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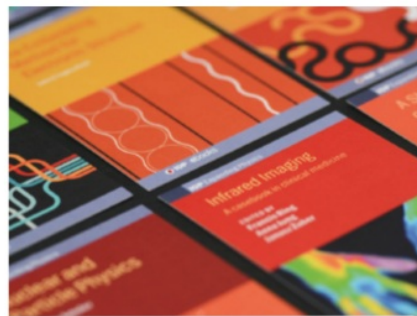
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Learning design of *geometri lukis* to support the prospective teachers' problem posing ability

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Abstract. This study aims to design the design of mathematics Geometri Lukis to support the ability to submit pre-service mathematic teachers. Design research is chosen as a type of research consisting of preliminary design, experimental pilot and teaching experiment. By integrating the ability to submit questions in painting geometry, learning design was obtained with the local instructional theory which included activities: The pilot experiment was carried out in STKIP PGRI Sidorajo by involving 6- semester 4th pre-service mathematics teachers. This activity was held for 3 meetings, with the following activities: 1) pre-test, 2) propose question- related the procedure of sketch lines and angels according to condition and term have given and solved it, 3) sketch lines or angles by propose new question to difficulties incomplete question the beginning and solve it, 4) sketch lines and angles by proposing another new question is appropriate with condition and term to have given and solve it, when students could complete of istimewa angle using dividing angles and lines concept. The things that are done in the Preliminary design phase are: 1) analyzing the learning objectives, 2) determining and determining the initial conditions of the study, 3) designing and discussing the conjecture or HLT to be developed.

1. Introduction

A teacher should have four, namely pedagogical competence, personal competence, social competence, and professional competence. Each of these competencies is very closely related to one another. In this pedagogic competence, a teacher is required to master skills in all learning processes. These pedagogical skills include mastery of the foundation of education, mastery of learning materials, ability to develop learning programs, ability to carry out learning programs, and the ability to assess learning processes and outcomes. Each of these abilities has an important role. One of the activities on pedagogic competence that is always carried out in the learning process is the assessment process [1-4].

A pre-service teacher needs to have assessment skills. The activity that must be carried out by the teacher in the assessment begins with the activity of making questions according to the material to be tested. This activity is called problem posing. Problem posing is an important part of mathematics learning [5]. As a student pre-service teacher this activity is closely related to the assessment activities that must be owned. However, based on the pretest related to the submission of questions on the material of sketch Geometri Lukis shows that some teacher-students is still lacking the ability to submit or raise some questions about prospective mathematics.

2. Theoretical Background

2.1. Problem Posing and Geometri Lukis

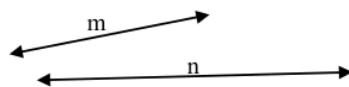


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Problem posing is an important activity in mathematics that has several advantages [6-7]. Problem posing is of central importance in the discipline of mathematics and in the nature of mathematical thinking [8]. Problem posing can support creativity in learning mathematics. Problem posing includes problems in solving activities. The ability of problem posing is positively correlated with problem solving skills [9]. Problem solving and posing skills are among the most fundamental skills in mathematics curriculum [10-11]. These two skills are an essential component of mathematics education [12-13]. When someone makes a question, then he must be able to solve the question that has been submitted. The term "problem posing" has been used to refer both to the generation of new problems and to the reformulation of given problems [14]. In problem posing, someone does not need to make a new question, but they can reformulate the question that has been given by considering the terms and conditions of the previous question.

Problem posing could be done in three forms of mathematical cognitive activity that are presolution posing, within-solution posing, and post solution posing [9]. Presolution posing is when someone makes a question of the situation given. The situation description given example is as follows.

There are two lines, namely line m and line n . The instruction given is to make one question related to sketching the angle and solve it. The possibility of the problem that could be proposed is "Given the line m and n , draw the angle of 30° with a leg of angle m and n !"



In this case, someone is said to be able in problem posing when the questions made have the right conditions and they can solve it correctly.

Within-solution posing is someone's ability to reformulate a problem as it is being resolved. The description of the submission of this type of problem is as follows.

