The Originality Idea of Prospective Teacher's in Mathematics Problem Solving

FransiskusXaveriusDidik Purwosetiyono[1]
[1]Malang State University, Malang, Indonesia
E-mail: fransiskus.1603119@students.um.ac.id

CholisSa'dijah[2]
[2]Malang State University, Malang, Indonesia
E-mail: cholis.sadijah.fmipa@um.ac.id

Erry Hidayanto[3]
[3]Malang State University, Malang, Indonesia
E-mail: erry.hidayanto.fmipa@um.ac.id

Tjang Daniel Chandra[4]
[4]Malang State University, Malang, Indonesia
E-mail: tjang.daniel.fmipa@um.ac.id

Corresponding author e-mail: cholis.sadijah.fmipa@um.ac.id

Abstract

The purpose of this study is to describe the originality of teacher candidates' ideas in solving mathematical problems. The research method used is a qualitative method. The subjects of this study were prospective teacher students 7th semester in Semarang-Indonesia. Subjects have taken based on upper, medium, and lower ability criteria that gave rise to original ideas. The instruments used are; 1) mathematical tests to determine the subject, 2) problem-solving tests to bring up creative thinking, and 3) interview guidelines. The results showed that students with high ability and medium ability fulfilling the aspect of smoothness and flexibility only, but for the originality aspects have not compatible yet. However, to get the originality of the idea, it is necessary to have an additional phase of time, which is by giving added time, so that the thinking of prospective teacher students becomes more divergent, and explorative. After a phase of additional time, prospective teacher students finally bring up the originality of the idea in the form of an idea modification, although, in fact, the idea is not a completely new or original. In the group below the average cannot bring fluency, flexible, originality of ideas.

Keywords: Originality, Problem solving, Prospective teachers, Mathematics teachers.

1. Preliminary

Creative thinking is very important in learning mathematics. According to NCTM (2000) all levels of students must be able to think creatively, especially those related to mathematical concepts. And creative thinking also a component of 4CS (communication, collaboration, critical thinking, creativity). According to Morais& Azevedo (2011), Creative thinking is all that is related to originality, flexibility, fluency, and divergent thinking. Also according to Leikin (2013) that creative thinking of students is shown

through flexibility, investigative abilities, and problem-solving abilities. Creative thinking is closely related to mathematical concepts and problem-solving in mathematics. Associated with originality by As'ari (2016) think creative power is something that is abstract, bold, disciplined, and inquisitive, as a result
of environmental conditions encourage someone to do something in creating new ideas, namely ideas that are different from the ideas thought before. So that the ability to think creatively is needed to understand and develop concepts, solve mathematical problems. But, sometimes there will be ideas that are very different from what we think, and call it the originality of the idea.

Students' conception about creative thinking at various levels of ability leads to the same understanding. The conception of creative thinking led to the emergence of new ideas and build on the idea/notion resolving mathematical problems based on the experience they have. Some students argue that the appearance of a new idea in question is an idea that is different from the procedure in solving problems, or ideas that are used to solve problems with logically different points of view. In solving problems, the existence of different questions encourages students to come up with ideas, and find solutions to problems. Students revealed that it was very important to understand the concept of creative thinking in solving mathematical problems. According to Panaoura (2014) that a) creative thinking is smooth, flexible about concepts, ideas for solving mathematical problems. b) C math teacher has not been able to meet the criteria of originality. c) Creative thinking of prospective math teachers tends to explore the possibilities of problem-solving, but still has difficulties in generating ideas that are completely different. So it can be said based on this that mathematical problem solving is very much related to the concept understood by students.

View above is a little different from what Kadir& Lamasi (2014) conveyed that

the context of learning that attracts students' attention has not been used to construct mathematical concepts to improve creative thinking skills. In fact, the concept of creative thinking should be used by students to solve mathematical problems from various perspectives based on their learning experience, so that they can develop various mathematical problem solving with several different points of view. Hwang & Chen (2007) that the representation skills of students are the key to successful mathematical problem-solving. Based on the opinion of Kadir, Lamasi, and Hwang that creative thinking is closely related to their ability to solve problems, by describing their thoughts using diverse ideas.

Based on the background of these problems the researcher wanted to describe the originality of the teacher candidates' ideas in solving mathematical problems.

1.1. Mathematical Troubleshooting

Good mathematical problem solving requires stages and procedures. There are 4 stages of solving the problem, namely; understand the problem, plan solutions, carry out calculations, review processes and results. However, if the stages of the problem are applied to solving mathematical problems to bring out the originality of the idea, then this will limit the ability of prospective teacher students to come up with new ideas. This is very important to be studied. That idea is originality can arise when there is an understanding of the concept, and when solving mathematical problems.

