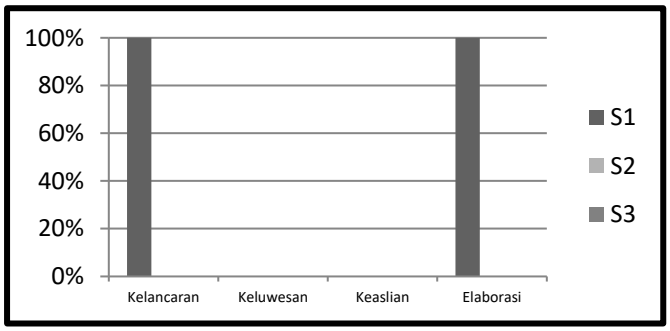


Based on Figure 8, in terms of the fluency indicator, it is observed that some students can understand the questions well, enabling them to answer correctly. In terms of flexibility, overall, each student does not provide many answers; students only give one answer on average, and students' answers are not yet correct. In terms of originality, overall, students are unable to meet this indicator because they cannot provide new ideas while working. In terms of elaboration, overall, students seem to have a limited understanding of the meaning of the questions, thus they cannot answer the questions correctly; students are unable to detail and develop ideas while working.

Analysis of Mathematical Creative Thinking Skill Based on Field Notes

Figure 9

Classification of Achievement of Mathematical Creative Thinking Skills Based on Field Notes

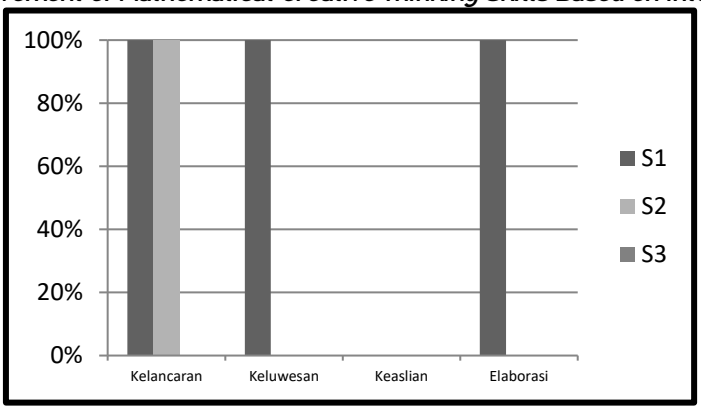


Based on Figure 9, in terms of fluency indicators, it is evident that only S1 can meet this indicator because they can generate many ideas while working, whereas S2 and S3 cannot meet the fluency indicator. In terms of flexibility indicators, overall, there are no students who can meet this indicator because students appear unable to provide many answers while working. In terms of originality indicators, overall, there are no students who can meet this indicator because students appear unable to generate new ideas while working. In terms of elaboration indicators, overall, there are no students who can meet this indicator because students appear unable to develop and elaborate on ideas while working.

Analysis of Mathematical Creative Thinking Skill Based on Interview

Figure 10

Classification of Achievement of Mathematical Creative Thinking Skills Based on Interview



Based on Figure 10, in terms of the fluency indicator, it is observed that S1 and S2 can fulfill this indicator because they can provide many ideas, whereas S3 cannot fulfill the fluency indicator. Regarding the flexibility indicator, it is noted that only S1 meets this criterion because they can provide many answers. Meanwhile, S2 and S3 cannot meet the flexibility indicator as they cannot provide many answers. As for the originality indicator, it is observed that none of them can meet this indicator because they cannot provide new ideas. In terms of the elaboration indicator, it is seen that only S1 can meet this criterion because they can develop ideas and detail their answers. However, S2 and S3 cannot meet the elaboration indicator because they cannot develop ideas and detail their answers.

