

Design Of PBL Student's Worksheet In The Properties Of Determinants And Matrix Inversions

Nafida Hetty Marhaeni, Suparman

Abstract: Problem-solving, including methods, procedures, and strategies, is the core and primary process in the 2013 curriculum. The presence of teaching materials that integrated with these skills is one effort to increase problem-solving ability. Designing of problem-based learning student's worksheet to extend the problem-solving ability of eleventh-grade senior high school in the properties of determinants and matrix inversions is the intention of this study. The kind of research is development research and uses a 4D model. That is define, design, development, and dissemination. The eleventh-grade of senior high school 1 Imogiri, Indonesia were the subject of this research. Afterward, the curriculum, student's characteristics, and evaluation of teaching substance is the object of this research. This research shows that it is necessary to analyze problem-based learning student's worksheet to improve problem-solving skills needed. For that reason, the design of Problem-Based Learning (PBL) student's worksheet was made which had the potential to improve student's problem-solving skills. Cover, introduction, table of contents, instruction manual, basic competencies, supporting information, action steps, and exercises consists in the design of student worksheets. This research can continue to the development phase and the dissemination phase.

Index Terms: 4D Model, Determinant Matrix, Development Research, Matrix Inversions, Problem-Solving, PBL, Student's Worksheet.

1. INTRODUCTION

CREATING students who have high reasoning is an educational goal [1]. This can be done by analyzing what is happening so that when experiencing problems can make the right decisions [1]. Students are motivated to put it into practice if they know the value and use of mathematics in their lives [2]. So, in-school, mathematics becomes a part of learning that has essential roles and function [3]. Formal science that utilizes symbolic terms to learn the concept as though numbers, structure, variations, and interval can be conceived as mathematics [4]. That is because developing students' creative thinking ability, which is one of the characteristics in the high-thinking level, should be emphasized in mathematics learning [5]. Also, problem-solving ability must be possessed by students to train them to be familiar with problems, either in math or others areas of study, moreover, to apply to solve the complex problems in daily life [6]. In the school curriculum, a teaching goal that has long been reviewed, an important problem is problem-solving [1]. That is because one of the most complex intellectual function is problem-solving [7]. Problem-solving including methods, procedures, and strategies, is the core and primary process in the 2013 curriculum. In the curriculum of 2013 emphasizes that a contextual approach becomes the process approach as the strengthening of the use of the scientific method [8]. Unfortunately, when there is a relatively permanent change in individual deed and new knowledge or skills, it is only called learning [9]. So, setting specific and measurable learning can be improved the quality learning [4;10]. Learning is defined as extending the individual experience of a given phenomenon while teaching as a way to enhance students' experience of the phenomenon given through aligning the critical dimensions

of this experience [4;11]. Therefore, teachers have an essential role in learning to rectify the quality of learning [12]. The challenges of a teacher are improving students' problem-solving ability. The standard process of learning mathematics is problem-solving, think logically to evidence, communication, correlation, and the representation [13]. Therefore, the essential to learning mathematics is learning how to solve the problem [4;14;15]. The problem-solving methods used four steps by Polya strategies. It is comprehended the problem, stacking a plan, fulfill the plan and extend [15;16] The problem-based learning approach is perfect for helping students solve various types of problems [17]. That is because problem-based learning is student-centered learning [18]. Also, they can investigate the situation and find a solution to the problem that must be resolved by attending the directive of PBL [19]. In science, PBL typically advises learners' scientific habits of thought. The eight dissimilar to the operational compose, that is asking questions, constructing hypotheses, designing and conducting a science investigation, recured trials, accurate data, giving conclusions, applying data and realizing [19;20]. Therefore, teaching materials are needed that can develop students' problem-solving ability with a problem-based learning approach. Teaching material is all type of substance to carry out teaching and learning activities [21]. In this study, teaching material that is developing is students worksheet. A worksheet can support students to write good ideas and upgrading creativity in learning [22]. The student's worksheet will design through PBL. PBL is defined as the learning that able to teach students from the process until students understand and can solve a problem [23]. Therefore, designing of PBL student's worksheet in the properties of determinants and matrix inversions is the intention of this study.

