UJMER 10 (1) (2021) 24 - 34

Unnes Journal of Mathematics Education Research

http://journal.unnes.ac.id/sju/index.php/ujmer

Students' Mathematical Creative Thinking Ability in terms of Learning Styles and Gender in Problem Based Learning

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Article Info

Article History:
Received :
10 December 2020
Accepted:
29 January 2021
Published:
30 June 2021

Keywords:
Mathematical Creative Thinking Ability, Problem Based Learning, Learning Styles, and Gender

Abstract

This researchaims to describe students' mathematical creative thinking abilities in terms of learning styles and gender.The method used is descriptive qualitative, data collection techniques in this study were carried out through direct activities at school. Data collection was carried out by means of tests of mathematical creative thinking skills, learning style questionnaires, interviews and documentation.
The results of the research are (1) students 'mathematical creative thinking abilities in terms of visual and gender learning styles are more likely to fulfill authenticity and detail indicators, but what is unique is that only one subject can fulfill fluency and flexibility indicators, (2) students' mathematical creative thinking abilities in terms of style. Auditory learning and gender are more likely to meet the indicators of authenticity and detail, however, what is unique is that only one subject cannot meet the indicators of flexibility and fluency, and (3) students' mathematical creative thinking abilities in terms of kinesthetic learning styles and gender, there are only two students who tend to fulfill indicators of fluency, flexibility and detail and two students meet indicators of fluency and detail because they are able to solve problems in a very detailed and systematic manner,while the other two students only meet the authenticity indicator.

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p-ISSN 2252-6455
e-ISSN 2502-4507

INTRODUCTION

The development and improvement of the education sector in Indonesia continues to be carried out because through education human resources can be fostered. Investment in education is a long-term investment in macro terms, the benefits of this investment can only be felt after ten years of efforts to improve the quality of human resources. The quality of human resources has a significant influence on the development of a country. One measure of quality human resources is seen from the aspect of education quality. Achieving the quality of education depends a lot on how the teaching and learning process is designed and applied professionally.

Mathematics is one of the subjects that plays an important role in education (Rizqi, 2019). Through mathematics students are prepared to be able to deal with changing circumstances that develop based on logical, critical, rational, honest, careful thinking and use a mathematical mindset (Saputri et al, 2016). In addition, mathematics can also describe problems in everyday life in a mathematical model so as to get a faster and simpler solution (Sulistyawati et al, 2018).

Mathematics learning also needs to be designed in several ways so that it can be used to develop students' mathematical creative thinking skills (Sulistyawati et al, 2018). Students' abilities needed in learning mathematics include the ability to communicate, think critically, and think creatively (Pratiwi et al, 2019). The importance of creative thinking is as a way of generating ideas that can be applied to world problems (Maftukhah et al, 2017). Mathematical creative thinking is a combination of logical thinking and divergent thinking based on intuition but still in awareness (Nugroho, et al, 2013).

Not only students 'creativity in solving a problem, learning styles have an important role in students' mathematical creative thinking processes and improve student achievement (Geradus, & Bire. 2014). There are several factors that influence students' mathematical creative thinking processes in solving problems, including internal factors and external factors (Richardoet al,2014). In line with this Afifudinet al,(2017) said that basically students learn according to their learning styles, and each learning style has an effect on thinking processes and learning outcomes. Every student has a different way of thinking in solving problems, this is thought to be influenced by their learning style.

The learning model that is thought to improve students' mathematical creative thinking skills is problem-based learning. The problem-based learning model is a problem-focused, student-centered learning model and student-teacher self-reflection (Wahyuniet al,2016). Asikin, & Cahyaningrum, (2015) state that problem-based learning is a learning model that encourages student understanding of the material and applies their knowledge to solve daily problems.

