Needs Analysis to Develop Mathematics Teaching Material of Senior High School (SMA) Based on Problem Based Learning

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Abstract. Students’ ability in solving mathematical problem has optimal yet. This is due to mathematics learning provide less opportunity for the students to get involved in a challenging problem during learning process. The purpose of this research is to develop learning devices in the form of lesson plan and worksheet based on Problem Based Learning (PBL). This is a development research. The development model employed in this research is Plomp Model. This model consists of 3 phases, namely, preliminary research, development or prototyping phase, and assessment phase. In this part, the reported one is the preliminary research. The result of data analysis on preliminary research shows that: 1) Teacher is not able yet to develop learning device in order to improve students’ ability in problem solving. 2) Students’ inability to solve story problem. 3) Students are not capable to work on different question from the sample given. 4) Students are expecting to have a real life context problem on worksheet in relation with their daily life. 5) Students prefer to work on group. 6) Students who live in a rural coastal area tend to be less motivated and less active in the learning process.

1. Introduction
The ability to solve problem is a must possessed by students in learning mathematics [1-2]. The research developed in the United States of America is aimed to educate the students to be skillful in the 21st century, and are able to participate in Science, Technology, Engineering, and Mathematics (STEM) [3]. Research conducted in some other countries such as: Pakistan, Caribbean, Turkey and London revealed the importance of students’ ability in problem solving that is for them to be able to implement mathematics concept in the real life and in the real future time [4]. Therefore, the ability to solve problem is of vital importance for the students, so that the material they learned can be implemented in their real life. The previous research shows that the ability to solve mathematical problem of Junior High School students are still low [5]. The next problem found during preliminary research in Public Senior High School (SMAN) 1 Batang Kapas is that students find it difficult to work on question that is different from the example provided by the teacher and also find it hard to work on story type question. As the effect, the result of their mathematics learning is still very low and cannot pass the Minimum Completeness Criteria (KKM). This is also due to lack of learning resource which enable the students to find mathematics concept. Therefore, it is expected that worksheet provides steps of activity process to lead the students into the finding of mathematics concept they are about to learn.
Based on the above problem, a learning device to facilitate both mathematics teacher and students on classroom learning process is of vital importance. This learning device need to be developed to allow students to be more motivated in mathematics learning [6]. Lesson plan and worksheet are significance learning devices. Lesson plan is a planning program designed based on learning implementation instruction for every process of learning activity [7]. Worksheet is well prepared teaching material to enable the students to learn it independently [8]. Based on the above opinion, it can be concluded that both lesson plan and worksheet can help mathematics teachers and students in the classroom learning process. The researchers are motivated to develop learning device based on Problem Based Learning [2]. The developed PBL can help teacher to improve students thinking skill and problem solving skill in which later can give rise to their motivation [9].

There are steps in the learning process [2]: (1) Students’ orientation on problem. In this stage, teacher give students the problem related with their daily life, this problem can be solved with the students’ early knowledge. (2) Organizing the students to learn. In this stage, teacher form a learning group, every group consists of 4 students with higher level ability, middle level ability, and low level ability. (3) Guiding both individual and group investigations. At this stage, teacher directs students to work actively together among the groups in order to collect information in order to solve the problem. (4) Developing and presenting group work. In this stage, teacher helps students to make the discussion result or report of problem solving. Each member of the group presenting the discussion result in front of the class, and (5) analyzing and evaluating both process and the result of problem solving. In this stage, teacher evaluates students discussion result and together with the students concluding the learning material. Based on the explanation, researcher conduct an investigation about the development of leaning device based on PBL model in order to improve students’ ability in solving mathematical problems.

2. Materials and Methods
The research development implemented is Plomp model. Plomp model has many advantages, particularly its practicality, namely, one to one, small group, and field test [10]. This model consists of three phases: preliminary research, prototyping phase and assessment phase [11-15]. Preliminary research consists of needs analysis, curriculum analysis, concept analysis, and student analysis [10, 15]. At the prototyping stage, in the making of this prototype, formative evaluation took place. Prototyping stage consists of prototype 1; it is self evaluation and expert review; prototype 2, one to one; prototype 3, small group; prototype 4, field test. The assessment stage is to conduct field test to class X SMAN 1 Batang Kapas in order to see its practicality and effectiveness. Research data were collected through self evaluation sheet, validation sheet, observation sheet, and interview guidance, questionnaire sheet of teacher respond and student respond, observation sheet of lesson plan implementation, and final test of problem solving. Device validation is conducted by three Mathematics lecturers, one Indonesian Language lecturer, and one lecture of Education Technology.

3. Results And Discussion
The results of data analysis on preliminary research stage are as follow:

3.1. Needs Analysis
Based on the result of interview and observation conducted in SMA N 1 Batang Kapas, it is found that students need learning device to help them in understanding the learning material. One of the learning devices used is worksheet. Worksheet used by the students is worksheet available in the market and the color is only black and white, so the students are not less interested in using it. This worksheet consists of learning material, question sample, and exercise. However, this worksheet has no question story; hence students are not able to work on it. This worksheet also has no procedure and steps to guide the students to find and to understand the learning material. It can be concluded that, the
worksheet used has yet been able to lead the students to discover mathematics concept, and has yet been able to train students to solve a problem in a story question form. As the effect, students find it hard to remember what they have learned.

Based on the above explanation, it can be concluded that students are expecting for an attractive worksheet, for both display and content, containing problem and steps to solve it. Problems in worksheet help the students to train to be active in the learning process as to improve their ability in solving problem.

