

Developing Mathematics-Students Worksheet Based On Realistic Approach For Junior High School In Bilingual Program

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Abstract

The aim of this study is to develop mathematics-student worksheet based on realistic approach for junior high school in bilingual program. The criteria used to generate product are valid and practical.

This research was applying the Research and Development design as adapts the development model of Borg and Gall (1983). Those are (1) need analysis, (2) product development (3) organization of learning material prototype (4) trial run, (5) product revision and (6) final result.

In its development, mathematics-student worksheet has been tested through formative evaluation that covers several stages, i.e. content or material expert review, instructional design expert review, instructional media expert review, individual test, small group test and field test. The formative evaluation results in form of suggestion, response or assessment used as feedback in revising and finishing the mathematics-student worksheet.

The content or material experts review, the instructional design expert review and the instructional media expert review of mathematics-student worksheet result in "very good" category with percentage of 90%. According to the students' responses, it was found that students worksheet was very interesting, exciting and can help the students to comprehend the concept.

Key Words: Student worksheet, Realistic Mathematics

I. INTRODUCTION

1. Background

Globalization era which has been increased the competition among countries in the world automatically demands the development of competence and competitiveness of Indonesian in international forum. Thus, the government makes an effort to improve Indonesian competence and competitiveness by implementing International Standard School. The learning process is done by using bilingual. The development of bilingual program has also been an attention by Indonesian government as mentioned in UU No. 20 Year 2003. About national Education in Chapter 50 verse (3), that is, the government and/or Regional government hold at least one unit of education in all education levels to be improved as International Standard School. Ellerton & Clarkson (1996) stated that the importance of bilingual learning which engages international communication language will support integration and will also ease information transfer in globalization era.

The improvement of Indonesian competence and competitiveness is also done by increase students' independence and creativity in the school subject including mathematics. Students are expected to understand the materials of the mathematics learning comprehensively and holistically. The students' understanding not only fulfill the objectives of the mathematics learning in substantive way but also is expected that there will be "side effects", namely comprehend the use of mathematics in human life, be creative and innovative (JICA, 2001: 254).

The importance of International Standard School and the improvement of students' independence and creativity to develop the competence and competitiveness of Indonesian demand a development of teaching materials that can facilitate to achieve those two matters. According to Newby et al (2000), student worksheet is one of the teaching materials that can improve students' competence in analyzing and solving any problems independently. Student worksheet can minimize students' dependence to the teacher and increase the students' needs of information. Hence, the utilization of student worksheet can increase students' independence. It motivates a group of researchers and some of students to conduct a research about a development of mathematics realistic based student worksheet in bilingual mathematics learning in junior high school. The problem formulation is; what is the design of realistic mathematics based student worksheet in bilingual mathematics learning in junior high school?

This research is aimed at designing realistic mathematics based student worksheet in bilingual mathematics learning in junior high school that has valid and practice specification. As the objectives, the research is a development research which used development model 4D- Model namely define, design, develop, and disseminate. The research will adopt the model until the third D, develop stage, that obtain a valid teaching device.

II. Realistic Mathematics Education

Realistic mathematics learning is designed to change the mathematics image, from "mathematics as a final product or scientists' invention which has to be memorized" to "mathematics as human activity". In common mathematics learning, the students consider that mathematics is a subject that contains a lot of formulas that have

to be memorized, not as an invention that can be used in daily life. In realistic mathematics learning, the materials can be an elaboration of students' findings (with teacher's guidance). Besides, it changes the habit of demanding the students to hear, make a note, memorize the formulas, and do the exercises to learning by doing, reinventing mathematics from realistic contextual problem, reflecting process, discussing process and result of students' discussion, connecting the invention with the previous knowledge, and presenting the conclusion in front of the class.

Realistic mathematics education is very affected by Hans Freudental's thought about mathematics as an human activity, not only an object which must be transferred from teacher to students (Freudental, 1973 and 1991). Based on Freudental, mathematics learning has to be connected with daily context. The main focus of mathematics learning is not mathematics as a closed system, but mathematics as an activity which has a mathematical process objective. Therefore, realistic mathematics education connects informal mathematics knowledge that is obtained by the students in daily life with formal mathematics concept. The word "realistic" not only means a linkage with the fact but also contextual problem that has to be meaningful for the students. The simple example is the use of context of snow for Indonesian children. Snow is exist but Indonesian children are hard to figure it out because they do not experience the snow directly. Thus, the context of snow is not "realistic" for learning in Indonesia.

The application of contextual problem is also used in a learning which uses algorithmic mechanistic approach. However, there is a fundamental difference between in the application of mechanistic approach and realistic approach. In the mechanistic approach, the contextual problem is given in the end of the learning as a form of application of the concepts being studied. Whereas in realistic approach, contextual problem is used as a basic and an application of a mathematics concept (van-den Heuvel-Panhuizen, 2000). In the beginning of the learning, contextual problem is used as a starting point of a learning of a concept. The other difference between mechanistic approach and realistic approach is on the problem solving. Mechanistic approach emphasizes on procedure or algorithm in solving the problem. The procedure and algorithm is closed and limited so that students only act as "receiver" and less creative

in developing their strategies. Realistic approach focuses on the students as active learners. The students are guided to find a strategy to solve the problem communicate it to the class.