Based on an interview with Ms. Heni as a math teacher at MTS Islamic Center Cirebon in 2019, he informed that there are still students who think mathematics is a difficult and scary subject. This is caused by the learning process used by the teacher, namely conventional.Students are also less actively involved in participating in learning activities and cannot work on questions that are in accordance with creative thinking skills and there are still many students who get scores below the KKM on flat shape material.Several studies describe the problems faced by some students in carrying out the mathematics learning process, namely students do not really understand the material they are studying or even the material they have studied (Rizqi, 2018). In line with this, Rizqi (2019) argues that the average math teacher in the school still uses conventional methods, teachers rarely form study groups in class, there is minimal variation in math problems presented in class, students are not given enough opportunities to present their answers, and the teaching materials used in learning do not attract students' interest in learning.

Students have not had the freedom to express the ideas they have because learning is dominated by teachers from the beginning to the completion of the learning process and students memorize more mathematical concepts given by the teacher (Rizqi, 2019). Based on the relevant research results, there is a significant influence on visual, auditory and kinesthetic learning styles on learning achievement (Geradus, & Bire, 2014). Students' creative thinking skills can develop well and increase in students, so that this ability can be developed properly through

problem-based mathematics learning (Arifin et al,2019). The results of Afif's research et al,(2016), the following conclusions were obtained, from 34 students of class VIII E in problem-based learning there were 7 students with visual learning styles, 22 students with auditory learning styles, 2 students for kinesthetic learning styles, 2 students for auditory visual learning styles, and 1 student type of visual kinesthetic learning style. In problem-based learning, students are required to be more active in finding alternative solutions and students will use their existing learning styles to solve these problems, so it is hoped that learning objectives can be achieved according to teacher expectations and students' creative thinking skills increase in terms of learning styles and gender.

In problem-based learning, students are required to be more active in finding alternative solutions and students will use their existing learning styles to solve these problems, so that it is hoped that learning objectives can be achieved according to teacher expectations and students' creative thinking abilities increase in terms of learning styles and gender. This research aim at know the description of students' mathematical creative thinking abilities in terms of learning styles and gender.

METHOD

The research method used is descriptive qualitative, the results shown from the research will be analyzed and described to describe the mathematical creative thinking skills. Data collection techniques in this study were carried out through direct activities at school. The data was collected by means of tests of mathematical creative thinking skills, documentation, learning style questionnaires and interviews. Qualitative research subjects came from students in the experimental class.

The data collection techniques used in this study consisted of observation, testing, questionnaires, documentation and interviews. The research instruments were tests of creative thinking skills, learning style questionnaires, and interview sheets. The goal is to find out the description of students' mathematical creative thinking abilities in terms of learning styles and gender.

RESULTS AND DISCUSSIONS

Description of Students' Mathematical Creative Thinking Ability

The data for grouping students based on learning styles and gender were obtained from filling out a learning style questionnaire with 30 questions, while the grouping category was the learning style group with gender in Table 1

Table 1. Grouping students based on learning styles and gender

No.	Student Code	L / P	Postest Value	Learning Style	Group
1	R-2	P	83	Kinesthetic	Upper Group
2	R-32	L	82	Kinesthetic	
3	R-15	P	80	Auditory	
4	R-27	L	80	Auditory	
5	R-14	P	79	Visual	
6	R-33	L	78	Visual	
7	R-8	P	75	Visual	Middle Group
8	R-1	P	75	Kinesthetic	
9	R-25	L	75	Kinesthetic	
10	R-9	P	74	Auditory	
11	R-23	L	74	Auditory	
12	R-34	L	66	Visual	
13	R-5	P	64	Auditory	Lower Group
14	R-16	P	64	Kinesthetic	
15	R-30	L	64	Visual	
16	R-3	P	62	Visual	
17	R-21	L	62	Auditory	
18	R-28	L	50	Kinesthetic	

The following is one of the student jobs:

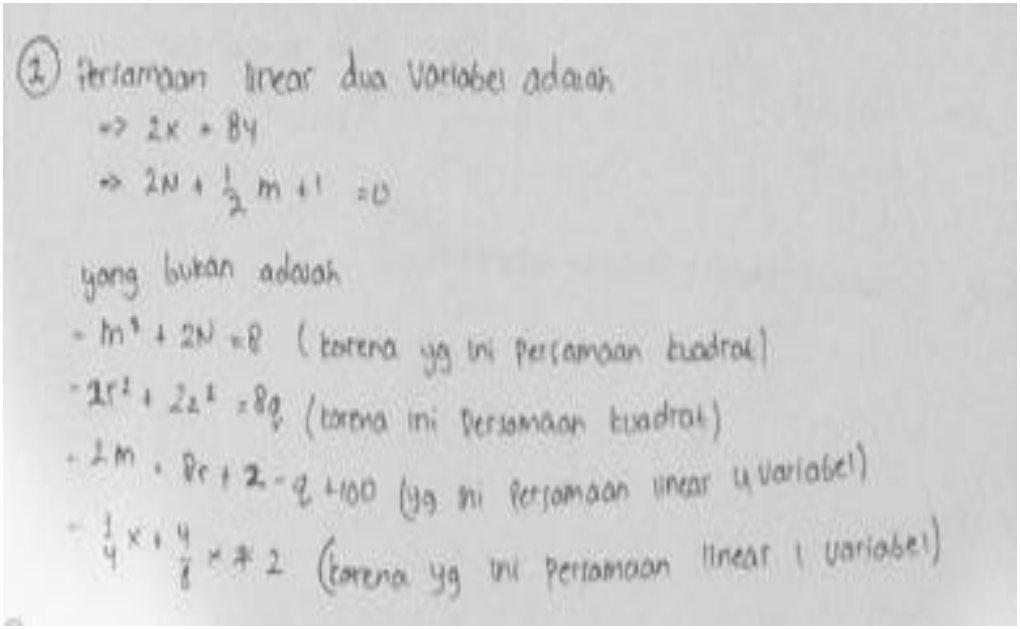
a. Subject R-32

Analysis of the creative thinking ability of the subject R-32 includes the results of tests of creative thinking abilities and the results of interviews. The results of tests of creative thinking skills and interviews will be used as a basis for describing students' creative thinking abilities and then grouping students into a specific Mathematical Creative Thinking Ability (TBKM), which will later draw conclusions by means of data triangulation. Following are the results of data analysis of the subject R-32 on the written test, interview, and triangulation.

1) Fluency indicator

a) Written test data

The following is the work of Subject R-32 for the fluency indicator which can be seen in Picture 1.



Picture 1. Answer subject R-32

Based on picture questions 1, the answers to the subject R-32 on the mathematical creative thinking problem item number 1, the subject R-32 is able to provide answers smoothly and correctly accompanied by the right way to do it. However, the information provided was still incomplete. Overall, the work on item 1 was correct and directed.

b) Interview result

Regarding the data on the results of the R-32 mathematical creative thinking ability test, the researcher then conducted an interview with the R-32 subject to further explore the indicators of fluency. The following is a snippet of the interview with the subject R-32 as presented in Table 2.

Table 2. Interview with the subject R-32

P	Previously, have you ever worked on a problem like this?
R-32	Not yet, sir
P	Did you do the test questions using your own ideas
R-32	Yes sir
P	Can you name the information provided in the question? Mention.
R-32	Can you, I can group the information that is known from the questions directly between PLDV and non-PLDV
P	You have completed the student ability test (shows the results of the student's abilities that have been made). How do you get the thoughts (ideas) to solve this problem?
R-32	I got the idea by looking at the question being asked, namely the word "group the equations that are included in PLDV". So I just grouped it, sir. I see, sir.
P	Are there any obstacles or difficulties in getting thoughts (ideas) to solve this problem? Try to explain.
R-32	There is pa, maybe the conclusion in the end result that I forgot to write pa
P	Do you feel that you combine several other thoughts (ideas) to solve the problem? How did the process happen?
R-32	No pa, I just categorized it
P	Are you sure your answer is correct?
R-32	Sure sir

The interview snippet shows that the subject R-32 fulfills the indicators of fluency in solving item 1. R-32 is able to work on problems fluently, R-32 is also able to explain again the answers that have been written smoothly and clearly.