3.2. Curriculum Analysis
The result of curriculum analysis is the explanation of indicator has been based on KI and KD of 2nd semester. The explanation of achievement indicators of competence achievement (IPK) is conducted to assure that the intended material can be well understood by students. There are 4 KD that will be mastered by students. KD 3.9 is explaining sine and cosine rules. There is an addition of indicator toward KD 3.9; it is to determine the area of n regularity. This indicator is implemented after students learn about the width of the triangle area of an arbitrary triangle.

3.3. Concept Analysis
Based in the result of concept analysis, it is found that learning topic that will be learned by the students of class X, second semester is trigonometry. The material that will be learned on this topic is about the measure of angles in degrees and radians, trigonometric comparisons on right triangles, trigonometry comparisons at special angles, trigonometric comparisons in all quadrants, trigonometry identity, sine and cosine rules, area of triangle and function graph [16]. Based on the concept analysis, then the learning device that will be developed is sine and cosine rules.

3.4. Student Analysis
This analysis is conducted to students of class X SMA N 1 Batang Kapas in Pesisir Selatan District on academic year of 2018/2018 by distributing the questionnaire. Of total 33 distributed questionnaire toward the worksheet that will be developed resulted in: 16 students or 48% students choose A4 size paper; 7 students or 21% choose folio size paper; 10 students or 30% choose regular notebook size. The expected types of font: 8 students or 21% choose times ne roman; 6 students or 15% choose berlin san FB; 25 students or 65% choose comic san MS. The expected worksheet size: 5 students or 15% choose size 11; 17 students or 51% choose size 12; 8 students or 24 % choose size 14; and 3 students or 9% choose the other size. Next, the expected cover of the worksheet: 21 students or 60% choose blue color; 7 students or 21% choose pink; 5 students or 15% choose green; and 1 student or 3% choose other color. For the selection of picture and color, 18 students or 36% choose colorful LKPD; 22 students or 44% choose LKPD with pictures on it; and 10 students or 20% choose LKPD with attractive font. Next, picture illustration on worksheet: 31 students or 93% vote yes; 2 students or 7% vote no. The expected picture: 18 students or 36 choose animation/cartoon; 9 students or 18% choose occupational picture; 10 students or 20% choose art; 7 students or 14% choose game; and 6 students or 12% choose sport.

The problem in worksheet: 13 students or 30% choose problem related with students’ daily life; 5 students or 11% choose problem related with students life at school or at the workplace; and 25 students or 58% choose problem related with the use of mathematics knowledge in real life and in a broader environment in students’ daily life. To bound mathematics worksheet: 5 students or 15% choose regular bound; 25 students or 76 choose plastic spiral bound; and 3 students or 9% choose spiral wire bound. Moreover, the expected learning style: 23 students or 70% choose working on group; and 10 students or 30% choose to study independently.

Based on the interview with teacher and teacher observation, it is found that teacher find it hard to deliver the material since students are in a great variety of learning style [14]. Teacher can use
conventional method and discussion method to deliver the learning material to the students. On conventional method, students are less active in the learning process, some students pay attention to teacher’s explanation, but some others are doing their individual activity. For the students who are focusing on teacher’s explanation, there is no guarantee that they can comprehend it. It is evidence that some students provide an incorrect answer. Whenever teacher asks whether they understand or not, most of the students says that they understand, but when it comes to exercise, they start asking one another and getting help from their peer.

By using discussion method, students are more motivated in the learning process. Students are divided into groups in order to be able to comprehend material on LKPD or text book, and then later work on the exercise together with their peer. By employing this discussion method, middle level or low level students can consult their higher level ability peer. Students are reluctant to ask their teacher. Once, a group presenting in front of the class, the other group start actively asking the group with questions related to the presentation or learning material.

Furthermore, the result of interview and observation also shows that the cause of students less motivated and less active in the learning process is they live in rural coastal area. In order to improve their motivation and their active engagement on learning process; hence mathematics learning is then relate with the students’ living environment, that is by giving real life problem related with their real life situation. One of the problem samples that can be given is: “Mr. Rahmad is one of the head of the family who lives of the Kasai Bay Beach. Mr. Rahmad is 1.6 m height. He has a son named Roni. Roni is at 6th grade of elementary school. Roni is 1.2 m height. To support the family living, Mr. Rahmad works as the coconut tree climber. One day, Mr. Rahmad asks his son Roni to go along with him. Roni is a good kid. He loves asking question. Roni asks his father about the height of the coconut tree, Mr Rahmad smiles and replies the height of the coconut tree is 16m. In that late afternoon Roni spent with his father, he look at the shadow of every object on the ground. He then takes meter line and measure his dad’s height and the coconut tree shadow’s height, 3 m and 20 m. but he couldn’t measure his own shadow’s height since his shadow always goes following his every movement. If you were Roni, can you measure your own shadow’s height?”

Students are asked to observe the problem, write the information and solve the problem in a group discussion.

4. Conclusion
Based on the data analysis on preliminary research; hence the expecting learning devices by the students are as follow:
1. Students choose A4 size worksheet, with Comic San MS font, size 12, and blue color cover, colorful and picture featured with animation or cartoon, the problems discussed have to be related with mathematics knowledge in real life and a broader life in students’ daily life. The students love plastic spiral bound and students prefer to work in group.
2. The reason the students prefer to work in group is because some of them find it comfortable asking their peer about part of the learning that they find it hard to understand. Group work fill in the gap.
3. Students live in a rural coastal area. This has influence their motivation in learning. Therefore, mathematics learning would explore more contexts on the students’ living environment to arouse their motivation in mathematics learning.
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