

THE DEVELOPMENT OF STUDENT'S WORKSHEET BASED ON SCIENTIFIC APPROACH ON MATRIX MATERIAL IN HIGH SCHOOL

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ABSTRACT

The formulation of the problem from this research was "Is the development of LKPD based on a scientific approach on matrix material in high school feasible to use? How do students respond to LKPD based on a scientific approach to matrix material?" The purpose of this study is to find out whether the development of LKPD based on a scientific approach to matrix material in high school is feasible to use. This research was a research and development that used a 4D development model which consists of 4 stages, such as the definition stage, the design stage, the development stage, and the dissemination stage. However, in this study, the researchers only limited it to the 3D stage, which was defining, designing and developing. The instrument in this study was a questionnaire sheet for the expert feasibility test. Based on the validation results from the validator, the student's worksheet assessment scores were obtained by two expert lecturers and one mathematics teacher with an average percentage value of 79% and categorized as "Eligible". For student responses to LKPD based on a scientific approach to the matrix material, the average percentage value is 86% and is categorized as "Very Good". It can be concluded that the LKPD based on a scientific approach to the matrix material developed by the researcher is feasible to be used as additional teaching material for students.

1. INTRODUCTION

At this time, there are still many students who still have difficulty understanding the material in mathematics. This is due to their lack of knowledge of the objectives of learning mathematics. One of the goals of learning mathematics according to the Ministry of National Education (2006:388) is that students have the ability to: 1) understand mathematical concepts, explain the relationship between concepts and apply concepts or algorithms, flexibly, accurately, effectively, and precisely in problem-solving, 2) using reasoning on patterns and traits, performing mathematical manipulations in making generalizations, compiling evidence, or explaining mathematical ideas and statements, 3) solving problems which include the ability to understand problems, design mathematical models, complete models and interpret solutions obtained, 4) communicate ideas with symbols, tables, diagrams, or other media to clarify the situation or problem, and 5) have an attitude of appreciating the function of mathematics in life, such as having curiosity, attention, and interest in learning mathematics, as well as a tenacious and confident in solving the problem.

One of the materials in mathematics is a matrix. This material is studied by students at the high school level in class XI. Students often make mistakes in answering questions related to the material because it is difficult to define the matrix concept and students lack understanding of the material.

One way that can be done to overcome these problems is by improving the factors that might affect student learning outcomes, including factors that come from teachers, students, curriculum, quality of the learning process, learning facilities, learning media, learning environment, and so on.

In the Gestalt learning theory (Slameto, 2016), it is stated that one of the principles of learning is the learning experience that determines how much knowledge students have. The learning process will appear when someone gets a new problem. In this case, it shows that a teacher should develop learning instruments that can build students' understanding and also provide a lot of learning experiences for students.

Learning is one of the most influential factors in student learning outcomes. Therefore, to achieve the objectives of teaching and learning activities, teaching materials are needed that are suitable to the needs of students. One of the teaching materials is the Student Worksheet (LKPD).

According to Marah Doly et al, the LKPD obtained by students is also not the same as the characteristics of students because the LKPD received is not made by the math teacher but is purchased from a publisher. As a result, the learning objectives made by the teacher are not conveyed to students. This is one of the causes of low student learning outcomes

LKPD has an important role in creating interactive and effective teaching and learning activities between teachers and students. Not only that, LKPD is expected to help students to achieve the Basic Competencies (KD) that have been set by the curriculum and also to increase student activities to improve learning achievement.

LKPD is a sheet consisting of tasks that must be finished by students. The uses of LKPD include helping students to better understand the material being taught and developing concepts, encouraging students to be more active during teaching and learning activities, as a guide for teachers and students during the teaching and learning process, helping students to get more information about the concepts being studied, and helping students get notes of the material that has been studied.

In the 2013 curriculum, each lesson requires teaching materials that guide students to be able to learn independently and think critically. To realize this, applying a scientific approach is appropriate. The scientific approach consists of observing, asking, reasoning, experimenting, and communicating.