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2 METHOD

The kind of this research is development research used 4D model from Thiagarajan and Semmel Semmel. The a 4D model is defined, design, development, and dissemination [24]. The PBL student's worksheet to upgrading student's problem-solving abilities is the product to developing. The eleventh-grade of senior high school 1 Imogiri, Indonesia were

the subject of this research. Afterward, the curriculum, student's characteristics, and evaluation of teaching substance is the object of this research. Questionnaires, interview instruction, observation guides, and question used for data collection. To get what the curriculum is used and student characteristics, the researcher used observation instruction. Then, the interview was used to obtain evaluation data on resource inspection. To find out student's abilities, researcher use questions. For data analysis used Miles & Huberman, that is consisted of data reduction, displaying data, and conclusions [25]. Figure 1 is the development course.

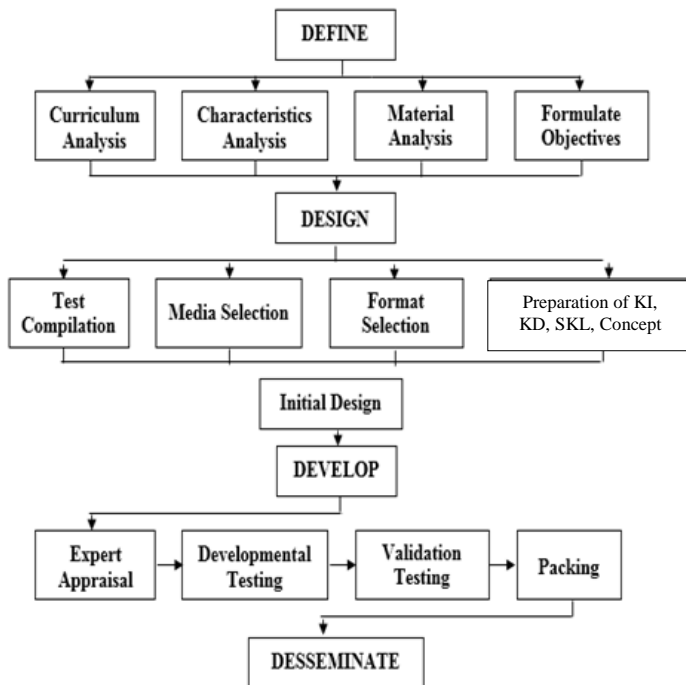


Fig.1. Development Course

3 RESULT AND DISCUSSION

3.1 Define Phase

The first development of student's worksheets is define. The problem analysis phase has been carried out and shows that (1) students' problem-solving abilities are still relatively low; (2) the learning model and teaching materials used do not stimulate students to increase problem-solving skills; and (3) PBL learning model can help students to develop problem-solving skills. This study concluded that problem-based learning student's worksheet that can stimulate problem-solving skills need to be developed. The information obtained from the result of discussions with mathematics teachers at senior high school 1 Imogiri, is that the teacher did not have or develop teaching materials. Student's worksheets purchased from the publisher indicate that used by the teacher and students are. There are several frailties of student's worksheets publishers: (1) does not contain all indicators of achievement of competencies; (2) the order of display not adjusted from easy to complicated, and (3) does not make students more favorable in learning. The result based on conversations with teachers. So far, competency tests or tests did not include problem-solving steps.

Define phase conclude the curriculum analysis, analysis of learner characteristics, substance analysis, and formulate

object [10;26]. The results of curriculum analysis are listed in the mathematics syllabus in the sequence and series subject matter available in the 2013 curriculum. The fundamental competencies contained in the syllabus are translated into indicators of skill achievement. This indicator is a reference for the construction of student worksheets. Basic competencies found in the sequence and series material are in Table 1:

TABLE 1
BASIC COMPETENCE

| No | Basic Competence |
|-----|---|
| 3.3 | Explain matrix and similarities of matrix by using contextual problems and do an operation on the matrix which includes addition, subtraction, scalar multiplication, and multiplication, and transpose |
| 4.3 | Resolving contextual problems that are related to the matrix and its operations |

3.2 Design Phase

The design phase is the second of development student's worksheet. Based on the analysis result in the define phase, so this phase is done by designing the product. The product of this research is PBL student's worksheet to improve the problem-solving skills in the properties of determinant and matrix inversions. Cover, introduction, table of contents, instruction manual, basic competencies, supporting information, action steps, and exercises consists in the design of PBL student worksheets. The student's worksheet contains the syntax of problem-based learning, there are orient students to the problem, organizing students for learning, helping independent and groups investigation, develop and present artifacts (works) and exhibit them, analysis and evaluation of the problem-solving process. Draft 1 is the result of the beginning design.