The mathematical concept consist of special traits, and must not eliminate its theoretical identity. The identification of mathematical concepts is described in the right flexible representation, by providing a number of situations, the transformation of representations about the mathematical concept. For example, problem-solving abilities can be done by drawing diagrams visually and explained verbally. (Deliyianni, Gagatsis, & Elia, 2015). Mathematical problem solving has a clear

procedure but needs to be supported by good conceptual abilities. Conceptual ability is related to mathematical thinking in solving mathematical problems. This is in line with research conducted by Kim (2017) revealing that mathematical thinking is able to explore students' conceptual thinking and reasoning. Mathematical thinking processes provide an extension of students' learning opportunities and do not limit the productivity of their thinking in solving mathematical problems.

Conceptual mathematical problem solving requires mathematical thinking. Mathematical thinking can be done by using appropriate procedures in solving mathematical problems, but the rest needs he right representation skills to produce flexible problem solving and to lead to creative thinking. This requires a mathematical problem-solving format that is able to bring up the mathematical creative thinking of students and prospective teachers. In the previous study, there were mathematical problem-solving problems that increased creative thinking but still had not formulated how to solve mathematical problems that lead to the original thinking of students. In this study it will be examined how to solve mathematical problems that can bring up the original teacher candidates' thinking.

1.2. Overview of Creative Thinking for Teacher Candidates

Students of the prospective math teacher at the undergraduate level certainly have a good concept of creative thinking. They have been taught how to solve problems in several ways. There are many mathematical materials that require several strategies to solve these problems. It's just that the prospective math teacher candidates at the bachelor degree often only use one strategy to solve the problems faced. These habits directs them to monotonous thoughts that converge to only one point of view of problem-solving. But that does not mean that prospective teacher students at the undergraduate level do not have diverse ideas in solving mathematical problems. If students of

prospective mathematics teachers are asked to explore their ideas, researchers assume that prospective math teacher candidates at the undergraduate level will be able to bring up their creative thinking, especially in bringing up the novelty of their ideas.

The ability to think creatively of the candidate of math teacher in solving mathematical problems require certain tests. Leikin et al. (2006) and Leikin&Waynberg (2007) define Multiple Solution Tasks (MSTs) as a task that explicitly asks to find more than one solution to a particular mathematical problem (Levav-waynberg & Leikin, 2012). In this case, a test based on the MSTs is needed to measure the ability to think creatively about certain abilities, namely the abilities possessed by the observed subject. If the test is applied to the subject of the prospective mathematics teacher candidates, there will certainly be different findings that will be obtained or raised about the characteristics of their mathematical creative thinking in solving mathematical problems.

There have been previous studies on creative thinking. Research conducted by Panaoura (2014) that in creative thinking, mathematics teachers have not been able to meet the criteria of originality. The results of the study did not show clearly about the smoothness, flexibility, and originality of ideas in solving mathematical problems. The results of the research by Delice& Kertil (2013) describe the fluency which is a multi-representation ability. Multi-representation will emerge when someone has high-level thinking in exploring and coordinating his ideas to produce different ideas, and this is related to the smoothness of their thinking in relating to many representations or to only one representation. Research conducted by Deliyianni et al. (2015)discusses Flexibility as the complexity of several concepts in solving problems that lead to representational transformation. The flexibility of representation in problem-solving is built from representational thinking in solving mathematical problems that require the theoretical and practical

application. However, from some studies the top studies have not been explained especially in terms of originality of ideas, there are still doubts about the limitations of the panaura researchers say that the prospective mathematics teacher has not been able to meet the originality criteria, further research is needed.

2. Research methods

The research method used is a qualitative method. The subjects of this study were 3 prospective teacher students who were initially 64 on 7th semester teacher candidates in Semarang-Indonesia. Subjects have taken based on upper, medium, and lower ability criteria that gave rise to original ideas. In the first stage, researchers conducted a mathematical test to determine the subject. Based on these mathematical tests, obtained 3 subjects that will be explored as research subjects. Furthermore, the 3 subjects of the study were explored using problem-solving tests that can bring the idea of originality and creative thinking. And the next step is an interview.

The instruments used are; 1) mathematical tests to determine the subject, 2) problem-solving tests to bring up creative thinking, and 3) interview guidelines to get in-depth information/data from the subject.

To describe the ability to think creatively of the candidate of math teacher in solving mathematical problems, it requires certain tests. Leikin et al. (2006) and Leikin&Waynberg (2007) define Multiple Solution Tasks (MSTs) as a task that explicitly asks to find more than one solution to a particular mathematical problem (Waynberg & Leikin, 2012). In this case, a test based on the MSTs is needed to measure the ability to think creatively about certain abilities, namely the abilities possessed by the observed subject.

The prospective teacher asked to do and present various solutions to solve mathematical problems. The mathematical problems used are as follows.

a
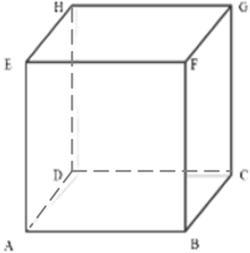
Look at the cube ABCDEFGH

Determine the shortest point A to point G through the possible cube ABCDEFGH give an explain for every answer you think!

b

Complete the table below!

Number	units	pictures
1	4 m²	...
½	...	1 (over 2)
1	...	2 over 2
½	2 m²	...

In the pattern answer column, describe the possibilities of building up the data!

