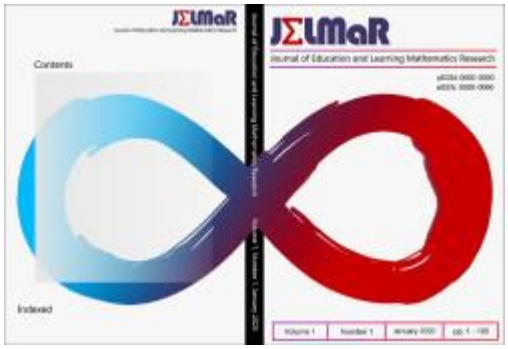

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Students Creative Thinking Ability With Reflective Cognitive Style On The Phytagoras Theorem

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***Abstract**: Mathematics is a universal science that cannot be separated from human life. Mathematics has an important role in supporting the development of science and technology. In learning mathematics, students' creativity is needed because in mathematics students are expected to be able to come up with new creative ideas in analyzing and solving problems. The way students solve problems will be different according to their cognitive style. So that differences in cognitive styles can trigger differences in students' creative thinking. The type of research used in this research is qualitative research with descriptive method. The subjects in this study were students of class VIII K at SMP Negeri 2 Balaraja who had received the Pythagorean theorem material. Subject selection was done by purposive sampling technique. The instruments used in this study were test and non-test instruments. The test instrument used is the Matching Familiar Figures Test (MFFT) test sheet and the creative thinking ability. While the non-test instrument used in this study was an interview guide. The data analysis of this research used the constant comparative method. Data analysis in this study was carried out through three stages, namely: 1) data reduction, (2) data presentation, (3) drawing conclusions.Based on the results of the data analysis and discussion that has been presented, it can be concluded that based on the reflective cognitive style, students' mathematical creative thinking abilities can be grouped into 2 groups in each indicator with different creative thinking abilities.*

Keyword: creative thinking, cognitive styles

INTRODUCTION

Mathematics is a universal science that cannot be separated in human life. Mathematics has an important role in supporting the development of science and technology (Sundayana, 2016). In Indonesia, the importance of mathematics in various aspects of life can be seen by the existence of rules in the National Education System which explain that mathematics is one of the subjects that must be contained in the primary and secondary education curriculum (UU Nomor 20 Tahun 2003).

In mathematics learning, student creativity is needed because in mathematics there are problems that involve students to think creatively and students are expected to be able to put forward creative new ideas in analyzing and solving problems (Kemdikbud, 2013). The ability to think creatively in mathematics is commonly referred to as the ability to think creatively mathematically. Creative thinking is a form of mental activity that can create or produce a fairly new idea or idea (Fitriana & Sudiana, 2020). Creative thinking is a mental activity that a person uses to build new ideas or ideas (Tatag Yuli Eko Siswono, 2008). According to Munandar (1999) creative thinking is the ability to create something new that can be applied in problem solving. Silver (1997) mentioned that the ability to think mathematically creative has several indicators, namely *fluency*, *flexibility*, and *novelty*.

According to (Andianti & Rafianti, 2021), the difficulty of students in understanding mathematics lessons is caused by several cognitive factors, one of the factors is the lack of creative thinking ability possessed by students. Based on TIMSS (*Trends in International*

Mathematics and Science Study) data which is an international institution on mathematics and science achievements of junior high school students in class VIII, the mathematics achievement ranking of grade VIII (SMP) students in Indonesia in 2018 was ranked 38th out of 42 countries with a score down 19 points from the TIMSS results in 2007, namely 405. This score is still below the international average score of 500. Meanwhile, based on PISA (*Programme for International Student Assessment*) in 2018, Indonesia is ranked 75th out of 80 countries with an average score of Indonesian students' mathematics ability of 379. The score is still below the international average of 459.6. From these achievements, it can be seen that students in Indonesia are only able to solve simple problems. This means that students' high-level mathematics thinking skills such as creative thinking, critical thinking and so on are still very lacking. Wardani & Rumiyati (2011) stated that based on the results of the PISA and TIMSS evaluations, this shows the low creativity of students in mathematics, because the questions tested in PISA and TIMSS are contextual problems, demanding reasoning, argumentation and creativity in their completion.

