



THE DEVELOPMENT OF STUDENT WORKSHEET BASED ON PROBLEM BASED LEARNING APPROACH ON MATRICES TOPICS

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Abstract

This study aims to develop Problem Based Learning (PBL)-based worksheets to improve student's critical thinking skills in contextual problem solving. The research design used is a feasibility analysis by research and development methods. The research was carried out using research and development (R&D) research and development methods. The sample consisted of 40 students from science programs in 11th grade. The data collection instrument used is the expert assessment sheet, student responses to the created worksheet. The development procedure with 8 stages namely potentials and problems, information gathering, product design, expert validation, first revision, product trial, second revision, final product. From the results obtained the average feasibility value by the media is 81.46% (very feasible), the average graphic feasibility value is 81.85% included in the very feasible criteria, the language eligibility average value is 76% included in the appropriate criteria and the average value of student responses is (87.40%) (very positive).

Keywords: Matrices, Problem based learning, Research and development, Student worksheet.

Abstrak

Penelitian ini bertujuan mengembangkan lembar kerja berbasis PBL untuk meningkatkan keterampilan berpikir kritis siswa dalam sebuah pemecahan masalah secara kontekstual. Dengan rancangan penelitian yang digunakan adalah analisis kelayakan dengan metode penelitian dan pengembangan. Sampel terdiri dari 40 orang siswa dari program sains di kelas XI. Instrumen pengumpulan data yang digunakan adalah lembar penilaian Ahli, respon siswa terhadap lembar kerja yang dibuat. Prosedur pengembangan dengan 8 tahapan yaitu potensi dan masalah, pengumpulan informasi, desain produk, validasi ahli, revisi pertama, uji coba produk, revisi kedua, produk akhir. Dari hasil yang diperoleh nilai rata kelayakan oleh para media yaitu 81,46% (sangat layak), nilai rata kelayakan kegrafika yaitu 81,85 % termasuk dalam kriteria sangat layak, nilai rerata kelayakan Bahasa yaitu 76 % termasuk dalam kriteria layak serta nilai rerata respon siswa yaitu (87,40%) (sangat positif).

Kata kunci: Lembar kerja siswa, Matriks, Pembelajaran berbasis masalah, Penelitian pengembangan.

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INTRODUCTION

Education in Indonesia is now implementing the 2013 curriculum design which is expected to give birth to useful, imaginative, creative individuals through coordinated mental, ability and information strengthening (Eriyani et al., 2022). SMA 51 Jakarta is one of the schools that applies the 2013 curriculum which is adjusted to the achievement of the competencies set in the 2013 curriculum which emphasizes. Students can

understand material with contextual problems and solve problems independently or in groups actively, creatively and innovatively. One of them is learning which includes many aspects of real life, namely mathematics which contains a realistic context, by presenting mathematical material in problems in daily life (Sari & Ditasona, 2019; Glasnovic-Gracin, 2018; Maryani & Widjajanti, 2020).

Through the Problem Based Learning approach in the 2013 curriculum the competencies expected for educators and students in terms of skills, attitudes and knowledge can be achieved optimally by solving mathematical problems using the Problem Based Learning approach so schools can apply the PBL learning model in the form of teaching materials in the form of (tools, materials, texts, and others) as learning resources or additional references for educators and students, for example student worksheets (Ramury, Gustina, & Putri, 2020).

Based on the researcher's experience when completing field experience practice at school, it was found that the material displayed during the lesson was not the result of the teacher's own design, not even all students had the teaching material. Where students only work on competency test questions and learning is still based on lectures. During the PPL implementation, the researcher saw that the teaching materials owned by the students did not provide enough stimulus so that student learning activities became passive. through the dissemination of written interviews, it appears that the school requires the development of learning media for the learning process where the learning process still uses lecture techniques and in the learning process at the school uses a scientific approach and students are seen to be less active in asking questions. While what is expected in class learning is active students in asking questions and students can develop themselves in thinking and solving a problem contextually, with the development of teaching materials students can study independently or in groups to increase activity and creativity (Kristin, Ditasona, & Lumbantoruan, 2021). By learning to use worksheets due to a lack of students' understanding of the material and teaching materials, therefore it is necessary to develop problem-solving-based teaching materials such as the Problem Based Learning approach to find out whether student learning outcomes increase or decrease when students are emphasized to look for problem concepts first.