Fig 1 (a). The first problem-solving test instrument (b). The second problem-solving test instrument

Figures 1(a) and 1(b) are mathematical problem-solving test instruments used to generate creative thinking skills. Through these questions, it is expected that prospective mathematics teacher candidates can come up with answers or ideas that are multi-solution, so as to allow answers not single.

Basic creative thinking researchers use creative think view defined by Morais &Azevedo (2011) that creative thinking is all that is

associated
with smoothness, flexibility, originality, and divergent thinking. Researchers simplify these 4 aspects into 3 aspects, namely; fluency (smooth), flexible, flexibility and convergence), the novelty of ideas (originality).

Table 1. Modification of creative thinking rubrics

No.	Character	Very satisfactory	Satisfying	Not satisfactory
1	Fluency: Smoothness That idea generated.	Many ideasgenerated.	Have good ideas	Not many ideasgenerated.
2	Flexibility & divergence : Have a variety of ideasgenerated.	Provide different and feasible ideas	Identify several different ideas.	Have ideas that are similar to what is taught.
3	Authenticity: novelty of ideas	The idea is reallynew or evenunique.	The idea ismodification orrepair fromexisting concepts	The idea is a copy of the existing concept.

Table 1 above is a table of creative thinking modifications. The table is modified based on Morais and Azevedo that creative thinking is all that is related to smoothness, flexibility, originality, and divergent thinking. But for aspects of divergent thinking combined with aspects of flexibility, because flexibility requires divergent thinking.With divergent thinking, it is expected that prospective teacher students are able to provide ideas that are feasible based on their experience and insight. So that researchers use three main aspects, namely; Fluency, flexibility and divergence, and authenticity/originality.

The researcher doing the math test to determine the subject. Based on these mathematical tests, obtained 3 subjects that will be explored as research subjects. Furthermore, the 3 subjects of the study were explored using problem-solving tests that can bring the idea of originality and creative thinking. Then the interview stage is carried out.

Interviews were conducted with 3 students, namely students who had top average ability, students with average ability and students with abilities below average. During the two interviews, students were asked to provide as many solutions as possible of the 2 math problems given. They were allowed to ask for instructions if they felt that they cannot come up with ideas. After they reach certain limits, namely when they have difficulty finding ideas and cannot continue the ideas they have. This means they have arrived at the stage of the idea of originality. So that obtained 4 aspects of modification consisting of; 1) fluency, 2) flexible, 3) novelty of ideas.

Furthermore, data collection techniques were carried out, namely: Data collection techniques used by researchers in this study were 1) mathematics tests to determine subjects, 2) problem-solving tests to bring up creative thinking, and 3) interviews to get in-depth information/data from the

subject. Technique data analysis used is qualitative data analysis technique that consists of three phases, namely, data reduction, data presentation, and conclusion. 1) Data reduction, defined as the selection process, focusing on simplifying, abstracting and transforming "rough" data that emerged from written records in the field. 2) Data presentation, namely delivery, description, and assembly of information organizations, based on data that is owned and compiled well by using the sentence and the language of the researcher so that when read, it can be easily understood. 3) Conclusions and verification. Conclusions are drawn by paying attention to the results of written test work done by prospective teacher students and interview results to think creatively. Then the data must be tested (verified) the validity so that the conclusions of the study become more robust and more reliable.

3. Result

The research subjects were 3 on 7th semester teacher candidates in Semarang-Indonesia. The researcher held a mathematics test for the 64 students, and from the test results 3 students were selected with some criteria. The ability criteria is the criteria for the students who have a top ability, medium ability and low ability, then the researchers used a consideration of the z-score to determine the three students to see the sign, 1 student with top ability we can find by looking at the z score of the most positive, 1 student with medium ability we can find by looking at the z score is close to zero, and 1 student with low ability we can find by looking at the most negative z score. From the mathematics test in determining the subject, 3 students were obtained as follows.

Table 2. Research Subjects

No.	Name	Code	z-score	Note
1.	A	Z_+	+ 1.49	Top ability
2.	B	Z_0	0.09	Medium ability
3.	C	Z_-	- 2.19	Lower ability

Table 2 above shows that the subject taken is that has been chosen based on its capabilities. Using the z-score calculation, 3 criteria are obtained, namely; subjects who are top average ability, subjects with average ability, and subjects whose abilities are below average. After obtaining 3 selected subjects, then a mathematical problem-solving test is performed. Mathematical problem-solving tests are used to obtain data on students' abilities in solving mathematical problems. Then we can get the data from the students' answer from the mathematical problem-solving tests that will be used as data that is explored for the purpose of knowing "How do theoriginality ideas of the teacher candidates' in solve mathematical problems ?" from three subjects, further in-depth interviews to elicit information from each subject.