In solving mathematical problems, everyone has different ways and processes of thinking because not everyone has the same thinking ability and has a special way of acting, which is expressed through perceptual and intellectual activities consistently (Indriati et al., 2019). According to Solso (1995), most people can be assumed to be creative, but have different degrees of creativity. The way the student solves the problem will differ according to the cognitive style he has. So that differences in cognitive styles can trigger differences in students' creative thinking. Cognitive style is a characteristic of a person in receiving, analyzing and responding to a given cognitive action. According to Bassey et al. (2007) "cognitive style is a control of self-management to determine the conscious activity that a learner uses to organize and organize, receive and disseminate information and ultimately determine behavior".

Based on the description above, it is assumed that creativity and this cognitive style have a very important role and need to be considered in the learning process. However, in reality, mathematics learning still rarely pays attention to students' creativity and cognitiveness. This is in line with the opinion of Siswono (2005) who states that mathematics learning in the classroom still emphasizes students' understanding without involving creative thinking skills. From this, researchers are interested in conducting research with the title "Mathematical Creative Thinking Ability of Students with Reflective Cognitive Styles on Phytagoras Theorem".

METHOD

The type of research used in this study is qualitative research with descriptive methods. According to Moleong (2010), qualitative research is research that aims to understand an event experienced by the research subject, for example behavior, perception, action, holistically and description in the form of words and language by utilizing various scientific methods. The procedure of this study as revealed Moleong (2007) went through 3 stages, namely the pre-field stage, the field work stage, and the data analysis stage.

The instrument used in this study is the researcher himself as the main instrument in data collection. In addition, this study also used two auxiliary instruments, namely test and non-test instruments. The test instrument used in this study is a test sheet containing questions used to measure students' cognitive style and creative thinking ability. The cognitive style test used in this study is the *Matching Familiar Figures Test* (MFFT) designed and developed by Warli (2010) and has proven its validity and reliability. The creative thinking ability test consists of 3 questions in the form of a description. This test is compiled based on the indicators of creative thinking ability presented by Silver (1997),

namely: (1) *fluency*, (2) *flexibility*, and (3) *novelty* aspects. Meanwhile, the non-test instrument used in this study was the interview guideline.

The subjects in this study were class VIII K students at SMP Negeri 2 Balaraja who had received phytagoras theorem material. The selection of this subject is carried out by *purposive sampling* technique. *Purposive sampling* is a sampling technique that is carried out by determining certain criteria. The subject criteria here are based on the results of the cognitive style difference test obtained using the *Matching Familiar Figure Test* (MFFT) instrument. If the MFFT results are found that the student has a reflective cognitive style, then it is chosen to be the subject. Furthermore, the responses of all subjects who have a reflective cognitive style are carried out categorization. The data analysis of this study as a whole uses a *constant comparative method*, so that more detailed subject exposure is carried out on two subjects from each of these categories. Data analysis in this study was carried out through three stages, namely: 1) data reduction, (2) data presentation, (3) drawing conclusions.

RESULT AND DISCUSSION

Result

After the cognitive style test, students with reflective cognitive style take the next test, which is the creative thinking ability test and interview. Based on student responses on *fluency* indicators, subjects can be grouped into 2 response groups, namely groups of students who are fluent and able to represent problems with various and groups of students who have not been able to represent problems variously. To describe students' creative thinking ability reflectively on fluency indicators, two groups will be formed, namely fluency group 1 and *fluency* group 2. In the *flexibility indicator*, the responses of the subjects can be grouped into 2, namely the group of students who are able to provide 2 different ways of completion and the group of students who are only able to provide 1 way of completion. To describe students' creative thinking ability reflectively on *the flexibility indicator*, two groups will be formed, namely *flexibility* group 1 and *flexibility* group 2. And for *novelty* indicators, the responses of the subjects can be grouped into 2, that is, groups of students who use unique and different ways and groups of students who use ordinary ways. To describe students' creative thinking ability reflectively on novelty indicators, two groups will be formed, namely the novelty group 1 and *the novelty* 2 group.