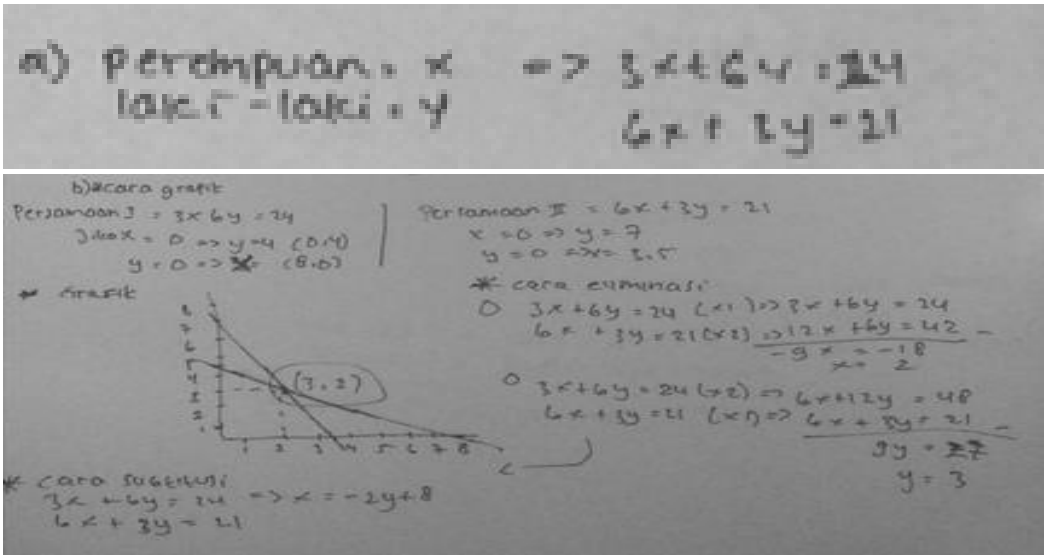
c) Data triangulation

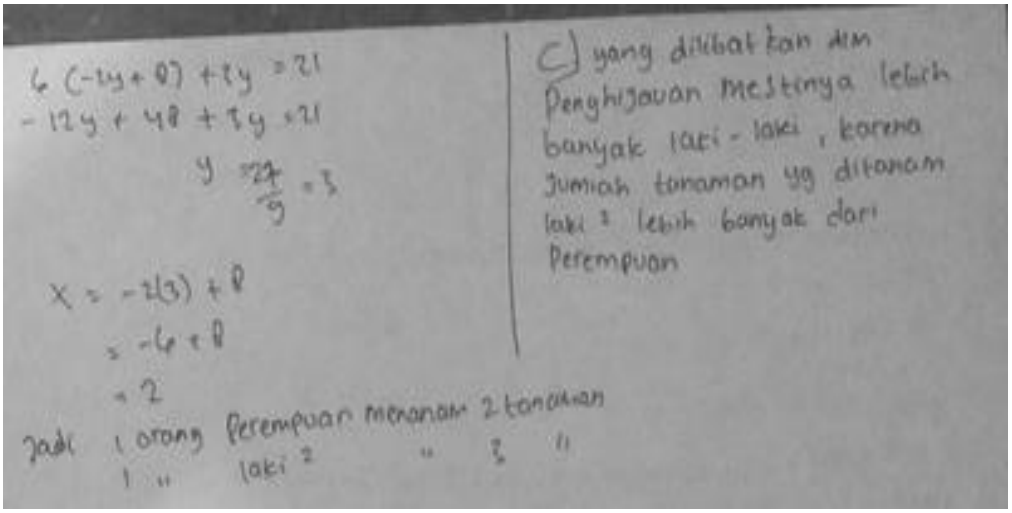
Based on the test results, R-32 was able to work on item 1 correctly and smoothly, but the explanation was still not perfect. After the interview activity was carried out, R-32 explained quite well, R-32 also provided clear information and there were some who were not given reasons, from the triangulation, it can be concluded that R-32 has met the smoothness indicator for the item questions the.