The following are answers to question no. 1 on subjects (a) students with abilities, (b) students with moderate abilities, and (c) students with lower abilities, in solving mathematical problem-solving problems that aim to create creative thinking. As follows.
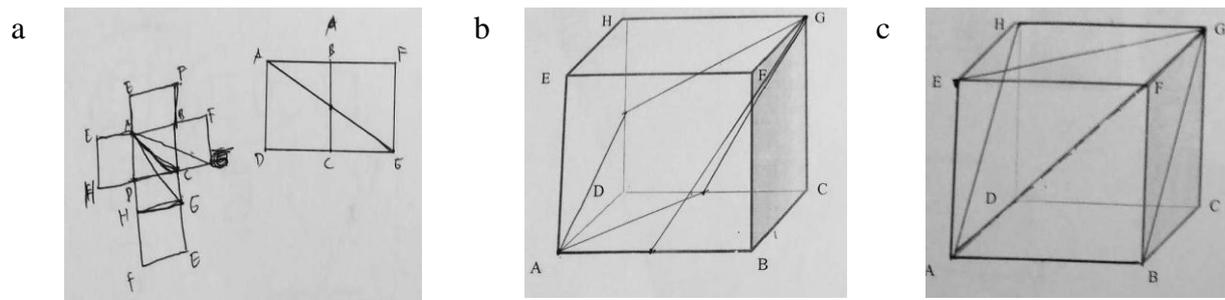
a
b
c

Fig 2. (a) Answer students with the ability to, (b) Answer students with moderate abilities, and (c) Answer students with lower abilities, in solving mathematical problems first.

Mathematics student teachers are able to meet aspects of the ability on creative thinking and flexible fluency, but for the novelty of the idea can arise when researchers performed additional stages, namely the give opportunity for subjects to improve the idea, and finish the complete answer. This is because the researchers still saw the potential of the student teachers, can still be explored his ability with the give was little opportunity or time to think and express the answer. On average ability is almost the same as students with top abilities. But the subject is unable to solve the problem completely. The researcher carried out an additional stage namely the time addition phase, the subject had not been able to bring up a completely different idea, but there was already a modification of thought which was the result of accommodation from his knowledge. Unlike students with abilities below average, at first it looks fluent, but when asked to explain some of the ideas given, the subject is confused. Subjects have tried to come up with ideas, but ultimately are unable to solve problems, and only have ideas that tend to be single.

Interview results on subjects (a) students have the following abilities.

P : *"What do you understand about the problem?"*
A : *"From the cube, is asked to determine the distance between point A to G but through the surface of the cube, so that it cannot pass through the cube"*
P : *"What are you doing next?"*

A : *"From the cube I draw a line from A to G but through the surface, can ABG, ADG, AEG, ADG, AHG,*
         AFG"
P : *"Then why do you paint another line?"*
A : *"After I think about it, it turns out there are still other lines going through the surface, namely A1G, A2G, A3G, A4G, A5G, A6G".*
P : *"What do you think is right?"*
A : **thinking,** *"Oh yes sir, no word of the shortest distance?", "Means a shorter yes sir?"*
P : *"Which one do you think is correct?"*
A : *"The A1G, A2G, A3G, A4G, A5G, A6G sir"*
P : *"Are you sure of your answer?"*
A : *"Not yet sir"* **while silent**
P : *"Now I give 30 minutes, please think again if there are other answers that can ensure your answer is correct!"*

Pause, then the researcher gives additional time as a 30-minute time addition phase. Maybe there will be ideas that emerge.
A : *Next the subject describes one of the cube nets, and gives a streak, the line that connects A to G (**shown in figure A**)*
P : *"Beat the image from your answer/picture!"*
A : *"I try to make a picture of a cube net like this, it turns out it looks more how long the shortest distance is in a straight line, sir"*
P : *"What else do you get?"*
A : *"It turns out that A1G is a straight line if the cross section is opened", and A1G, A2G, A3G, A4G, A5G, and A6G, the length is the*

same? ", So there are 6 possible shortest distances from A to G, but have the same length".

From Figure 2 (a) and the results of the interview above, it indicates that the candidate math teacher's with top ability meet the criteria of creative thinking in the aspects of fluency and flexibility, and has shown aspects of the novelty of ideas. From the picture, it is shown that top-capable students are able to give different thoughts, namely by linking the ideas of the cube network in solving problems, so that with these representations students of the upper ability are able to provide explanations/answers that are different from those taught at the time of learning.

Interview transcripts on subjects (b) students with moderate abilities as follows.

P : *"What do you understand about the problem?"*

B : *"Determine the distance between point A to G but through the surface of the cube, or the distance outside the cube sir, but the shortest distance desired"*

P : *"What are you doing next?"*

B : *"On the surface of the cube, I draw a line from A to G can ABG, ADG, AEG, ADG, AHG, AFG"*

P : *"Then why did you paint another line?"*

B : *"After I think about it, it turns out there are still other lines going through the surface, namely AO1G, AO2G".*

P : *"Is that only?"*

B : **thinking,** *"Oh yes sir, no A03G, A04G, AO5G, and AO6G" So there are 6 lines through O1, O2, O3, O4, O5, O6 ".*

P : *"Means there are 12 lines that you draw, which do you think is the right answer?"*

B : *"Which through midpoints O sir, there are 6 lines that seem to be the same length, sir"*