3.2.1 Cover

The cover entitled "Lembar Kegiatan Peserta Didik; Matriks Kelas XI IPA SMA." The student's worksheet is designed with problem-based learning in the probabilities of the determinants and matrix inversions material and used for eleventh-grade of the senior high school. The cover is shown in Figure 2.



Fig. 2. Cover

3.2.2 Introduction

The introduction serves to give the students an explanation of the subject matter or description contained in the student's worksheet. The introduction includes a thank you to Allah, thank you to people who helped, and if the student's worksheet it's not good yet so the research apologizes, as well as urgency that can encourage others to read the student's worksheet. Figure 3 shows the introduction.

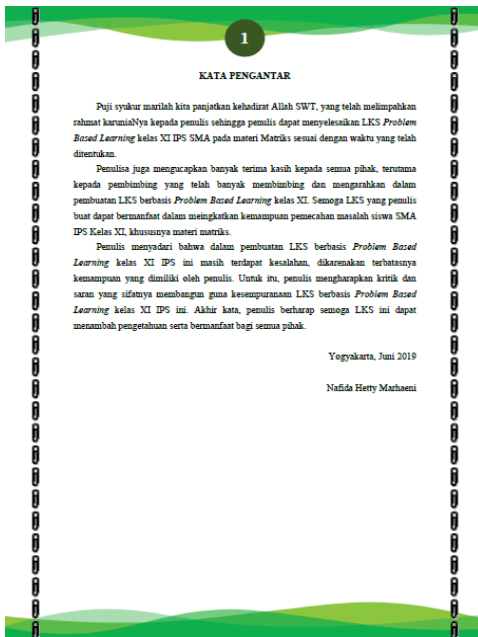


Fig. 3. Introduction

3.2.3 Table Content

To make it easier for you to find material is the function of the table of content. It is arranged based on the page order on the student's worksheet Figure 4 shows the table content.

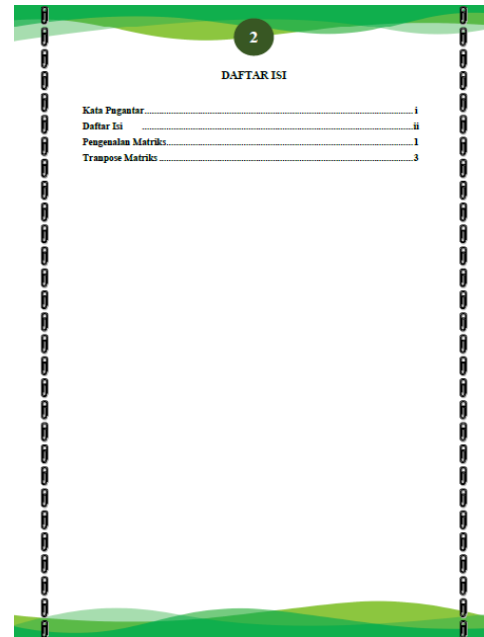


Fig. 4. Table Content

3.2.4 Instruction Manual

The instruction manual explicate how students use student's worksheet. So, the instruction can be interpreted a way of explanation to hshow how to use it. The Instruction manual can be seen in Figure 5.

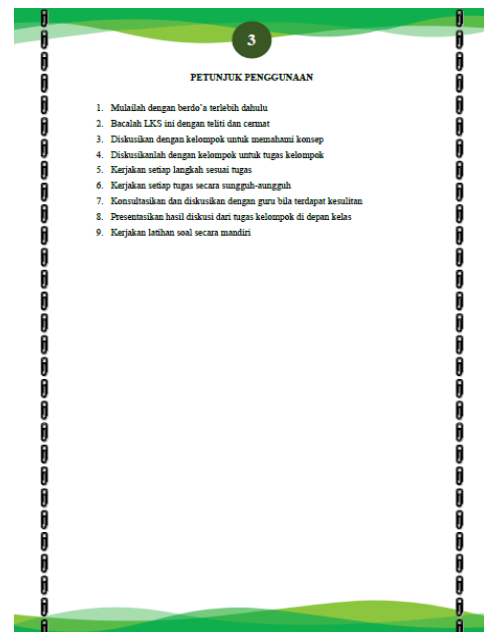


Fig. 5. Instruction Manual

3.2.5 Basic Competence

The achievement of learning outcomes that must be achieved by students contains in the results of curriculum analysis. That

is basic competence and can be seen in Figure 6.