To describe students' mathematical creative thinking ability with a reflective cognitive style, one group will be taken by one person to decrypt the response. Meanwhile, the selected subjects to be described are presented in the following table.

Table 1. Selected subjects

Group	Selected Subjects
Fluency 1	IK
Fluency 2	FF
Flexibility 1	IK

Flexibility 2	MAF
Novelty 1	MAS
Novelty 2	MAF

A. *Fluency* Group 1

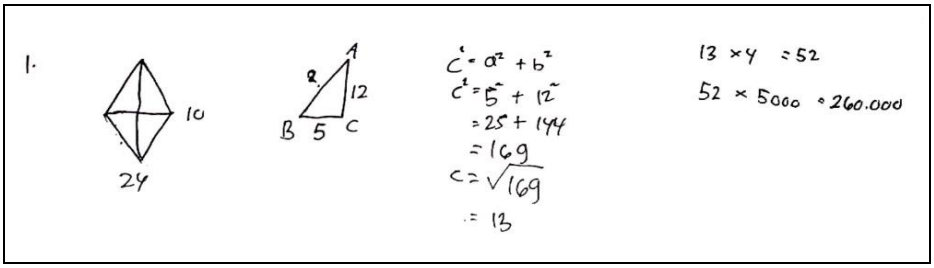

Figure 1. IK subject test results

Based on the results of the creative thinking test presented in the picture above, it was obtained that IK was able to connect the mathematical concept he chose with the problem presented. Then, the answers given are also complete and correct.

Related to the data analysis of the results of the IK creative thinking test, researchers conducted interviews with IK to find out more about IK's creative thinking ability in the *fluency* aspect.

P : "*Have you ever encountered and done a problem like this before?*"
IK : "*Ever. Tapu forgot*"
P : "*When and where did you find a question like this?*"
IK : "*Time is repeated if not wrong*"
P : "*Do you understand the meaning of question no. 1*?"
IK : "*Understand*"
P : "*Try to explain*"
IK : "*Order to find the price of the wire entirely to go around the garden. So the current is sought first around the garden with a diagonal that is already known*".
P : "*Did you have any difficulties while doing this question?*"
IK : "*None*"
P : "*Are you sure that the answer you have written is correct? Try to explain your answer*"
IK : "*I'm not sure. Eh, it's okay*".
P : *Let you explain the solution you have done on question no. 1*"
IK : "*So this was originally drawn rhombic first, with known diagonals. Then later form some right triangles, well take one of them. From this triangle the sides of the diagonal were divided by 2, so 5 m and 12 m. But, there is one side that is not yet known, that is, the hypotenuse. And the hypotenuse of this triangle is the side of the rhombus. So, you must first find the hypotenuse using the phytagoras theorem. It gets 13 m. Because the rhombus has 4 sides, so 13 x 4 = 52. The perimeter of the garden is 52 m, and if you want to be surrounded by wire at a price of Rp. 5000 per meter, just multiply Rp. 5000 x 52 = Rp. 260,000*"
P : "*Apart from this is there any other event?*"

IK : "*I don't think of any other way*"
P : "*Did you solve this problem with your own thinking ideas?*"
IK : "*Yes, I have thought about this when I read the problem*"

Based on the results of tests and interviews that have been conducted, it can be seen that the subject of IK is able to solve the problem using the concept of the phytagoras theorem. The subject of IK is able to use and distinguish mathematical symbols such as A for angles and a for sides, IK can use different points of view to solve problems related to flat building, namely by using the phytagoras theorem. Thus, this IK has met the *fluency* indicator.