Based on the results of observations of teacher training at SMA Harapan Mekar Medan, during the teaching and learning process, the researcher found that students used the LKPD provided by the school. However, the use of this LKPD was not optimal enough because there were still students who were confused in solving the questions in the LKPD and the process of teaching and learning activities tends to be teacher-centred. Then, based on the design aspect of the LKPD, it only used black and white and the paper used was quite simple. In addition, the LKPD used was known to be purchased from the publisher even though the LKPD made by the publisher did not necessarily match the characteristics of the students. Based on the existing problems, it was necessary to develop an LKPD that can overcome student problems and also complement the existing LKPD. The LKPD developed must also have the right method or approach so that it can be used to minimize existing deficiencies.

2. METHODOLOGY

This research was conducted at SMA Harapan Mekar Medan which is located at Jl. Marelan Raya No. 77 Medan. This research was conducted in the odd semester of the 2021/2022 academic year. The data collection technique used in this research was using validation test and questionnaire method.

3. RESULT AND DISCUSSION

The research conducted was development research. The product resulting from this research was LKPD based on a valid, feasible and good scientific approach using a 4D development model that has been modified only to the development stage.

The stages of development are as follows:

Define Stages

At this stage, it aims to determine what is needed during the learning process. It consists of preliminary analysis, student analysis, task analysis, concept analysis, and goal specification. The results of the analysis at this stage are as follows:

Front-end Analysis

Based on the results of observations and interviews with mathematics teachers in class XI IPA at Harapan Mekar High School, it was known that the school has implemented the 2013 curriculum. In the 2013 curriculum, students are expected to be able to seek information and the teacher acts as a facilitator. However, the application in these schools is different because students in these schools are accustomed to receiving information provided by the teacher, not by looking for it on their own.

Furthermore, the researcher conducted an analysis of the LKPD in the school. The worksheets used in the teaching and learning process are purchased from publishers, which only contain short material and then practice questions. The colours on the worksheets are only black and white and the paper used is simple enough to attract students' attention.

Based on the results of the analysis above, the researcher determined that the mathematics worksheets to be developed were mathematical worksheets based on a scientific approach. The purpose of developing mathematical worksheets based on this scientific approach is so that students are able to find concepts from a learning material independently so that the teacher only acts as a facilitator, directs, and encourages students to think for themselves about the problems to be solved. If students are able to find their own concepts, students will automatically understand the concepts of the material.

Learned Analysis

Student analysis was conducted to determine the characteristics of students in SMA Harapan Mekar class XI IPA. This analysis was carried out by considering the abilities and experiences of students, both individually and in groups. Based on the results of interviews with mathematics teachers in class XI-IPA at SMA Harapan Mekar, it was found that students in class XI-IPA still could not study independently. This happens because during the teaching and learning process everything is centred on the teacher, not on the students. Students only wait and receive information from the teacher. To overcome this, students need appropriate learning media and adapted to mathematics learning methods/models, especially matrix material.

From these problems, with the existence of LKPD based on a scientific approach, students are directed to find out and find concepts from matrix material with the help of LKPD based on a scientific approach.

Concept Analysis

The material used in this research was the matrix material that led to the 2013 curriculum. This concept analysis aims to identify, and systematically arrange the concepts that will be studied by students in the matrix material which is then adapted to a scientific approach..

Task Analysis

Task analysis aims to analyze the main tasks carried out by students of class XI-IPA at SMA Harapan Mekar. The task analysis consisted of an analysis of Core Competencies (KI), Basic Competencies (KD) and Competency Achievement Indicators (IPK) on the matrix material that was developed through LKPD based on a Scientific Approach.

The following are Core Competencies (KI), Basic Competencies (KD) and Competency Achievement Indicators (IPK) in the matrix material:

Table 4.1 Mathematics Core Competencies, Basic Competencies, and Competency Achievement Indicators

<p>Core Competency (KI) Understanding, applying and analyzing factual, conceptual, and procedural knowledge based on their curiosity about science, technology, art, culture, and humanities with insight into humanity, nationality, state, and civilization related to the causes of phenomena and events, as well as applying procedural knowledge in the field of particular study according to their talents and interests to solve problems.</p>	
<p>Basic Competency (KD) Explain matrices and matrix similarities using contextual problems and perform operations on matrices including addition, subtraction, scalar multiplication, and multiplication, as well as transpose.</p>	<p>Competency Achievement Indicators(IPK)</p> <p>3.1.1 Defines a matrix and the elements of a matrix.</p> <p>3.1.2 Demonstrate the types and concepts of similarity matrices</p> <p>3.1.3 Determine the results of operations on the matrix, as well as transpose the matrix..</p>