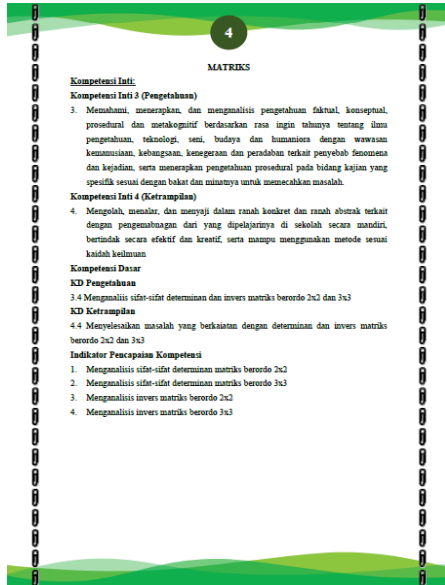


Fig. 6. Basic Competence

3.2.6 Supporting Information

To complete the teaching materials, there is additional information on supporting information. So, the student's are might be to master the learning objective faster. Supporting information also contains information that has been prepared to make it convenient to understand the material. Examples of supporting information can be seen in Figure 7.

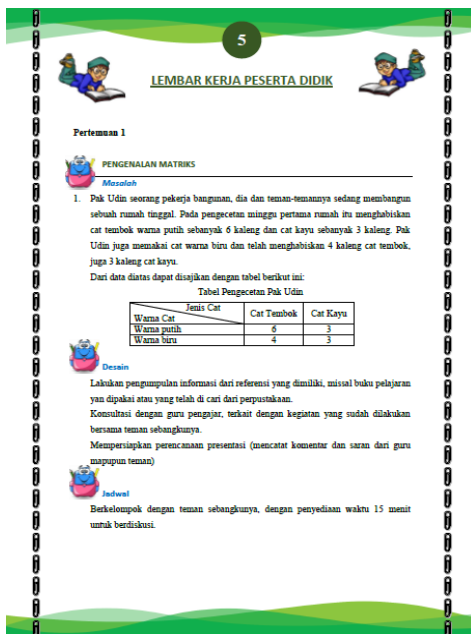


Fig. 7. Supporting Information

3.2.7 Action Step

In the section containing procedures what students must do in learning the PBL student's worksheet and some questions that must be solved. The problem presented consists of problems that must be worked out in groups and individuals. The action steps is based on syntax of problem-based learning. The action steps are shown in Figure 8.

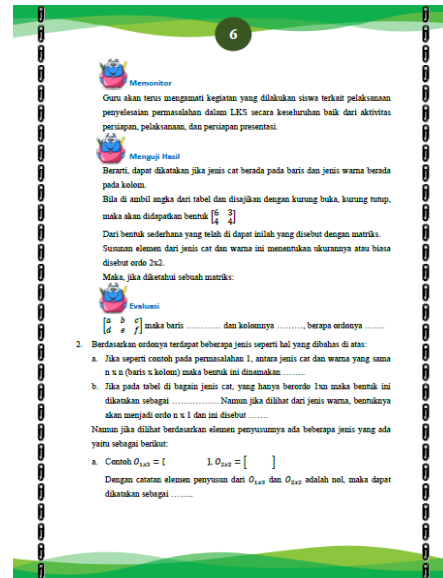


Fig. 8. Action Step

3.2.8 Exercise

An examples of exercise in Figure 9. The purpose of the assignment given to student's is (1) to practice skills after learning the teaching material; (2) to determine the level of mastery of student's worksheet; (3) to measure problem-solving ability of student's after following the learning process. That is because in exercise based on problem-solving steps.