B. *Fluency* Group 2

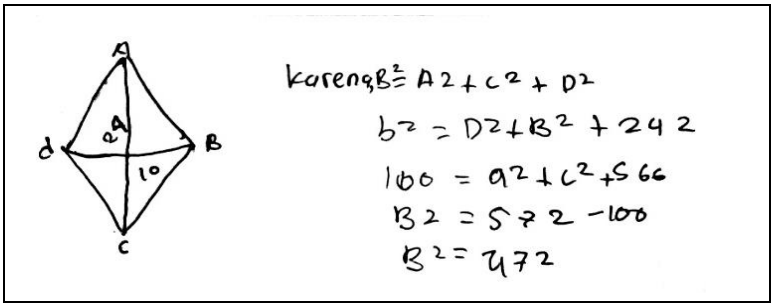

Figure 2. FF subject test results

Based on the results of the creative thinking test presented in the picture above, it was found that FF has not given an exact answer to the problem given. The answer given by FF is far from the existing command.

Regarding the data analysis of FF creative thinking test results, researchers conducted interviews with FF to find out more about FF's creative thinking ability in *the fluency* aspect.

P : "*Have you ever encountered and done a problem like this before?*"
FF : "*I've seen it*"
P : "*When and where did you find a question like this?*"
FF : "*Practiced questions in the book*"
P : "*Do you understand the meaning of question no. 1*?"
FF : "*Lack of understanding.Hmmm... But he was told to find the price of wire to go around the garden. So look around the garden first, sis?*"
P : "*Did you have any difficulties while doing this question?*"
FF : "*Hmmmm... Confused about how to find the circumference. This is what is known only the diagonal. So it's just confusing*"
P : "*Are you sure that the answer you have written is correct?*"
FF : "*No sis*"
P : "*Let you explain the solution you have done on question no. 1*"
FF : "*How about ya sis... Confused sis. But first drawn the rhombus, after that, yaudah added to this*"
P : "*Apart from this is there any other event?*"
FF : "*No sis*"
P : "*Did you solve this problem with your own thinking ideas?*"
FF : "*Yes, alone*"

Based on the results of tests and interviews that have been conducted, it can be seen that the FF subject is not able to give the correct answer and the FF has not been smooth to determine the solution that will be used to solve a problem. Thus, this FF does not meet the *fluency* indicator.

C. *Flexibility Group* 1

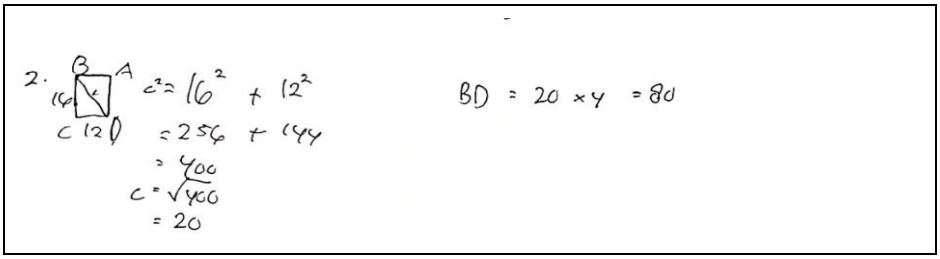

Figure 3. IK subject test results

Based on IK's answer to the creative thinking question shown by the picture above, it was obtained that the IK subject was able to answer the question correctly. However, IK also only wrote down 1 solution in this problem.

In relation to the data analysis of the results of the IK creative thinking test, researchers conducted interviews with IK to find out more about IK's creative thinking ability in the *flexibility* aspect.

P : "*Are you sure of the way of settlement you have written?*"
IK : "*Sure*"
P : "*Are you able to explain the way of completion that you have worked on on the answer sheet?*"
IK : "*Can*"
P : "*Try to explain*"
IK : "*There are many rectangular-shaped windows. The windows are rich in trellis, so they are smaller rectangular in shape. The question that is asked from this question is the BD Length. Because BD is a large rectangular diagonal, so here I find a small rectangular diagonal first using the phytagoras theorem like this (showing the answer). After that it can be diagonally 20 cm. Make it to BD, there are 4 small rectangles, so 20 x 4 results in 80 cm*"
P : "*Can you find a different way to solve the problem?*"
IK : "*There is a sis, so you are looking for the length and width of the rectangular whose size, later using phytagoras also get the BD*"
P : "*Try to write down the answer*"
IK : "*Good sis*" *(Writing down the answer)*