The use of student worksheets can help teachers in learning activities by discovering new concepts through the creativity of the students themselves (Ramury et al., 2020). In

the student worksheet, students will get material, summaries, and assignments related to the material that will be obtained in the lesson (Yulianti, Rusilowati, & Nugroho, 2020; Wahyuni, Efuansyah, & Sukasno, 2020).

Learning mathematics at SMA Negeri 51 Jakarta needs to be taught using the PBL approach to foster self-ability creatively, innovatively and critically which can develop character and improve students' cognitive learning outcomes. Matrix material is one of the mathematics materials that is contextual and closely related to everyday life which is learned in the 11th grade. Matrix material in general is often encountered on problems related to the economy, in the calculation of expenses. The interrelationship of matrix material and everyday life is very much tied to various approaches that help to facilitate learning. Efforts to overcome the observations found such as the unavailability of PBL-based teaching materials and students' lack of understanding of problems based on everyday problems. Based on this description, the development of student worksheets based on the PBL approach on this matrix material would be able to answer the problems that researchers found at SMA Negeri 51 Jakarta.

RESEARCH METHODS

The sample in this study were high school students in the 11th grade on science program. 40 students were involved in this research. 20 students were the first group of 11th grade on science program and another 20 students were the second group of the 11th grade on science program. The type of research used was research and development (R&D) method with the fourth level to produce a certain product, then testing the feasibility of a product would be carried out. The stages in the implementation of the research were carried out based on the Borg and Gall model with 8 stages of development namely potentials and problems, information gathering, product design, expert validation, first revision, product trial, second revision, final product (Nugroho et al., 2017).

The instruments in this study were interview guides for conducting needs analysis, validation sheets, and student questionnaires. Expert validation was carried out by 5 people each including 2 material experts, 2 learning media experts and 1 language expert. The validation sheet uses a Likert scale with a score of 1 to 5.

Then the result data from expert validators collected were analyzed using quantitative descriptive analysis techniques in the form of scores and percentages for

categories with a predetermined rating scale. Furthermore, after presenting it in percentage form, the next step is to describe each indicator. To find out the feasibility of developing an PBL approach-based worksheet, according to Arikunto (2013), it is assessed with the highest scale "very feasible" and the lowest scale "not feasible" with reference to the assessment criteria and categories in Table 1.

Table 1. Criteria for Validation Score Results

Percentage	Eligibility category
81-100%	Very feasible
61-80%	Decent
41-60%	Pretty decent
21-40%	Less feasible
0-20%	Not feasible

Student questionnaires are used to determine student responses to the products used. This questionnaire consists of 17 questions with four indicators, including interest, material, PBL components, and language as shown in Table 2.

Table 2. Criteria and Indicators of Student Response Questionnaires

Criteria	Indicators	Item Number	Total
Student Response	Interest	1-4	4
	Content	5-11	7
	PBL learning components	12-15	4
	Language	16-17	2

The percentage of student response questionnaire results will then be classified based on categories in Table 3.

Table 3. Percentage of Student Response Questionnaire Criteria

Percentage	Eligibility category
81-100%	Very positive
61-80%	Positive
41-60%	Less positive
21-40%	Not positive
0-20%	Very Not positive

RESULTS AND DISCUSSION

Needs analysis is the first step to find out the formulation in the development of PBL-based worksheets through observations with the SMA Negeri 51 Jakarta school which

was conducted on April 12, 2022. The observations made included teaching materials, media, and the physical condition of the school, students and teachers. Analysis of the availability of teacher and student learning media shows that they have used mathematics textbooks as a medium carried out in learning.

The results of written interviews with teachers in mathematics at SMA Negeri 51 Jakarta during mathematics lessons showed that they did not use student worksheets but only used textbooks and listened to explanations directly from the teacher. The results of the interviews also show that teachers really need teaching materials such as PBL-based worksheet. The use of PBL-based worksheet is intended to facilitate students in learning. In worksheet, it is possible to present contextual problems closely related to students' daily life.

After obtaining data about user needs, the researcher collects information related to learning materials. At this stage the researcher collects the core competencies and basic competencies contained in the curriculum used at the school.