Students are given a question, "Sketch an ABC equilateral triangle with circumference (k) in cm," The first thing to do is to solve the problem. In the process to solve it, students are asked to make new questions similar to the questions that have been given. The student can make a new question by changing the conditions or the terms of the question that has been given. Some questions that can be made are "sketch an equilateral triangle with circumference (k) in cm, $10 \leq k \leq 18$ ", "sketch the isosceles triangle with the circumference (k) in cm, $15 \leq k \leq 24$ ". The type of problem posing can be used when students experience difficulties during the process of solving the problem.

Post solution posing that is when someone is asked to modify the purpose or condition of the problem that has been solved to make a new question.

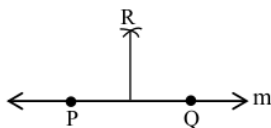
Students are given a question, "sketch an ABC equilateral triangle with circumference (k) in cm, $15 \leq k \leq 24$ ". The first thing to do is to solve the problem. After students solved the problem, they are asked to make a new question. Some questions that can be asked are "Attention the ABC triangle above. Sketch an equilateral triangle DEF with $AB:DE = 3:1$ ", "Sketch an isosceles triangle with height (t) in cm, $3 \leq t \leq 6$ ".

Problem posing has several meanings, which are a) formulating a simple question or re-formulating questions with some adjustments to make it simpler, b) formulating a question which has several

conditions in a specific question which need to be solved in order to find an alternative way in solving the question or to find another relevant question, c) formulating or creating a problem from the available set of questions, this is better done before, while or after solving a specific problem or problem [15]. Classification of problems posing tasks) free situations, students propose problem without any restriction, b) semi-structured situations, students propose similar problem with given problem or propose problems based on specific pictures and diagrams, c) structured problem-posing situations, students propose problem by reformulating solved problem or by manipulating the goals of given problems [16]. Student's inadequacy to solve some proposed questions (Initial question) could be overcome by giving or proposing another relevant question which is still relevant to the difficulties that the students encountered in solving the initial question. The situation as mentioned above could be described as follows.

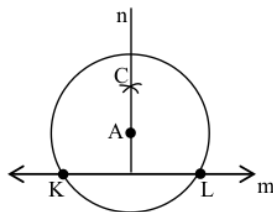
Given information: There is a line m and there is a point A outside the line m . The question following that information: Formulate a question which is dealing with sketch an angle and intersect a line, and then solve the question that you already made! The possible question that the student will formulate; "In the given information, there is a line m and point A which is located outside line m , draw a figure of straight lines which intersect line m and point A ." When student encountered difficulties in solving that initial question, they can propose and formulate another question which still has relevancy with the initial question, for example: Draw a straight line that in lines with line m .

New question:



1. Sketch a figure of line m
2. Sketch a figure of point P and point Q on line m , $P \neq Q$
3. Make a protactor from line P and line Q with the same amount of degrees.
4. Intersect both degrees on point R

Initial Question:



1. Sketch a figure of line m
2. Sketch a figure of point A outside the line m
3. Sketch a circular protractor which centralized in A and intersect the line m on point K and point L
4. Sketch a protractor from point K and point L without changing the amount of degrees, intersect in point C
5. Connect the point C and point A until intersect the line m
6. $n \perp m$

When students proposing a question and finding difficult to solve that question, then they can propose or formulate a simpler question that could help them solve the initial question. This new question must be relevant to the difficulties that student had encountered on the initial question. However, if someone could solve the initial question, then they must propose another new question which still has relevancy with the given information. This proposing a question activity can become an effective strategy in helping a student to propose a question. This following figure is a strategic chart in question proposing activity as design learning.

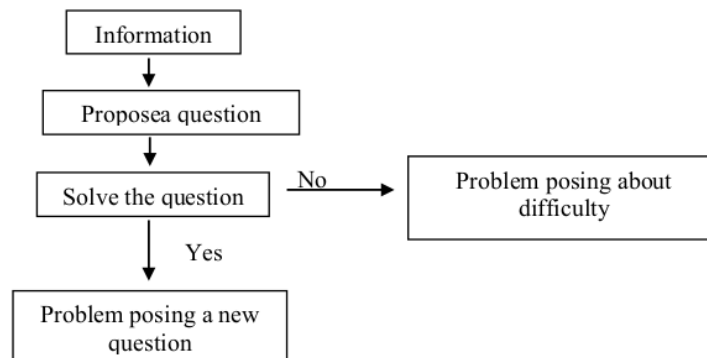


Figure 1. Design Learning of Problem Posing in *Geometri Lukis*

Problem posing as a tool for studying cognitive processes, it can be used to investigate the transfer of concepts across context, and to identify student's knowledge [17]. An individual mathematical experience could help them on their success in problems posing activity. Students should also have some experience recognizing and formulating their own problems, an activity which is at the heart of doing mathematics [18].