2) Flexibility indicator

a) Written test data

The following is the result of the work of the subject R-32 for the flexibility indicator which can be seen in Picture 2





Picture 2. Answer subject R-32 for item number 2

Based on Picture 2, the answer to R-32 meets the flexibility indicator because it has given several answers correctly and correctly.

b) Interview result

Regarding the data on the results of the R-32 mathematical creative thinking ability test, the researcher then conducted an interview with the R-32 subject to further explore the indicators of flexibility. The following is a snippet of an interview with the subject R-32 which will be presented in Table 3.

Table 3. The results of the interview subject R-32

P	Do you understand the meaning of this question statement
R-32	Got it, sir
P	Do you have any other answers besides the ones you wrote?
R-32	I think there is, sir
P	If there is how?
R-32	$3w + 6p = 24 \Rightarrow w = 8 - 2p$ Substitute it $w = 8 - 2p$ to equation (2), then $6(8 - 2p) + 3p = 21$ $\Leftrightarrow 48 - 12\text{p} + 3\text{p} = 21$ $\Leftrightarrow 9\text{p} = 27$ $\Leftrightarrow \text{p} = 3$ Then substitute it to equation to (1), then$\text{p} = 3$ $3w + 6(3) = 24$ $\Leftrightarrow 3\text{w} = 24 - 18$ $\Leftrightarrow 3\text{w} = 6$ $\Leftrightarrow \text{w} = 2$
P	Are you sure of the completed answer?
R-32	Insa Allah sir

In the interview excerpt, subject R-32 has met the indicators of flexibility in item number 2, in item number 2, subject S-32 finds another way, namely by using a table and also the two-time substitution method. The way the subject R-32 is conveyed is correct and easy to understand. The explanation given is also quite clear.

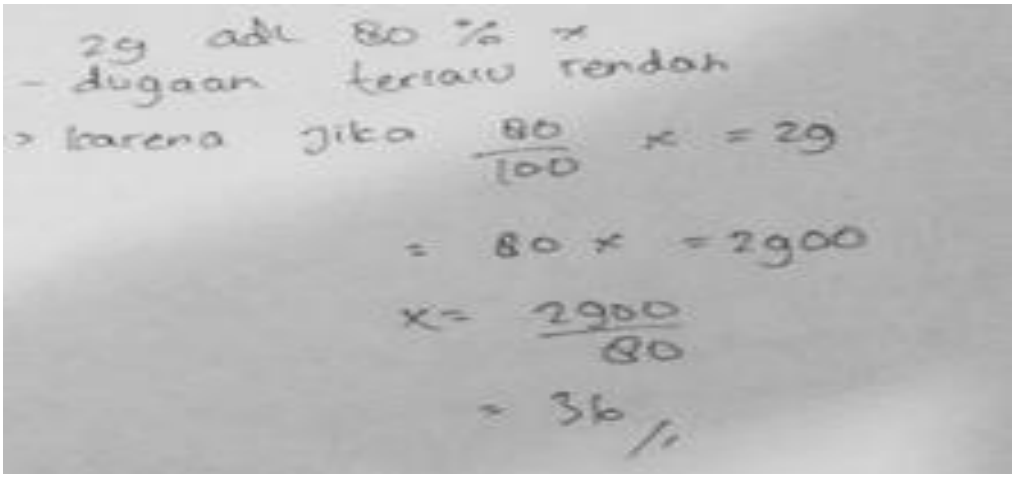
c) Data triangulation

Based on the test results for item 2, subject R-32 has been able to solve the problem by using more than one method with the correct process and answer, but the initial information for working on the question is not included in the answer and after being confirmed through the interview subject R- 32 was able to provide a pretty good explanation. The workflow is correct, but the initial information before working on the questions has not been included in the answer. Based on this triangulation, the subject of R-32 fulfills the flexibility indicator for item 2.

3) Originality indicator

a) Written test data

The following is the work of Subject R-32 for authenticity indicators which can be seen in Picture 3.