The design process is carried out by compiling an outline format that includes material, topics, descriptions and general goals explained in PBL-based worksheets. More specifically, the design carried out by the researcher includes student worksheet covers, prefaces, table of contents, instructions for using student worksheets, core competencies, basic competencies and achievement indicators, concept maps, learning activities, learning objectives, material descriptions, exercises, summaries and bibliography. The suitability of the material is very important in the preparation of worksheets to describe the content to be compiled. After the design is obtained, the researcher continues the research process to the validation stage.

The results of the validation carried out by 2 material experts are in the range of the appropriate and very feasible categories as shown in Figure 1.

From the results of material validation, the linguistic aspect obtained the highest percentage score of 83.77% in the very feasible category. After that, it was followed by the content feasibility aspect with a percentage of 81.46%. The presentation aspect has the lowest percentage, namely 79.16% but is still in the proper category. Of the three percentages obtained an average percentage of 81.46% with a very feasible category. Thus the design of the student worksheet is declared valid and very feasible to use.

In addition to material validation, validation is also carried out related to learning

media. In this validation the aspects assessed include content design, cover design, layout, appearance and size. The validation results from 2 media experts obtained an average percentage of 81.85% with a very feasible category. The validation results from language experts obtained the lowest score of 76%. This score is still in the decent category.

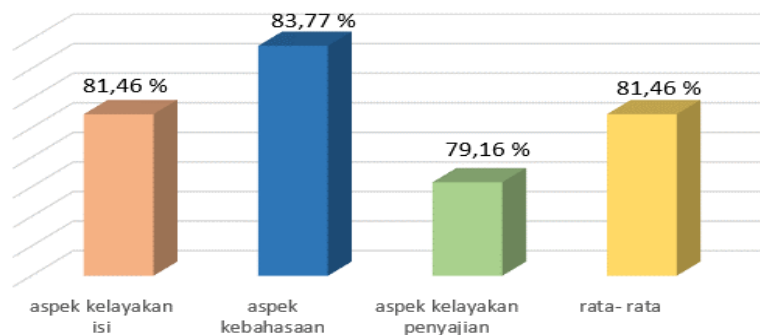


Figure 1. Content Expert Validation Percentage

Even though it has been declared valid and feasible to use, researchers need to make improvements based on suggestions from validators. Some of the improvements made include the cover design, preface, writing a table of contents, core competencies and basic competencies, concept maps, improvements to the content of the subject matter, improvements to the sentence questions, and writing references.

Tabel 4. Suggestions and Improvements from Media and Language Experts

Suggestions before stage 1 revision	Improvements after stage 1 revision
There are some texts that already have large fonts, then are bolded so that they become unclear. Some titles and subtitles do not start with a capital letter and it is better to use a formal typeface	Fonts and titles have been adapted to suggestions with size 12 and fonts have been adjusted to sizes 12, 14 and more formal fonts
The color combination is more attention. The red color on the cover that says "mathematics" is too bright, it's best to lower the color tone so it looks a bit softer. Color selection also affects the reader's interest, choose soft or weak colors so that it creates comfort when reading worksheet.	The color has been adjusted according to the validator's suggestion with a smaller size and softer color
The use of the word "where" is not standard for conjunctions	Has been corrected according to the validator's suggestion
Some sentences are too long for maximum readability.	It has been corrected with sentences that are simpler and easier to understand.

Suggestions for improvement from language and media experts include writing using capital letters, standard words, and using colors in writing that are too flashy can interfere with user comfort when reading. The validator also suggests simplifying sentences that are too long to make them easier to understand. Some examples of suggestions for improvement from language experts are shown in Table 4.

In addition to providing suggestions on the validation sheet, the validators also provide direct comments on the student worksheet documents. This really helps researchers to find out in detail the parts that must be corrected on student worksheets. As seen in Figure 2, the validator provides many comments in terms of the procedure for writing sentences, as well as choosing words.