2.2. Local Instruction Theory

The aim of this study is to design learning *Geometri Lukis* (sketch of lines, angles, and triangles) based on problems posing theory. The activity of design research aims to produce a local instructional theory (LIT). LIT is a theory that describes conjecture about learning trajectories on a topic, a series of learning activities and steps used to support learning processes [19].

3. Method

Design Research is a method in this study. The step of design research includes preparing for the experiment, the design experiment, and the retrospective analysis [20]. The first step, we formulated a HLT (Hypothetical Learning Trajectory) for learning the problems posing in *Geometri Lukis*. It consists of activity to achieve students learning goals and a conjectured learning process to sketch of lines, angles, and triangles. This study presents the Preliminary Design to sketch of lines, angles, and triangles.

3.1. Participants

The subject of this study was involving 6 pre-service mathematics teachers the 4th-semester mathematics education STKIP PGRI Sidoarjo. The six students were selected by the lecturers.

3.2. Data collection and analysis

Preliminary Design

The main goal in the Preliminary Design is formulating the hypothetical learning trajectory (HLT) that is elaborated and corrected during the experiment [20]. HLT is dynamic and can be adapted to students' thinking strategies during the design experiment. The first step that must be done at this stage is to review the literature on sketching lines, angles and triangles and the design research method as the basis for designing learning trajectories. The things done at these steps are (1) analyzing the learning objectives, (2) determining the initial conditions of the study, (3) designing and discussing the conjecture, design learning or HLT to be developed.

The research design can be described as follows.

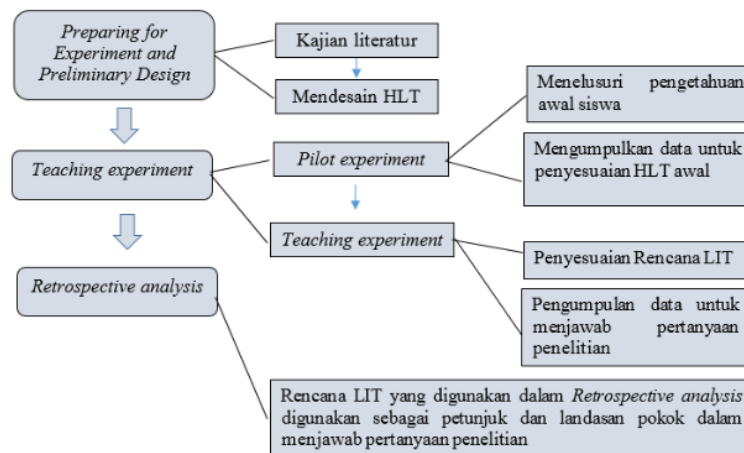


Figure 2. Diagram of Design Research

4. Results

This study produces a learning trajectory of problems posing sketch lines, angles, and triangles which in turn can contribute to developing *Local Instructional Theory* (LIT). Result and discussion can be described as follows.

In this step, we developed a design learning of problem posing in *Geometri Lukis*. This result can be used to develop a *hypothetical learning trajectory* (HLT). An overview of activities developed in the design learning stage first is all students can propose a question about sketch lines, angles, and finish it. The second stage is students could propose new question related to difficulties incomplete question the beginning. The third stage is when students could complete question beginning, then they could propose question another new one is appropriate with condition and term are given.

Compilation HLT preceded by analysis activity that aims to make learning curriculum designed corresponding with curriculum mathematics applicable for 4th-semester mathematics education students as the subject in activities learning. The Analysis covers determination teaching material and indicator learning. Learning outcomes of this material are solving the problem of *Geometri Lukis*. Focus the learning has proposed the question to sketch lines, angles, and triangles. The Indicator in learning that is able to propose questions related sketch of angles and lines according to condition and term given and solve it; able to propose new questions related difficulties incomplete question the beginning and solve it; able to propose question another new one and solve it, when students could complete question beginning.

The next activity is an analysis of the results of the students' pre-test about propose questions related to sketching lines, angles, and triangles. The Pre-test was given to 32 subjects. The following is one of the results of a subject's pre-test.