Picture 3. The answer to subject R-32 for item number 3

Based on Picture 3, the R-32 subject can provide answers by writing all the correct formulas and correct steps, but they are commonly used but the results are still wrong, so they do not meet the original indicators.

b) Interview result

Regarding the data on the results of the R-32 mathematical creative thinking ability test results, then the researcher conducted an interview with the R-32 subject to further explore the authenticity indicator. The following is a snippet of the interview with the subject R-32 as presented in Table 4.

Table 4. Results of interviews with the subject R-32

P	In your opinion, what does the question reveal?
R-32	29 is 80% of a number Rizqi guessed that the number was around 60 Is the allegation of rizqi correct?
P	Is there a connection between these questions? Explain!
R-32	Yes sir, if we know what information is contained in the question and what is being asked, I can solve the problem, sir
P	Based on the questions given, what things must be resolved first? Tell me.
R-32	The thing that must be solved is to make the initial equation for pa, then after that, just calculate pa
P	In your opinion, what should be considered or paid attention to in solving this problem?
R-32	In my opinion, sir, what should be considered is 29 is 80% of a number with an initial guess of 60. If I don't pay attention to this, maybe the problem isn't finished, sir.

In the interview excerpt, for item 3, R-32 provides an answer by writing all the correct formulas and correct steps, but it is commonly used but the results are still wrong, so R-32 does not meet the authenticity indicator.

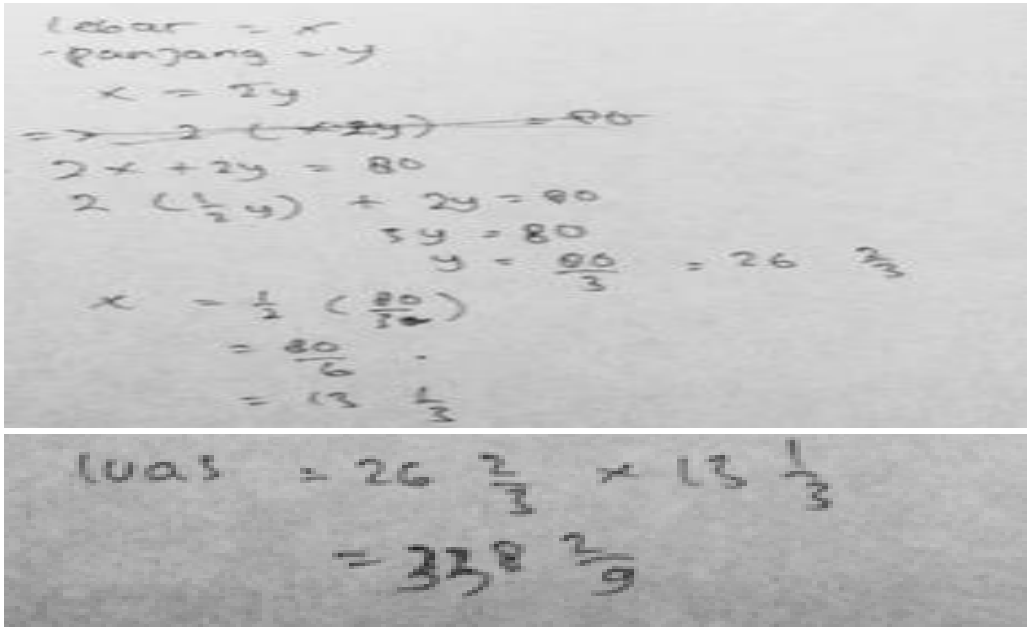
c) Data triangulation

Based on the test results for item number 3 do not meet the indicators of authenticity, the answers that have been given have written all the correct formulas and the right steps, but are commonly used but the results are still wrong, but after being confirmed by interview activities the subject R-32 is able to solve the questions well but the end result is wrong and the steps are like in general, so based on the triangulation it is found that the R-32 subject does not meet the authenticity indicator

4) Elaboration indicator

a) Written test data

The following is the result of the work of Subject R-32 for the detail indicator which can be seen in Picture 4.