P : *"Are you sure of your answer?"*

B : *"Not yet sir"* **while silent**

P : *"Now I give 30 minutes, please think again if there are other answers that can ensure your answer is correct!"*

Pause, then the researcher gives additional time as a 30-minute time addition phase. Maybe there will be ideas that emerge

B : ***The subject did not give additional answers, only I was more convinced that the shortest distance was a line through the midpoint of O which was 6 lines***, *"This seems like the same length, sir?"*

P : *"Is the answer enough?"*

B : *"yes sir, that's all"*

From Figure 2 (b) and the results of the interview above, it shows the ability of students in fulfilling the criteria of creative thinking on the aspects of fluency and flexibility, but for the aspect of novelty, the idea already exists but has not been clearly stated. Students with medium ability have come up with ideas, but the idea is still related to what is learned during learning, students are being able to manipulate objects directly, but have not dared to explore ideas that are completely different.

Interview transcripts on subjects 2 (c) below-capable students as follows.

P : *"What do you understand about the problem?"*

C : *"Determine the shortest distance between point A to G"*

P : *"What are you doing next, what line is there in the cube?"*

C : *"Space diagonal, the distance from A to G"*

P : *"What do you paint besides AG that goes through these sides?"*

C : *"The distance must go through the cube surface, which may be ABG, AFG, AEG, AHG".*

P : *"Is there more?"*

P : *"Is that only?"*

C : **iam thinking,** *"Still confused sir".*

P : *"Now I give 30 minutes, please think again if there are other answers that can ensure your answer is correct!"*

Pause, then the researcher gives additional time as a 30-minute time addition phase. Maybe there will be ideas that emerge

C : *"Still confused, sir"*
P : *"Is the answer enough?"*
C : *"Yes sir"*

From Figure 2 (c) and the results of the interview above, it shows that for students with lower ability, teachers cannot bring up creative ideas. That is, students with lower abilities only use the old methods commonly used before, but they are confused, so they cannot explain well, and are unable to represent the answers correctly.

Here is the answer to question number 2 in the pattern column on subjects (a) top ability students, (b) medium ability students, and (c) lower ability students, in solving mathematical problem-solving problems that aim to bring creative thinking. As follows.
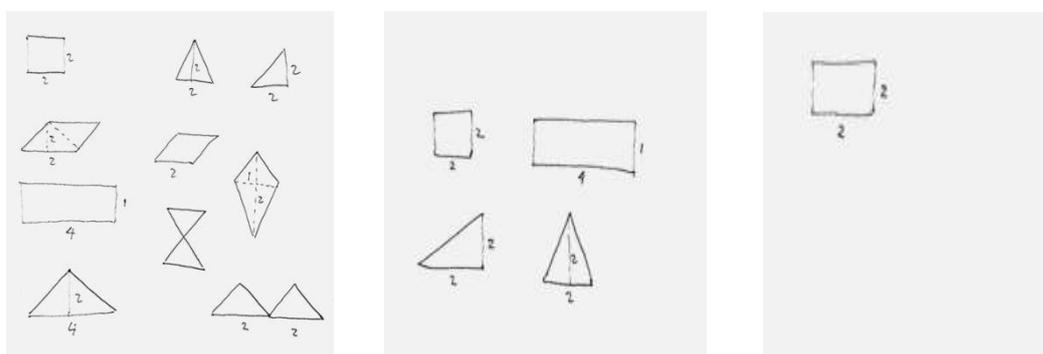

Fig 3. Answers (a) students with top ability, (b) medium-capable students, and (c) lower-ability students, in solving mathematical problems second question

From Figure 3 shows that the student's with top ability and the student's with medium ability are fulfilling the criteria for the smoothness and flexibility aspects, and also havealready shown the novelty aspect of the idea but has not been fully demonstrated. Whereas in the phase of improvement students' prospective teachers have been able to generate new ideas. For groups below average, they cannot bring creative ideas either fluency, flexible, the novelty of ideas, and phases of addition when students have not been able to come up with new ideas. According to Coelho & Cabrita (2015), media can provide a classroom atmosphere that allows exploratory activities that focus more on student tasks and these tasks can build the learning environment. With the existence of media, it may be easier for students to design/design their creative ideas. So that it could be that the media will help students to come up with new ideas. However, in this study, researchers ruled out the use of media in the implementation of the research process on subjects (a), (b), and (c).

The transcript of the interview on the subject (a) of the student's ability is as follows.