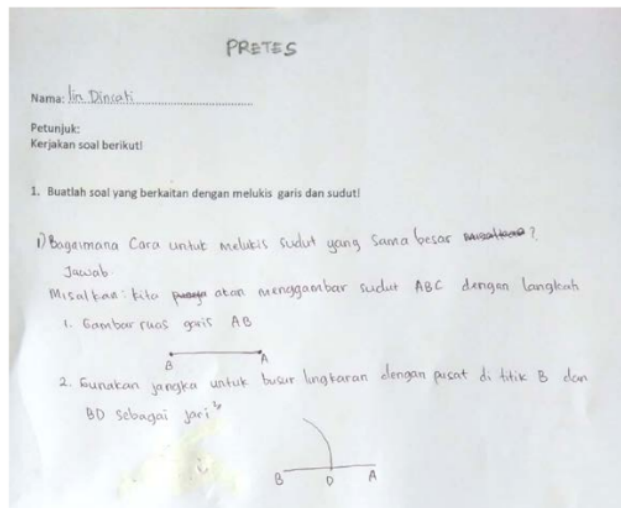


Figure 3. Example of results pretest

The pre-test results above show that ability proposes question student not yet looked with good. This is proven with wrong answer form settlement question number 1 submitted. While that, the number 2 shown that wrong in propose question to sketch triangle. Results this to show need design activities that can improve the ability of problem posing. Results interview to show that when they have made a question, they have difficulty solving it.

Therefore, in the design of learning developed hypothetical learning trajectory (HLT). The activity of this design learningis presented in the following table.

Table 1. Activity of design learning of problem posing in *Geometri Lukis* related sketch of lines, angle, and triangle

Number	Activity	Goal
1	Sketch lines and angles	Propose questions related to the procedure of sketch lines and angels according to condition and term have given and solved it
2	Sketch lines or angles	Propose new question to difficulties incomplete question the beginning and solve it
3	Sketch lines and angle	Propose another new question is appropriate with condition and term to have given and solve itwhen students could complete question beginning

4.1. The teaching sequences

1) Activity 1

In this activity, students propose questions related to the procedure of sketch lines and angels according to condition and term have given and solve it. Students are given information relating with points and line,

"There is a line m and point A is outside the line m".

Tasks are given to students

"Propose a questions related sketch of lines and angles, then solve the problem."

Some student test results are presented as follows.

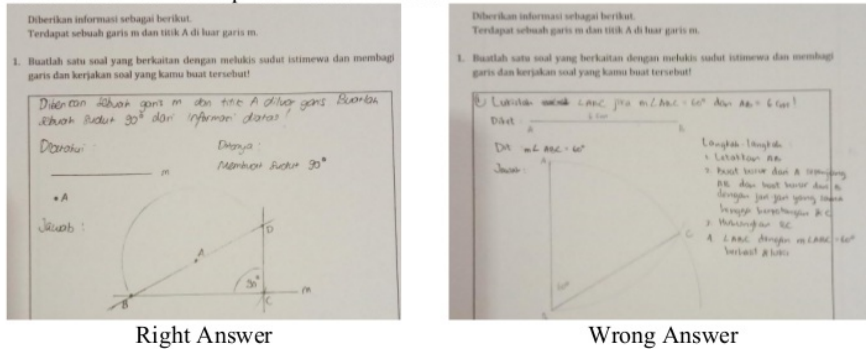


Figure 4. Result of Activity 1

Four students could propose a question and solve it correctly. One student proposes a question and solves it; however, do an error. One other student, doing error in propose questions the beginning.

2) Activity 2

Activity 2, the students propose a new question to difficulties incomplete question the beginning and solve it. Students are given information below.

"There is a line m and point A is outside the line m".

Tasks are given to students

"Propose a questions related sketch of lines and angles, then solve the problem. If you difficulty solve that, propose some question related to difficulty when solving question beginning and solve it"

This activity could help students to solve the beginning question. The question related to difficulties proposed by students can be simpler. They can learn to relate theories about sketch line and angle.

3) Activity 3

Propose another new question is appropriate with condition and term to have given and solve it when students could complete question beginning.

The information:

"There is a line m and point A is outside the line m".