Conclusion Drawing Stage

Based on the results of written tests, field notes, and interviews, S1 demonstrates high self-confidence and meets the fluency indicator with sub-indicators such as expressing many ideas/thoughts, flexibility by generating many responses, and elaboration by developing an idea/thought and adding or detailing a concept. However, S1 does not meet the originality indicator with sub-indicators related to generating new ideas.

S2's self-confidence is currently able to meet the indicator of fluency with the sub-indicator of expressing many ideas/concepts, but it cannot meet the flexibility indicator with the sub-indicators of generating many responses, elaborating with the sub-indicator of developing an idea/concept and adding or detailing an idea, and originality with the sub-indicator of providing new ideas. Meanwhile, S3, with low self-confidence, was unable to meet all indicators of mathematical creative thinking skills.

3.2 Discussion

Indicator of Originality

Based on a comprehensive analysis, the mathematical creative thinking skill of all students fails to meet the originality indicator. This aligns with the study by Dalilan & Sofyan (2022), also Rozi & Afriansyah (2022), which states that in terms of originality, students are also unable to provide solutions that are unusual or uncommon. Students can solve problems correctly and in detail but in the same way as the steps demonstrated by their teachers.

Indicator of Mathematical Creative Thinking Skill Between Moderate and Low Self-Confidence

Based on the comprehensive results, students with moderate and low self-confidence do not fulfill all indicators of mathematical creative thinking skills. Several tests completed by students with moderate and low self-confidence were correct but did not meet the sub-indicators for all indicators of mathematical creative thinking skills. This is because students with moderate and low self-confidence often hesitate to answer and doubt their answers, resulting in a lack of development in their mathematical creative thinking skills. This aligns with the opinion of Abbasi et al. (2020), Furthermore, Indriati (2022) stated that students also rush to conclusions, so that in problem-solving, their creative thinking skills do not develop, either in generating new ideas, new concepts, or alternative answers or methods.

Meanwhile, students with confidence can meet the fluency indicators, whereas students with low confidence do not meet all indicators of mathematical creative thinking skills. This is in line with the opinion of Junaedi & Juandi (2021) because students with confidence can provide alternative ideas.

High Self-Confidence in Flexibility Indicator

Based on the overall results, students with high self-confidence cannot fulfill the flexibility indicator. This is consistent with the opinion of Eviliasani et al. (2018), who stated that students with moderate creative skills in the flexibility indicator still face difficulties in partitioning plane figures into other forms of plane figures. This is because students only provide one answer when working, not fulfilling the sub-indicator of being able to generate multiple answers. This is due to students rushing through their work, resulting in an inskill to provide alternative answers. This is consistent with the views of Demuyakor (2020), who stated that students do not feel confident to seek and do something beyond what is exemplified by their teacher.

4. Conclusion

The level of students' confidence in social arithmetic material influences the level of students' mathematical creative thinking skills. This can be observed in students with high confidence being able to fulfill three indicators of mathematical creative thinking skills, namely fluency, flexibility, and elaboration, but not authenticity. Students with moderate confidence can fulfill one indicator of mathematical creative thinking skill, which is fluency, but are unable to fulfill flexibility, elaboration, and authenticity indicators. Meanwhile, students with low confidence are unable to fulfill all indicators of mathematical creative thinking skills.

The implications regarding the analysis of students' mathematical creative thinking skills in terms of self-confidence in social arithmetic materials, learning social arithmetic materials, if students have good self-confidence, then their mathematical creative thinking skills will also be good, and vice versa. Researchers have suggestions if anyone wishes to conduct similar research and is interested in studying mathematical creative thinking skills, namely, by reviewing students' mathematical creative thinking skills from other affective aspects, such as their interest or curiosity in mathematics; or they could also focus on other mathematical topics.

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Author Contribution

Author 1: Conceptualization, Writing - Original Draft, Formal analysis, and Methodology;
Author 2: Conceptualization, Writing - Review & Editing, Formal analysis, and Visualization;
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Conflict of Interest

The authors declare no conflict of interest.

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