Picture 4. Answers to subject R-32 for item number 4

The item that contains the detail indicator is item number 4, based on Picture 4 it shows that the subject R-32 has given an answer with a complete, clear, detailed procedure and the result is correct, so the R-32 has met the detail indicator.

b) Interview result

In connection with the data on the results of the R-32 mathematical creative thinking ability test, the researcher then conducted an interview with the R-32 subject to further explore the indicators of detail. The following is a snippet of an interview with the subject R-32 as presented in Table 5.

Table 5. Results of interviews with the subject R-32

P	Do you understand the meaning of this statement about?
R-32	Got it, sir
P	Can you tell us how you solved this problem?
R-32	I solve the problem by writing down the information on the problem, then converting it into a mathematical symbol and using a rectangular formula, then plugging in the complex numbers and calculating as usual sir
P	Is this the answer to your own thoughts?
R-32	That's right
P	Based on the questions given, what guesswork did you come up with to apply to your answer?
R-32	My guess is that I can use the rectangular formula to get the answer to this question, sir. Incidentally, the problem is easy to understand, sir
P	Explain the conclusions you did!
R-32	I conclude that the result is 355.5555. But it looks like on the answer sheet I wrote it differently, pa hehehe
P	Have you ever worked on a problem like this?
R-32	Almost like sir
P	Where did you come up with ideas for solving this problem? (classes, books, tutoring, daily experiences) Why?
R-32	I practiced questions, sir. I've met something that is almost similar to sir
P	Do you think the methods, concepts, or procedures for solving the problems are "new" or have never been thought of before?
R-32	Never thought sir
P	Are you sure of the completed answer? If not, why did this happen? What would you do!
R-32	Sure pa, it's just that I wrote the answer in lin form

In the interview excerpt, it was found that the R-32 did not yet meet the detailed indicators, because it had done detailed steps and the final result was correct. so that the R-32 has met the detail indicator.

c) Data Triangulation

Based on the test results for item number 4, it has met the detailed indicators, because it has worked with detailed steps and the final result is correct, but after being confirmed by the R-32 interview activity, it is able to solve the questions properly and the final result is correct, then based on the triangulation it is obtained that the R-32 has met the detail indicator.

The results of the exposure to the mastery of indicators of creative thinking abilities, R-32 is able to meet three indicators of creative thinking abilities, namely: indicators of fluency, flexibility and detail.

Based on these results, the research conducted by Wahyudi et al. (2017) states that The results showed that subjects with visual and kinesthetic learning styles were faster to understand and solve problems, so that they met more indicators of mathematical creative thinking abilities. As for according to Febryana, (2018) the fluency aspect refers to the truth and diversity of answers given by students, the flexibility aspect refers to the different ways students solve problems, while the novelty aspect refers to the answers given which are unusual for the level of student knowledge in general. and it can also refer to a new way that students present, this new way can be a combination of knowledge that students have previously acquired.

Febryana, (2018) said that women are weak in problems related to abstracts, which results in women being considered weak and less capable of learning mathematics. However, research by Nurmitasari & Astuti (2017) shows that male students and female students have the same good learning achievement. Nafi'an (2011) states that gender differences are no

longer only related to biological problems but then develop into differences in abilities between men and women.

CONCLUSION

Based on the research findings and discussion data presented in this study, the following conclusions can be drawn: (1) students' creative thinking abilities in terms of visual and gender learning styles are more likely to fulfill indicators of authenticity and detail, but what is unique is that only one subject can fulfill the indicators of fluency and flexibility, (2) students 'creative thinking abilities in terms of auditory learning styles and gender are more likely to fulfill authenticity and detail indicators, however, what is unique is that only one subject cannot fulfill the flexibility and fluency indicators, and (3) students' creative thinking abilities in terms of style learn kinesthetic and gender there are only two students who tend to meet the indicators of fluency,flexibility and detail and two students met the indicators of fluency and detail because they were able to solve problems in a very detailed and systematic manner, while the other two students only met the indicators of authenticity.

Suggestion:

The suggestion of this research is that the problem-based learning model is not implemented optimally, this is due to the pandemic period which causes the learning process to run in a very short time, and the need for extra treatment from the teacher so that problem-based learning gets effective results in running it.

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