Tasks are given to students

" Propose a questions related sketch of lines and angles, then solve the problem. If you could solve it, make another new question related to sketching lines and angles and solve it."

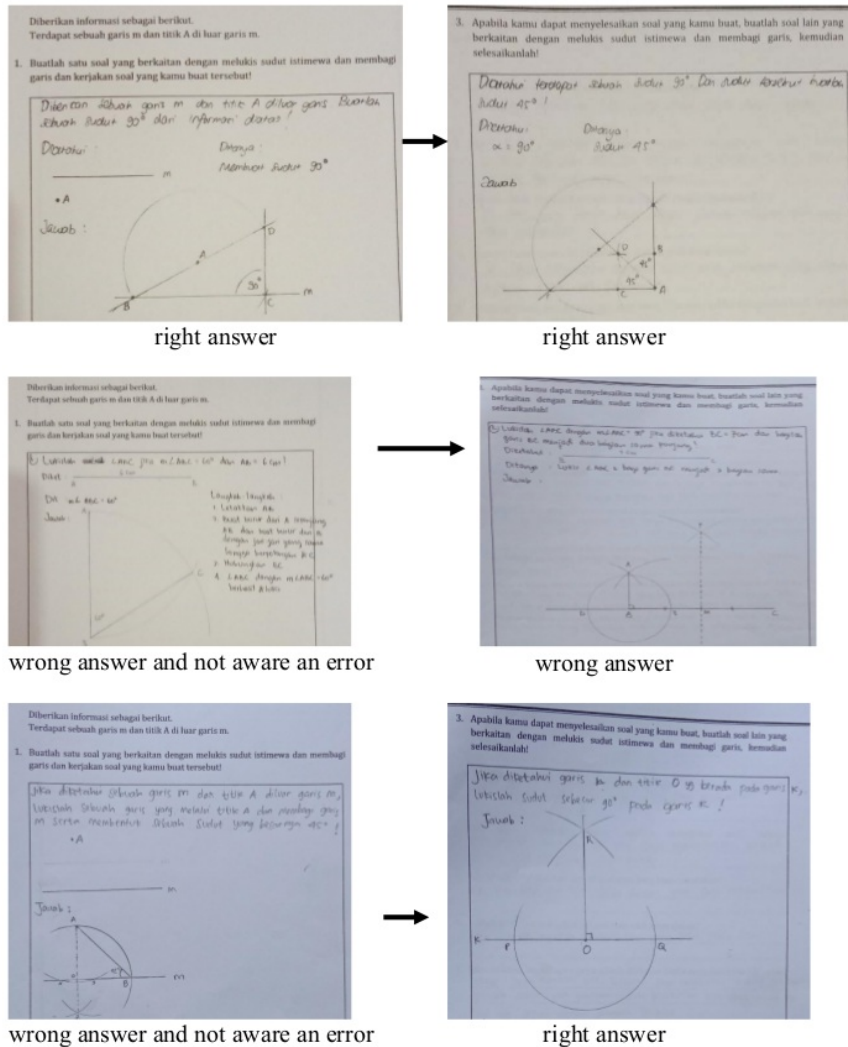


Figure 5. Result of Activity 3

According to three activities, there are four students could propose questions related term given and solve it with right. But the wrong one from fourth students that does error on proposing a new question in activity 3.

One another student propose a question and solve it; however, do an error in activity 1. He has not realized that the question was proposed is wrong. He too does error on proposing new question in activity 3.

The last student, doing error in proposing question in beginning. He has not realized that the question was proposed is wrong. However, he able to propose a new question and solve it with right in activity 3.

The results of the pilot project step can be seen in the following table.

Table 2. Result of Activity 1, 2, and 3

Problem Posing	Activity		
	1	2	3
True	4	2	3
False	2	4	3

5. Discussion and Conclusion

Four students out of six students could propose a question and solution correctly by this learning design study. Lack of experience and knowledge causes the low ability of problems posing [21-22]. In this study, prospective teachers have less knowledge and less experience in problems posing related *Geometri Lukis* so that it affects the low ability of problem posing. At the beginning of this learning design, HLT development was used as the initial method on problem posing about sketch of lines and angles. The next step of this research will use HLT on a pilot project. The draft of this research's learning design supports the students' ability to pose a question for prospective teachers. Generally, some activities on the learning design of this study can support problem posing of *Geometri Lukis*.

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