P: *"What is your answer from the first and second questions?"*
C: *"2 m^2 and 4 m^2 "*
P : *"Build what you describe in the first and second pattern columns?"*
C : *"My first question is a square sir, with size s = 2, and in the second question I draw parallelogram"*
P : *"Why did you draw the two builds?*
C : *"in the first question the possibility of a build being formed is a rectangle twice, so you can make a squarewith a 2x2 side. Whereas in the second question is the parallelogram that has half the area ".*

P : *"Are there any other answers?"*

P : *"Now I give 30 minutes, please think again if there are other answers that can ensure your answer iscorrect!"*

Pause, then the researcher gives additional time as a 30-minute time addition phase. Maybe there will be ideas that emerge

C : *"There is a sir, there are a few buildings that I tried to describe, but there are some that I am not sure about." While he showed a number of other buildings of the same size, the building was still a building that was in accordance with the concepts learned, but there were some pictures that he doubted but were still a building of the same size.*

Based on Figure 3 (a) and the results of interviews that students have top ability meet the criteria of creative thinking on the aspects of fluency and flexibility, and have demonstrated aspects of the novelty of ideas, although have not shown completely. Then given 30 minutes of additional time to think, the prospective teacher finally was able to come up with a new or an original idea. Students of top group teachers begin to emerge ideas that are more diverse and there are those that bring up ideas that are different from the procedures they get when learning is received, but there are some ideas that are raised but still not sure, is it correct or not? , but has led to the correct concept.

Interview transcripts on subjects (b) students with moderate abilities are as follows.

P : *"What is your answer from the first and second questions?"*

B : *"2 m ^{2} and 4 m ^{2} "*

P : *"Build what you describe in the first and second pattern columns?"*

B : *"In my first question a square with a side of 2, and in my second question a 2-foot high-angle right triangle"*

P : *"Why did you draw the two builds"*

B : *"In the first question, the area is twice as wide, and in the second problem the area is half, so my square is for two".*

P : *"Are there any other answers?"*

P : *"Now I give 30 minutes, please think again if there are other answers that can ensure your answer is correct!"*

Pause, then the researcher gives additional time as a 30-minute time addition phase. Maybe there will be ideas that emerge

B : *does not answer completely, but he tried to draw a rectangle with a length of 4 and width 1. "This is sir that I can work on, another one has no idea yet."*

Based on Figure 3 (a) and the results of interviews that students have top ability meet the criteria of creative thinking on the aspects of fluency and flexibility, and have demonstrated aspects of the novelty of ideas, although have not shown completely. Then given additional time to think for 30 minutes, the student teacher candidate was able to bring up a new idea. The students of the group have begun to think of possible solutions to the problem, but the solution produced is a solution that is still routine or the solution they have gained during learning.

Transcript of interview subject 1 (top ability) as follows.

P : *"What is your answer from the first and second questions?"*

A : *"2 m ^{2} and 4 m ^{2} "*

P : *"Build what you describe in the first and second pattern columns?"*

A : *"In my first question, draw a square with side 2 and in the second question empty"*

P : *"Why did you draw a square with 2 sides?"*

A : *"Because of the extent of the two times".*

P : *"Are there any other answers?"*

P : *"Now I give 30 minutes, please think again if there are other answers that can ensure your answer is correct!"*

Pause, then the researcher gives additional time as a 30-minute time addition phase. Maybe there will be ideas that emerge

A : *can't answer*

Based on Figure 3 (c) and the results of the interview that the prospective students of mathematics teachers have the ability to know about the concept of creative thinking, but when they work on problems or solve problems, the concept does not appear in the lower class students. Student teachers at lower group cannot create a good creative idea fluency, flexible, novelty idea, and when the researchers gave the stage of phase increments, students has also not been able to bring up a new idea.

From the results of student answers and interviews, the results of the resume can be seen in the following table.

Table 3 Test results resume and creative thinking interview for the first question

No.	*Creative* thinking aspects	AbilityOn	Medium Capability	Ability Under
1.	Fluency	Many ideasgenerated.	Have good and limited ideas.	Not many ideasgenerated.
2	Flexible	Provide different and feasible ideas	Have ideas that are similar to what is taught.	Have ideas that are similar to what is taught.
3	Novelty ideas	The idea ismodification orimprovements from existing concepts, but have not found anything unique.	The idea iscopy of existing concepts	The idea is a copy of the idea.
4	Increasing time	The resulting idea becomes more varied and divergent, explorative. Representations produced symbolically, visually, verbally.	The resulting idea becomes more varied and divergent, but less explorative. Visual, verbal representation.	Already trying to come up with ideas, but fixed on the concept that is owned only. Representation produced visually, less able to explain verbally)

Based on Table 3 shows the results of interview obtained from Confirmation of written tests done by three students, namely top ability students, the top ability students, medium ability and low ability under the test instrument mathematical problem solving that in the first test question. Look the differences between top, medium-average ability. Both of them have come up with ideas, but the students' ability to the idea is a modification of the existing concept but has not found anything truly new or unique, after the time-added phase has become more varied and divergent, explorative. Representations produced symbolically, visually, verbally. Whereas for the students the average ability of the idea is a copy of the existing concept after the additional time phase is produced it becomes more varied and divergent, but less explorative. Representation of visual, verbal generated ideas.

Table 4 Resume of test results and interview thinking creatively for the second question

No.	Aspects thought *out creative*	AbilityOn	Medium Capability	Ability Under
1.	Fluency	Many ideasProduced, but cannot yet create the intended idea category.	Have good ideas	Not many ideasgenerated.
2	Flexible	Identify several different ideas.	Identify several different ideas.	Identify several different ideas.
3	Novelty ideas	The idea ismodification orimprovement of existing concepts	The idea ismodification orimprovement of existing concepts	The idea is a copy of the idea.
4	Addition time	Idea generated becomes more clear, explorative. Visual, verbal representation.	The result is less varied and less explorative. Visual, verbal representation.	It's hard to come up with ideas, tend not to be explorative. The resulting representation of visual, verbal.