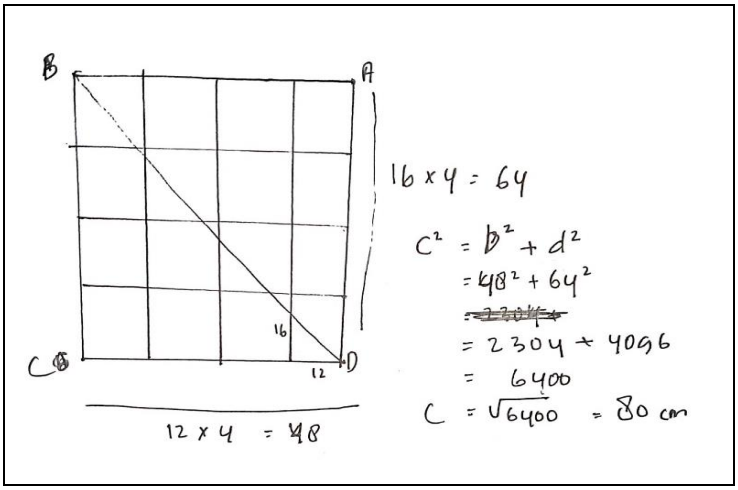

Figure 4. The result of another answer to the subject of IK

Based on the results of tests and interviews that have been conducted, it can be seen that IK is able to do questions for *flexibility* aspects well and IK is able to provide other ways of solving. Thus, this IK has met the *flexibility* indicator.

D. *Flexibility* Group 2

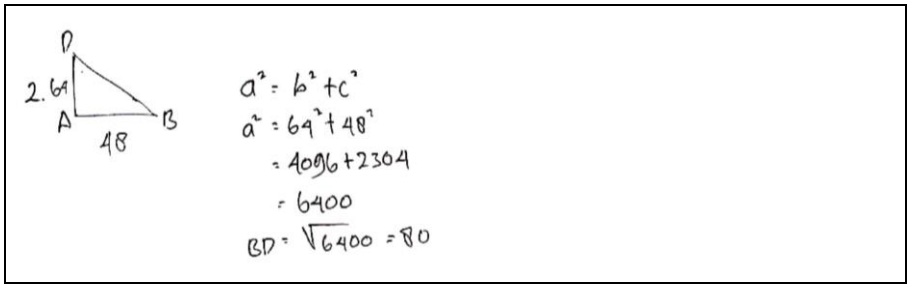

Figure 5. MAF subject Test Results

Based on MAF's answer to the creative thinking question shown in the picture above, it was found that MAF was able to answer the question correctly. However, he did not write in full how he came up with the new measure.

In relation to the data analysis of MAF's creative thinking test results, researchers conducted interviews with MAF to find out more about MAF's creative thinking ability in *the flexibility* aspect.

P : "*Are you sure of the way of settlement you have written?*"
MAF : "*Sure it's true. You see, I've repeatedly calculated the results here.*"
P : "*Are you able to explain the way of completion that you have worked on in the answer sheet?*"
MAF : "*Can*"
P : "*Try to explain*"
MAF : "*This is a rectangular shape with a rectangular shape. Now inside this rectangle there is a small square, with a panang size of 12 cm and a width of 16 cm. Because what BD asked, BD is a large rectangle, so you first look for a large rectangular size by means of its length multiplied by 4 to 48 cm and width multiplied by 4 to 64 cm. After that is drawn a line to BD, forming a right triangle. Now look for the hypotenuse using the phytagoras theorem. This result is 80 cm*"
P : "*Can you find a different way to solve the problem?*"

MAF : "*There's nothing like that*"

Based on the results of tests and interviews that have been conducted, it can be seen that MAF is able to do the questions for *the flexibility* aspect well. However, MAF can only provide 1 way of settlement and cannot provide another way of settlement. Thus, MAF has not met the *flexibility* indicator.