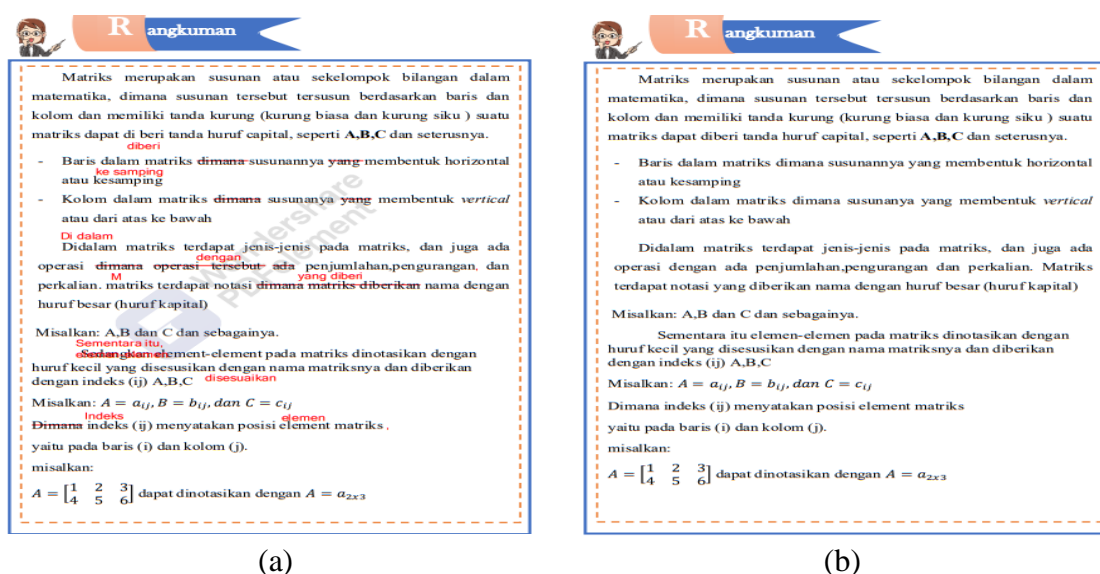


Figure 2. Validator Comments on Student Worksheets (a) and their Improvements (b)

Limited class trials were carried out using worksheets based on the PBL approach to 40 students in the first and second group of the 11th grade on science program at SMAN 51 Jakarta. In this limited class trial each class was taken by 20 students as respondents. Based on the results of limited trials, student responses to the worksheet that were developed were very positive. This can be seen from the interest aspect obtained from the limited test getting a percentage (85.71%) with a very positive category, material/content aspects getting a percentage (87.59% in a very positive category, aspects of PBL learning components getting a percentage (86.855) with a very positive category, in the discussion aspect it gets a percentage (89.39) with a very positive category and the average obtained from student responses is a percentage (87.39) with a very positive category. Thus the

developed worksheet is interesting, the material easy to understand, language that is easy to understand and worksheet in accordance with the PBL approach.

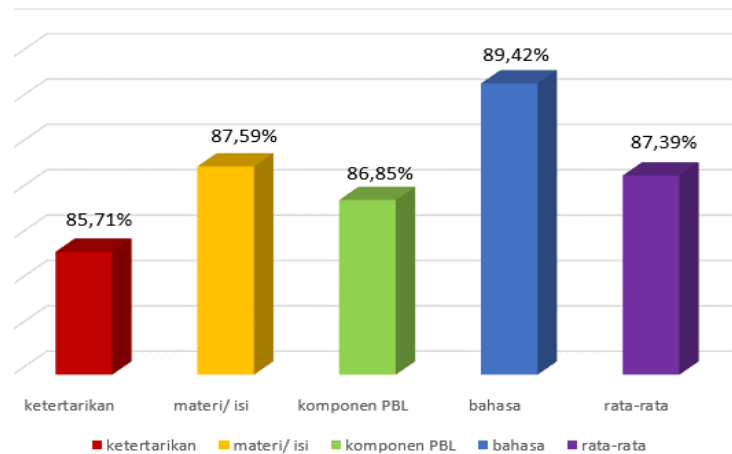


Figure 3. Percentage of Student Responses to Worksheets

CONCLUSION

PBL-based worksheet to matrix material for 11th grade students obtained an average percentage score for the feasibility aspect of content experts by 81.46%, the feasibility aspect for media graphics by 81.85%, and the language feasibility aspect by 76%. Thus, the student worksheet product is valid and feasible to use.

Student responses to the developed worksheets products in limited trials, from the aspect of interest obtained from limited trials, got a percentage (85.71%) in a very positive category. Material/content aspects get a percentage (87.59% in a very positive category. Aspects of the PBL learning component get a percentage (86.855) in a very positive category. On the language aspect get a percentage (89.39) with a very positive category. The average obtained from the students' responses, a percentage (87.39) was obtained with a very positive category. It can be concluded that the developed worksheet received a very positive response from students as its users.

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