Based on Table 4 shows the results of interview obtained from Confirmation of written tests done by three students, namely top ability students, the ability to be and the ability to lower the math problem-solving test instruments that in the second test question. It turned out that the same as the first mathematical problem-solving test, the table above shows the difference in top, average ability and lower than average. Both have created new ideas, but the ability of students is top average. The idea is a modification or improvement of existing concepts after the resulting time addition phase becomes clearer, explorative, the presentation of visual, verbal ideas are produced. Whereas for students with the average ability is the idea of modification or improvement of the existing concepts, after the addition of the resulting time phase is less varied, and less explorative, the representation of visual, verbal generated ideas.

A speculation of additional time in creative thinking was different from the results presented by Panaoura (2014) that in creative thinking, mathematics teachers were not able to meet the criteria of originality. The results of the study did not show clearly about the smoothness, flexibility, and originality of ideas in solving mathematical problems. Based on the results of research that has been carried out that students of the candidates ofmathematics teacher with bachelor degree reached the stage of the novelty of ideas in creative thinking, It was shown that in the A and B there was a phase of the emergence of new ideas that had been done.

Creative thinking for students of mathematics teacher candidates at the undergraduate level is often not used in solving problems. They often only choose one point of view that they remember, and do not try to think with several points of view in solving problems. With such a pattern of thought, directing prospective mathematics teacher candidates is only focused on a single answer. There are many alternatives to solving mathematical problems that can actually be used by them in solving mathematical problems but

are not used. So that prospective undergraduate math teachers seem to be unable to think creatively about solving mathematical problems. In this study, the researchers tried to see how the ability to think of prospective math teacher candidates at the bachelor degree to bring up the original idea. Original ideas are part of creative thinking.

Before researchers explore the original idea of prospective teacher students in solving mathematical problems, first the researcher will describe aspects of creative thinking, namely: fluency, flexibility. The first aspect is fluency. In subjects with the ability to tendencies, Many ideas are produced so that there are several alternative answers raised. The subject is able to explain several ways of solving written with several different possible points of view and can explain both the symbols and the images that have been produced. Whereas in medium-capable subjects tendencies have good ideas. However, it is not enough to explain in full about what is drawn or written. Basically, the subject has fluency in explaining the answer, but when someone asked more or deeply, the subject felt confuse. And on the subject matter of the underworld, there is not much idea produced. The subject is only able to explain the possibilities in a simple way that is seen from the problem. But it does not have a different view from another point of view, so the tendency of the answer is single.

The second aspect is flexible. On the subject of ability just be able to identify several different ideas. Subjects provide alternative answers, by identifying possibilities that can be done to solve the problem. But the subject has not been able to provide the most appropriate solution of the ideas. Because the subject is still not sure about the idea that is raised, even though the answer has led to the right answer. While the subject of ability is being inclined able to identify several different ideas.Subjects provide alternative answers, by identifying possibilities that can be done to solve the problem. But the idea of the subject is still very limited, and still doubt about what he wrote, even though the answer has led to the right answer, but it

is less able to explain. And on the subject of lower ability ₋ the tendency of the subject has tried to identify from one point of view. Subjects can only describe and write the answers, but less able to establish the ideas that others are assumed to be true. Students of prospective mathematics teachers at the undergraduate level try to bring up or find ideas as an alternative to their answers. In that case, they begin to produce multiple solutions. This is in line with the views of Kang & Liu (2018) that in generating multiple representations not only to provide alternative solutions. Alternative solutions are also used to solve mathematical problems and make relationships or representations, both concrete representations, and abstract mathematical concepts. According to Kinach concrete representations such as manipulating images, symbols, and mathematical notation, this is done to gain students' understanding, so that students avoid memorization or procedure. Added by Kuntze & Lerman (2016) s the viewpoint of mathematics teacher candidates is influenced by culture and adapted to the general needs of the development of the teaching profession. Based on Dreher's view, it is possible that each country has special needs in terms of achieving creative thinking. But researchers believe that the tendency of flexible thinking is owned by prospective mathematics teacher candidates. To achieve that, it takes the form of problems, tests, tasks, or even the appropriate media to bring it up.

The third aspect is the novelty of ideas. According to Morais & Azevedo (2011) that creative thinking is all that is related to originality, flexibility, fluency, and divergent thinking. But for students, it is still difficult to bring up their originality ideas or ideas that are really new. On the subject of ability over tendency, modification made by linking the concepts he has. Subjects try to find possible answers that might be possible by giving some statements both in writing and in pictures. It has given a different idea, but sometimes still not sure about the idea. While on the subject ability is inclination The idea is modification or improvement of existing concepts. By utilizing

cube images. Subjects tried to find solutions to these problems, tried to manipulate objects, but could not provide a completely different idea. And on the subject 's ability under inclination his idea is a copy of an idea or concept that already exists. So there is not much to do. Subjects only try to provide answers based on the images seen in the question only. But you can't see the answer from a different perspective.