Treffers as cited by Bakker (2004) mentions 5 characteristics of realistic mathematics education, namely: (1) phenomenological exploration, (2) using models and symbols for progressive mathematization, (3) using students' own construction, (4) interactivity, (5) intertwinement. Besides, realistic mathematics education also has three principles for the mathematics design and development (Bakker, 2004). They are: (1) Guided reinvention, (2) Didactical phenomenology, (3) Emergent model.

The application of contextual problem as a source and starting point of learning needs to consider these three things: (1) Mathematical phenomenology, (2) Historical phenomenology, (3) Didactical phenomenology. While, "model development" principal is elaborated from the second characteristic of realistic mathematics education namely using models and symbols for progressive mathematics. Gravemeijer (1994) mentions four stages of the model development, namely: (1) Situation stage, (2) Reference stage, (3) General stage, (4) Formal stage.

III. Developing Realistic Mathematics-Based Student Worksheet

According to Newby et al (2000), student worksheet is of learning materials which can improve students' competence in analyzing and solving the problem independently. Student worksheet can minimize students' dependence to the teacher and increase the students' needs of information. From the define stage, the researchers get the result of curriculum analysis, the main learning material for junior high school grade VII semester 2 is integers and their operations, fraction and their operations, operations of the algebra, linear equations, linear inequalities. Those subject matters are developed to obtain the competence standard: (1) comprehend the characteristics of operation count numbers and its application in problem solving; (2) comprehend the form of algebra, linear equations and linear inequalities of a variable; (3) apply the form of algebra, linear equations and linear inequalities of a variable in problem solving. The basic competence that has been determined in Content Standards 2006 is elaborated in

some indicators. These indicators become a reference to make the development of the student worksheet.

The utilization of student worksheet is expected to increase students' independence, thus the development of student worksheet contains some components as follows:

1. The learning process is begun with realistic matters.
2. Encourage active participation of the students.
3. Enable the model development which starts contains situation, reference, general and formal stage.
4. Repetition to strengthen the understanding.
5. Positive feedback to stimulate and increase the students' understanding.

After that, the outline of the design that was developed is divided into five parts, namely the initial, contextual issues, some of the activities, conclusions and exercises. The initial contains the objectives of the learning and students identities. The view of the initial section is presented as follows:

| STUDENT WORKSHEET 6 | |
|----------------------------|-------------------------------------|
| Basic Competence | : Understanding concept of subsets. |
| Class / Semester | : VII / 2 |
| Name | : 1) _____ () |
| | 2) _____ () |
| | 3) _____ () |
| | 4) _____ () |

Picture 1. The initial section of student worksheet.

Contextual issues are developed in accordance with the conditions of junior high school students in Yogyakarta. The contextual issues are developed by connecting the prerequisite materials with the materials that will be discussed by the students. In contextual issues, the worksheet is equipped with illustrations that can motivate the students.

The design of the activity is adjusted to the material being developed and the analysis of students' learning outcomes which enables the students to develop the model. It is one of the activity vies in student worksheet.

Activity 2

Do you still remember about "prime number"??

In this activity, we will play with them.

Consider $X = \{ \text{first three prime number} \}$

By listing / roster method, it can be written :

$X = \{ \dots, \dots, \dots \}$

Based on set X , determine subset of X ! Make subset of X as much as you can!

Picture 2. Activity section.

The conclusion section is presented to give opportunities to the students to bring up their findings during the activities that had been done before. This part is expected to be the formal mathematics for the students. The presentation of the conclusion section is as follows:

CONCLUSION

- Set A is a subset of B if _____
- _____
- And it can be written by symbol _____
- Set A is not a subset of B if _____
- _____
- And it can be written by symbol _____

Picture 3. Conclusion section

Then, there is an exercise in the end of the section. The exercises are given both repetition exercise and enrichment exercise. It is intended to make the students more skilled and have competence in addition to obtain a better understanding of the concept.

In development stage, it is also defined the criteria of the quality of student worksheet that will be developed. Here, the determination of the criteria is used for instrument development. Instrument that has been developed in accordance with the criteria is then validate by the media expert.

Based on the assessment of five reviewers consisting of three expert namely media expert and material expert and two mathematics teachers as practitioners in field who have been analyzed, it was found that the average of final score of student

worksheet development was 3, 3 with good qualification. The result of student worksheet can be seen briefly in the Table 1:

Table 1. The Assessment Recapitulation of Student Worksheet

| No | Aspects | Average | Qualification |
|---------|-------------------------|---------|---------------|
| 1 | Content Appropriateness | 3, 6 | Very good |
| 2 | Presentation | 3, 1 | Good |
| 3 | Graphs | 3, 2 | Good |
| Average | | 3, 3 | Good |

From the trial result, the researchers analyzed students' works. It was found that the thrust of their works was 90 %. It can be concluded that the students did not find any difficulties in comprehending the issues that were questioned in the exercise and in doing the student worksheet. Thus, the delivery of the material from the legibility of student activity sheets related to the use of discourse, paragraphs, sentences, and words that viewed from English grammar and language appropriateness could be understood by the students. In other words, mathematics student worksheet semester 1 has an excellent legibility.

IV. Conclusion

The development of mathematics student worksheet Jinor High School grade VII was done to actualize a learning that is appropriate to realistic learning so that it can increase students' independency and creativity. Therefore, there is a development which is equipped with some components namely: initial section, contextual issues, some activities, conclusion and exercises.

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