E. *Novelty* Group 1

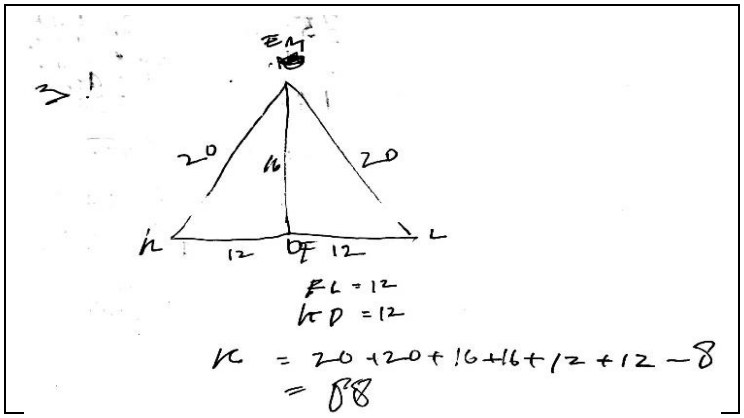

Figure 6. MAS subject Test Results

Based on MAS's answer to the creative thinking question shown by the picture above, it was obtained that MAS was able to get the right answer. In addition to being true, in this matter MAS also uses a different way of solving from other subjects. This different way he uses in looking for sides.

Related to the data analysis of the results of the MAS creative thinking test, researchers conducted interviews with MAS to find out more about MAS's creative thinking ability on the *novelty* aspect.

P : "*Do you think that the answer you have written is a "new" and "different" answer from other answers?*"
MAS : "*The difference is rich*"
P : "*Try to explain your answer?*"
MAS : "*His disoal command to search the circumference of this wake (pointing to the image). If you look at it again, here is one side that is not yet known. Because both are right triangles and the size of the hypotenuse and front sides are the same, so I suppose that these triangles are put together into isosceles triangles. It's a picture like this (pointing at the picture on the answer sheet). That means if it's like this is DK 12 long as well. After that it summed everything up to search the circumference, the result was 96. But here it is reduced to 8 again, because this drawing is 8 cm long. So it's not counted*"
P : "*Have you ever used a formula like this before?*"
MAS : "*If you go around it, it's not totaled. But if it's almost the size of the DK side, it's never used this way.*"
P : "*Are you able to find a different way / another way to solve the problem with a different solution?*"
MAS : "*It's like you can use the phytagoras theorem. You see, this is a right triangle*"
P : "*Can it be written?*"
MAS : "*Klo theorem phytagoras ya sama kaya biasa aja sih, sis*"
P : "*Hmmm.. Okay*"

Based on the results of tests and interviews that have been conducted, it can be seen that MAS is able to do the questions for the *novelty* aspect correctly and MAS is also able to provide a new way of solving them. Thus, this MAS meets the *novelty* indicator.

F. *Novelty* Group 2

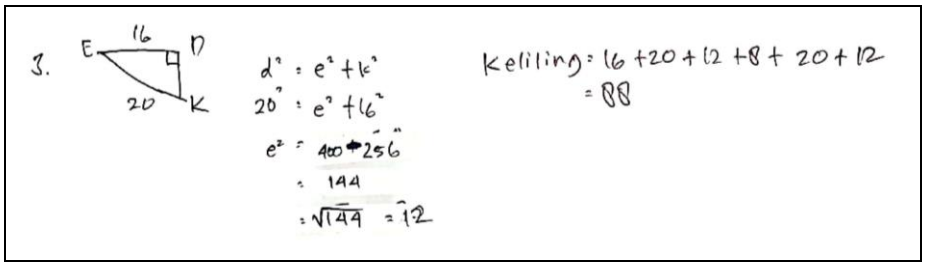

Figure 7. MAF subject Test Results

Based on MAF's answer to the creative thinking question shown in the picture above, it was found that MAF was able to obtain the correct and correct answer. However, MAF did not write down the full details in its resolution. In addition, in this solution it appears that MAF only uses the phytagoras theorem as usual and then sums the entire size to obtain the circumference of a construct that is in the disoal.

