Students’ creative thinking skills on the circle subject in terms of learning obstacle and learning trajectory

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Abstract. The study aims to describe students’ creative thinking skills in circle material based on students’ learning obstacle and trajectory. This research applied descriptive qualitative. The instruments used were circular questions and interviews. Data analysis carried out along with the data taken by analyzing students’ creative thinking skills based on students’ learning obstacle and trajectory. The research subjects were VI semester students who were able to handle analytical geometry. The results of the study shown that, most students experience learning obstacle (1). Students have difficulties in finding concepts from the meaning of circles, (2). Students have difficulties working on material circle questions and without re-examining the answers (3). Students found out difficulties in a concept from the general formula of the equation of the circle and make the graph, (4). Learning materials presented in textbooks do not build students' creative thinking skills, so they do not support meaningful learning. Learning trajectory based on analysis of learning obstacle experienced by students and analysis of causes of difficulties can occur. Preparation of hypothetical learning trajectory through learning situations designed is expected to create students' creative thinking, indeed, the student reconstruction process is created independent students form the concept of the formula set.

1. Introduction
Mathematics is one of the basic sciences in improving mastery of science and technology. To overcome the challenges of the development of science and technology requires highly skilled through critical, logical, creative and capable considerable.

Creativity is an interesting quality to study but quite complicated, thus it causes various differences, as a complex and multidimensional realm of psychology, it invites diverse interpretations. The definition of creative resolution provides different differences, depending on the basis of the theory that becomes the reference in creating some creative resolutions [1].

Edward stated that creative is a dynamic brain activity involved both subconscious and conscious mental processing in making things happened [2], Munandar stated that creativity is the ability to see or claim extraordinary, unusual things, combining information that supports and triggers new solutions or solutions that show fluency, flexibility, and originality [1]. The characteristics of creativity can be divided into two, namely cognitive characteristics (aptitude) and non-cognitive characteristics (non-aptitude). The cognitive characteristics of creativity consist of originality, creativity and fluency. While the non-cognitive characteristics of creativity include motivation,
personality, and creative attitude. Creativity complements cognitive traits as well as non-cognitive characteristics become one of the important potentials to be nurtured and developed.

Learning mathematics along with three things, namely teacher, student, and material [3]. If learning is only based on textual learning it will produce learning processes that are in accordance with the meaning and context, as well as the results-oriented learning process causes students to learn by using. Learning things is difficult to understand also help to understand mathematical concepts partially, not integrated between one concept and another.

Students' understanding of mathematical concepts partially, due to existing source books or learning processes that are not structured (learning trajectory), or [4] stated that practically, students naturally may experience a situation called learning obstacle that causes students' learning difficulties there are 3 factors, namely: ontogeny barriers (learning mental readiness), didactic (due to teacher teaching), and epistemology (on the knowledge of students who have a limited application context) [5]. Indeed, learning so far has formed obstacles to systemic learning for students, which is only limited to be in the classroom. This fact implies that an educator must create a learning situation for students so that learning becomes meaningful. One way to anticipate learning barriers, reduce or eliminate the difficulties that arise during the learning process, the instructor must design a situation which accommodate student responses cognitively and affective, indeed, the expected competencies can be achieved in accordance with the expected goals.

The series of learning designed should pay attention that each student has a different pattern or flow of thought in responding to the material presented. Suryadi said that in learning planning most teachers did not consider the diversity of student responses or didactic situations (patterns of relationships between students and material through teacher assistance) developed, so that the next set of didactic situations it is not in accordance to each student's learning trajectory [5].

In [6] explained learning trajectory is a description of students' thinking when the learning process is a guess or hypothesis from a series of learning to encourage the development of student thinking so that the mathematics learning goals are as expected. If the teacher has known the difficulties and obstacles that may be experienced by the students, then the teacher needs to think early to prepare the appropriate material, methods and presentation strategies, so that participants are always on the alternative path or hypothetical learning trajectory in line with expectations, so that they can achieve the expected learning goals.

A learning path has the characteristics of a starting point and end point. Furthermore, the learning trajectory is a guide for an instructor in creating a Hypothetical Learning Trajectory (HLT) which is an educator's learning plan based on student learning anticipation that might be achieved in the learning process, which is based on expected mathematics learning goals in students, knowledge and estimated levels understanding of students, as well as the choice of mathematical activities in a row. In this study, researchers analyzed students' ability to think creatively on circle material based on learning obstacle and learning trajectory during the learning process.