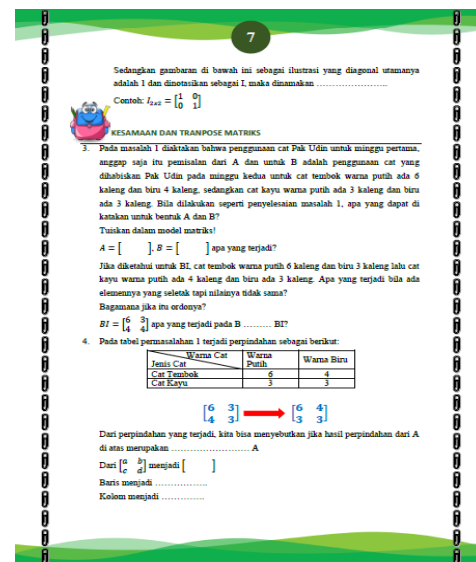


Fig. 9. Exercise

Validation of the PBL student worksheet uses an assessment instrument that has been reviewed by the lecturer, Dr. Suparman, DEA. After the design of the student's worksheet was completed, then the design of students worksheet was validity by media experts. Material experts consist of three people, namely Nuryadi, M.Pd. As UMBY Lecturer, then Ageng Triono, S.Pd. As Mathematics Teacher at Al-Azhar Yogyakarta Senior High School, and Diyah Istriyani, S.Pd. As a Mathematics Teacher at Sapuran 1 Senior High School in

Magelang. Inputs and suggestions about the design of the students' worksheet are then compiled and followed up. For some information and opinions about the design of instructional media in Table 2 below.

TABLE 1
FEEDBACK AND SUGGESTIONS AND FOLLOW-UP

| No | Feedback and Suggestions | Follow-Up |
|----|--|---|
| 1 | Some problems in the students worksheet are less complex, try cahinging more complex problems. | Problems that are less complex are replaced |
| 2 | The use of problem based learning must be reaffirmed | The use of problem based learning has been redesigned |
| 3 | There are no supporting images in the students worksheet | Add interesting images |

The results of the students' worksheet assessment of design validation were obtained from learning media design validation instrument using a Likert scale. Likert Scale is a scale that is used to measure regarding a particular problem. After validation of the results obtained, then the results are compared with the ideal assessment criteria's table, in Table 3.

TABLE 3
IDEAL ASSESSMENT CRITERIA

| Average Score | Classification |
|--------------------|----------------|
| $X > 4.2$ | Very Good |
| $3.4 < X \leq 4.2$ | Good |
| $2.6 < X \leq 3.4$ | Enough |
| $1.8 < X \leq 2.6$ | Less |
| $X \leq 1.8$ | Very Less |

The result of the validation of the student's worksheet design shows in Table 4 below:

TABLE 4
THE RESULT OF VALIDATION

| Assesors | Position | Score | Criteria |
|------------------------------|---|-------|----------|
| <u>Nuryadi, M.Pd.</u> | Lecturer in Mathematics Education at Mercu Buana University of Yogyakarta | 3.5 | Good |
| <u>Ageng Triyono, S.Pd.</u> | Teacher in Mathematics study at SMA Islam Al-Azhar Yogyakarta | 3.7 | Good |
| <u>Divah Istriani, S.Pd.</u> | Teacher in Mathematics study at SMA N 1 Sapuran, Magelang | 3.6 | Good |
| Average | | 3.6 | Good |

Table 4 shows that it can be concluded the design of the students' worksheet the criteria Good. So that the design of the students' worksheet can be declared Valid. Based on the result of the define phase and design phase, this research shows that it is necessary to analyze problem-based learning student's worksheet to improve problem-solving skill needed. For a reason, designing of problem-based learning student's worksheet was made which had the potential to improve these skill. The design of student's worksheet consisting of cover, introduction, table of contents, instruction manual, basic competence, supporting information, action steps, and exercise. The design of student's worksheet follows the result of the research according to Tio Akma and Suparman [26]. The student's worksheet was made with problem-based learning approach to improve problem-solving ability. The result of Siagian, et al. research showed that student's worksheet based on PBL could improved mathematical

problem solving [27]. Then, according to the Kurniati, et al. research showed that student's mathematical problem-solving abilities increase used student worksheet based on PISA on PBL models [28]. So, because of the design of students' worksheet in the criteria good, then the research can continue to the development phase and the dissemination phase.

4 CONCLUSION

This research shows that it is necessary to analyze problem-based learning student's worksheet to improve problem-solving skills needed. For that reason, the designing of Problem-Based Learning (PBL) student's worksheet was made which had the potential to improve student's problem-solving skills. Cover, introduction, table of contents, instruction manual, basic competencies, supporting information, action steps, and exercises consists in the design of student worksheets. This research can continue to the development phase and the dissemination phase.

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