With regard to the data analysis of MAF's creative thinking test results, researchers conducted interviews with MAF to find out more about MAF's creative thinking ability on the *novelty* aspect.

P : "*Do you think that the answer you have written is a "new" and "different" answer from other answers?*"
MAF : "*It's not different, it's just as rich as the others*"
P : "*Try to explain your answer?*"
MAF : "*Here there are 2 right triangle buildings, asked to find the entire circumference. So just add up to all the sizes of the sides. But, here there is a side of FK whose size is not yet known, so we first look for the size of the FK. Because this F is among the DK, so let's just look for the size of the DK. A triangle that is used as an ECK triangle. Continue to use the formula of the phytagoras theorem, obtained DK 12 cm. Keep adding it all up. The result is 88 cm*"
P : "*Are you able to find a different way / another way to solve the problem with a different solution?*"
MAF : "*No sis*"

Based on the results of tests and interviews that have been conducted, it can be seen that MAF is able to do the questions for the *novelty* aspect correctly. But he did not use a new way of solving it. Thus, MAF has not met the *novelty* indicator.

Discussion

Based on the results of research that has been carried out, it shows that subjects in *fluency* group 1, IK subjects are able to provide answers correctly, eloquently and also fluently explain the meaning of the problem and explain the solution that has been written, are able to use various mathematical concepts in solving problems and are able to use different points of view to solve problems. In addition, the solution given is based on the results of one's own thoughts. In *fluency* group 2, the subject, namely FF, was able to use various mathematical concepts, but the solution strategy used was not correct and the answers given were not quite right. FF subjects have not been able to use different points of view in solving the problem.

In *flexibility* group 1, the IK subject was able to give the correct answer and was able to provide 2 different alternative solutions. The subject of IK provides different alternative answers after being asked by the researcher. The subject of IK was able to explain well to researchers regarding other alternative solutions that they found well, correctly and quite completely. In *flexibility* group 2, MAF subjects were able to give correct answers but were only able to write down 1 way of completion and had no other alternative solution.

In *the novelty* group 1, MAS subjects can write answers that are different from other subjects. In the settlement used, the subject of MAS applies the concept of triangular revival in its completion. This settlement was not used by his other colleagues, so the settlement he wrote was considered quite new and unique. In *the novelty* 2 group, MAF's subjects already gave the right answers, but MAF subjects used the same concepts as their other colleagues.

CONCLUSION

Based on the results of data analysis and discussion that has been presented, it can be concluded that based on reflective cognitive styles, students' mathematical creative thinking ability can be grouped into 2 groups in each indicator. For fluency indicators, there are two groups of students, namely fluency group 1 and *fluency* group 2. In the first group, students are fluent and able to represent problems variously. Meanwhile, in the second group, students have not been able to represent problems variously. For flexibility indicators, there are two groups of students, namely *flexibility* group 1 and *flexibility* group 2. In the first group students are able to give at least 2 alternative different answers. While in the second group students were only able to provide 1 alternative answer. For the novelty indicator, there are two groups of students, namely the novelty group 1 and *the novelty* group 2. In the first group students are able to use unique and different ways of solving them. Meanwhile, in the second group, students only use the usual method and there is no uniqueness or novelty of the answers they give.

Based on the results of the study, researchers can provide suggestions including, as follows: (1) For teachers, it is necessary to pay attention to the cognitive style of students in learning mathematics because there are differences in the way students solve problems, teachers of mathematics subjects in making or developing problems can consider several things related to improving students' creative thinking ability, and teachers can use creative thinking problems in learning mathematics to hone students' creative thinking skills, (2) For students, it is hoped that they can continue to train themselves in improving mathematical creative thinking skills, (3) For subsequent researchers, it is necessary to conduct further research on the number or percentage of each student's cognitive style to be used as a guide in curriculum preparation, considering that the type of learning from each type of cognitive style of students is different. In addition, subsequent researchers should consider using different material.

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