2. Methods
This study is descriptive qualitative research that aims to examine the ability of students to think creatively based on learning obstacle and learning trajectory observed centrally. This research data is in the form of words. This is in accordance with the nature of qualitative research [7]. The setting of the study is STKIP Collage, located in Bima, The research subjects were students of the sixth semester of mathematics education, which are taken based on their initial mathematical abilities.

Data collection is done by using test and interview methods. The procedure of this study begins by giving a test of mathematical abilities on circle material designed according to indicators of creative thinking. Then compile clinical interview instruments to reveal the students' creative thinking skills, learning obstacles and learning trajectories and their factors.
3. Result and Discussion

The results of the study included the findings of learning obstacles in trajectory fund that occur when students work on it. The following is data on students' thinking skills in the circle concept based on learning obstacle and trajectory. The findings obtained in analyzing the creative thinking ability based on the learning obstacle and learning trajectory on the circle concept are as follows:

3.1 Obstacle Learning Analysis

In solving the matter of the circle above, the learning obstacle found in the circle material students are of three types, namely ontogenic, didactical and epistemological obstacles. The ontogenical obstacle is found because there is a jump on the student's thinking process, based on the results of interviews showed that students have not been able to understand the basic concepts of understanding circles and also confused in planning problem solving from the questions given. It can be found that students have difficulties in connecting lines between given points and not connecting with others. Students’ difficulties are included in the epistemological obstacle are mostly found in the process of working on the matter of circle material. Epistemological obstacle occurs because of by student’s limitation of knowledge. Most of students have been able to do simple questions, rather than use them in the context of more complex. Didactical obstacles are found in several basic concepts that are taught, but have a major impact in the process of creating students’ concepts of circle material. Based on interviews of several students, most of lecturers are using conventional approach, such as explaining the material, working on the sample questions, and assigning students to work on not exemplified problem. Thus students understand the procedures taught and lecturers do not involve students in the formation of material concepts provided only they are assigned to study without knowing the basic concepts of the material. So that, the material concepts are not well understood. The following is one of the student answers based on the procedure that was previously known.

In solving the problem, the students worked on the questions in accordance with the procedures obtained during the learning process with the lecturer without thinking the steps to solve the problem other than those he knew, because in detail students tried to find easier ways to find the value of radius by dividing the coefficient on equation with the value of multiples.

3.2 Learning Trajectory Analysis

In constructing a learning process, an instructor needs to predict on how the possibility of students learning mathematics specifically is by predicting how creative thinking skills and students’ understanding of the concept of circles relation and will develop designed of learning process. A Hypothetical Learning Trajectory (HLT) or learning path provided by the lecturer must be based on the idea of choosing a specific learning design, so that learning outcomes are achieved well. This can be seen from the thinking and planning that occurs in teaching, including spontaneous responses.

Learning trajectory teaching can only be a hypothesis, because the experience of the lecturer in making decisions and adapting aspects of the activities planned in response is to prove the thinking and learning that is done by students, for learning trajectory is designed in the form of hypotheses or guesses called HLT.

3.3 Analysis of Creative Thinking Ability in circle material in terms of Learning Obstacle and Learning Trajectory

Based on the students’ interviews in solving circle material questions because they are difficult in developing ideas in planning problem solving. Students work according to what has been obtained before and based on what has been learned in the textbook given as a reference during the lecture and according to what has been explained by the lecturer. The solution to the questions given by students only uses one method. The students immediately use the method of multiplying coefficients on variables with multiple numbers, besides the limitations of book references greatly influence the development of students' creative thinking in training mindset in solving more complex problems.
4. Conclusion
Characteristics of student learning obstacle on circle material is divided into several things including Ontogenical obstacle, Epistemological obstacle and Didactical Obstacle. Ontogenical obstacle is found because there is a leap in students' creative thinking processes in problem solving, Epistemological obstacle occurs because of the limited contexts known to students, while Didactical Obstacle is found on some basic concepts taught by the Lecturer and has a major impact on the formation of student concepts. In learning trajectory, students contribute theories (cognitive psychology) about how student learning flows in problem solving circles. It can be concluded that students’ creative thinking abilities on the concept of a circle based on learning obstacle and learning trajectory need to be better developed and also need to know in advance the prerequisite material before solving the problem solving problems on the circle material in order to obtain a good didactic design, so that it can be implemented effectively.

5. References
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