After the researchers conducted research on aspects of creative thinking, namely; smoothness, flexibility, and the emergence of new ideas. But to reach the originality stage, it is not easy for undergraduate math teacher candidates. The researcher tried to find out what caused the originality idea to not appear optimally. Furthermore, researchers provide another alternative, namely by giving added time to think. The researcher gave 30 minutes of extra time to think about finding ideas like the prospective teacher's students. Let say, by giving an extra time is an additional aspect of time. On a spec of giving an extra time is intended for student of the mathematics teachers' candidate who have bachelor degree to give the opportunity again to bring up or create the new ideas. In the subject of the ability of the tendency idea produced becomes more varied and divergent, and further explores the idea so as to find new views that were previously unthinkable, and find many solutions. Even though I cannot represent the solution completely, but verbally can convey it smoothly. Whereas in the subject of moderate ability the tendency of the resulting idea to be more varied and divergent, and yet less to explore new ideas so that the views on new ideas are limited and tend not to be able to solve the problem completely (only find a few solutions). Subjects have limitations in representing with symbols, rather than representations using images or verbally. And on the subject of lower ability _ the tendency has been to try to bring up ideas, but limited to the previous concept so that the ideas presented cannot solve the problem. The subjects tried to show a solution, but were still confused in answering both pictures,

symbols, and verbally. According to Delice & Kertil (2013) that challenges and motivations are a process that directs students to form consistency changes that arise in different representations. Based on the view of Delice&Kertil that in bringing up different ideas, challenges and motivations are needed which both require sufficient time to bring about changes in views. With the addition of time phase that causes the prospective mathematics teacher candidates to be able to bring their ideas more varied and divergent, and further explore their ideas so as to find new views that were previously unthinkable.

In this study related to the originality of the ideas of prospective math teacher candidates for bachelor degree, at the stage of the emergence of new ideas, there are difficulties in their verbal abilities in conveying new/original ideas. When they come up with original ideas, they tend to reduce their fluency. That is, the process of emerging new ideas requires hard thinking. So the higher they think about generating ideas, the lower their level of fluency. This is in line with what was conveyed by Waynberg & Leikin (2012) that the ability of originality is not in line with fluency and its flexibility. The more people trying to bring out the originality, the more they reduce the level of fluency and flexibility. Based on opinion Waynberg&Leikin effort and hard work that requires a collaborative environment and social situation to bring out their original ideas are needed. Reinforced by the results of Silver (n.d.) research that problem posing problems are effectively used significantly to bring up creative knowledge and mathematical thinking on the Arithmetic material, but have not been able to bring up the creative verbal abilities of prospective mathematics teacher students. Based on the research and views of some of these experts, that the prospective math teacher candidates for bachelor degree have been able to bring up the idea in an original way, after adding an additional time phase, although there are still weaknesses in terms of fluency and decreased flexibility.That is natural because when someone tries to bring up the original it will reduce the level of fluency and flexibility.

This study reveals student activities that are individual but it has not revealed the originality of the idea if it is done in group activities. According to Kohler, Boissonnade, Giglio (2015) social issues in learning that lead to creative thinking must lead to group interaction and to a minimum of individual interaction, so that the proportion of the combination of group and individual activities must be designed to better suit the learning objectives. This is in line with the opinion of Albert & Kim (2013) that through creative problem solving is an act of control and regulation of cognitive processes. Problem-solving requires a collaborative environment and application of skills. Thus, through group activities, it may lead to more creative thinking of students, and may also bring more ideas. Further research is expected to explore the ability to think creatively both individually and in groups. So we can get more information about how to create students' creative thinking, how to bring up original student ideas through group learning activities both students and prospective mathematics teachers.

4. Conclusions

Students of prospective math teachers at the undergraduate level can bring up original ideas. After the researchers added an additional phase, namely the time addition phase, it turned out that the prospective teacher could turn out new ideas. This resulted in a difference with what was conveyed by Panaoura (2014) that in creative thinking, mathematics teachers have not been able to meet the criteria of originality. From the results of these studies have not clearly shown the originality of the idea in question in solving mathematical problems. Based on the results of research that has been carried out that students of prospective mathematics teacher bachelor degree have reached the stage of the novelty of ideas in creative thinking. It could be that the idea resulting from the modification made is unique, meaning that the student is the first time using this method in solving the mathematical problems he is working on. This is in line with what was conveyed by Waynberg &

Leikin (2012) that original solutions at the individual level are based on new concepts used as unique solutions, which allow them to be identified as original ideas. In this case, the researcher have not paid attention to whether the modification obtained from the idea made by the student is a creative endeavor from him, or obtained from the experience he has learned before. Therefore, in the field of education there is a need to limit the originality of ideas; originality is truly unique, or originality arises from a variety of ideas obtained from the accommodation of the knowledge it has.

Acknowledgments

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