Specifying Instructional Objectives

This stage is the stage of formulating learning objectives based on Basic Competencies (KD) from concept analysis and task analysis that have been carried out. The learning objectives that serve as a reference in designing LKPD based on this scientific approach were:

- 1) Able to define matrix and matrix elements.
- 2) Able to mention the types of matrices and arrange similarity matrices.
- 3) Able to solve operational problems on matrices and transpose matrices.

Design

At this design stage, the researcher designed all activities that was carried out before the trial was carried out. The results at this stage were the initial draft of the LKPD. The following is a description of the initial draft of the LKPD:

Media Selection

The learning media used were mathematical worksheets based on a scientific approach, lesson plans (RPP) and supporting tools, such as blackboards, markers, erasers, notebooks, and so on.

Format Selection

The format chosen by the researcher in developing mathematical worksheets based on a scientific approach was adapted to the matrix material. The following format was used, such as:

Lesson Plan

Lesson plan is a guide for the steps that the teacher will take in the teaching and learning process with a scientific approach-based learning scenario for each meeting.

Student Worksheet (LKPD)

Lesson plan is a guide for the steps that the teacher will take in the teaching and learning process with a scientific approach-based learning scenario for each meeting.

Initial Draft

At this stage, the resulting design is the lesson plan for 3 meetings and LKPD for each meeting. The initial design that was carried out on the lesson plan and LKPD was as follows:

Lesson Plan

The designed lesson plans consisted of 3 meetings, with each time allocation of 3 X 45 minutes with matrix sub-materials.

Student Worksheet (LKPD)

LKPD developed using the steps of a scientific approach. This worksheet contained activities that guided students in finding concepts. LKPD draft I can be seen in the attachment.

Development Stages

This stage was carried out as a follow-up to the design that has been carried out at the design stage and then the development stage was carried out to produce a revised draft II based on comments and suggestions from the validator. The following activities were carried out at the development stage, such as:

Expert Validation on the Draft I

Expert validation is carried out to conduct an assessment on the draft I, while the validators in this assessment are::

Table 4.2
The List of Validator Name

No.	Name	Description
1.	Putri Maisyarah Ammy, S.Pd.I., M.Pd	Dosen ahli media
2.	Sri Wahyuni, S.Pd., M.Pd	Dosen ahli materi
3.	Azalia Azwar, S.Pd	Guru Matematika

At this stage, the validator provided an assessment as well as criticism and suggestions on the first draft that the researcher has developed. Criticisms and suggestions from the validator was used as input for the revision of draft I. The following is a picture of the LKPD before and after development:

Picture 4.1 Before and After Development of LKPD

Cover of LKPD before development

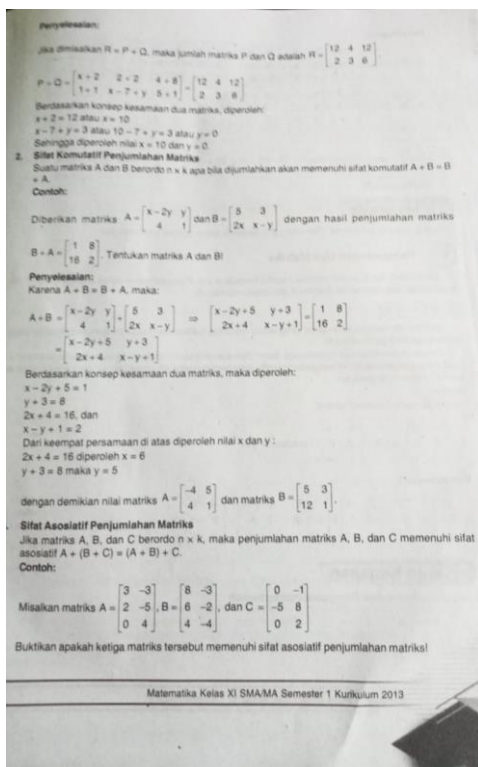
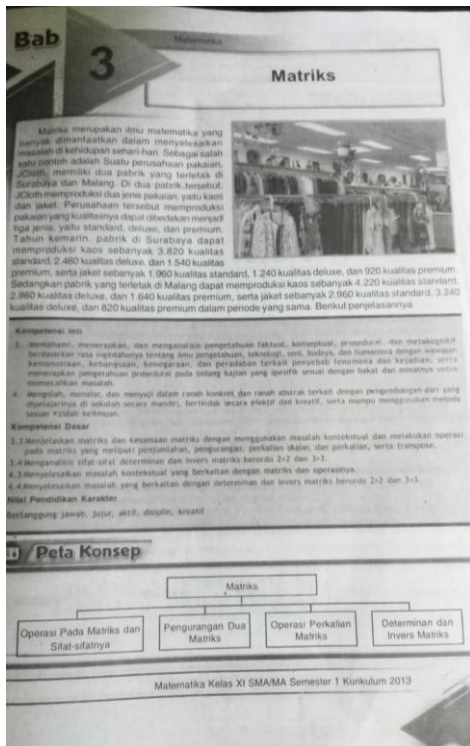


The content of LKPD before development

Cover of LKPD after development



The content of LKPD after development



Kegiatan 1

Menentukan Konsep dan Unsur-Unsur Matriks

Pendahuluan

Dalam kehidupan sehari-hari, tanpa kita sadari seringkali penerapan matriks kita temukan dalam aspek kehidupan. Contohnya, susunan buku di meja, susunan baju di lemari, posisi siswa berbaris dilapangan, susunan keramik di lantai dan lain-lain.

Sumber: Longkahimu.com

Gambar 1. Siswa berbaris

Susunan-susunan tersebut dapat kalian lihat membentuk sebuah pola baris atau kolom, bukan? Nah, bentuk dari susunan yang berupa baris atau kolom tersebut akan memunculkan konsep matriks yang akan dipelajari. Contoh lainnya adalah susunan angka pada bentuk tabel. Dalam tabel terdapat baris dan kolom, ukuran sebuah tabel bergantung pada banyaknya jumlah baris dan jumlah kolom yang ada pada tabel tersebut. Dari tabel tersebut dapat dibuat kedalam bentuk yang lebih sederhana dan disebut dengan matriks.

LKPD KURIKULUM 2013 | MATEMATIKA 2

Ayo Kita Menalar

- Pemilik swalayan ingin menata koleksi barang yang tersedia. Ubahlah bentuk susunan barang di swalayan berikut menjadi matriks dan tentukan entry-entrynya.

KOLEKSI Shampoo 15 (item)	KOLEKSI Sabun 25 (item)	KOLEKSI Detergen 22 (item)
KOLEKSI Kecap 17 (item)	KOLEKSI Susu 13 (item)	KOLEKSI Minyak goreng 40 (item)
KOLEKSI Permen dan Coklat 31 (item)	KOLEKSI Snack 19 (item)	KOLEKSI Biskuit 8 (item)

- Diberikan matriks $Z = \begin{bmatrix} 3 & 4 & 2 & 5 \\ 11 & 7 & 6 & 13 \\ 0 & 1 & 10 & 19 \\ 9 & 8 & 12 & 18 \end{bmatrix}$
Sebutkan entry matriks yang terletak pada:
a. Baris ke-4
b. Kolom ke-1
c. Baris ke-4 dan kolom ke-2
d. Baris ke-2 dan kolom ke-4

LKPD KURIKULUM 2013 | MATEMATIKA 6

Table 4.4

Lesson Plan Evaluation Results by Validator

No	Validator	Total Score	Mean Score	Percentage	Criteria
1	Validator 1	60	4,00	80%	Eligible
2	Validator 2	54	3,6	72%	Eligible
33	Validator 3	63	4,2	84%	Very Eligible
	Total	177	3,93	78,7%	Eligible

From the table above, it can be seen that Validator 1 (Lecturer of media experts) gave a percentage score of 80% with eligible criteria. Validator 2 (material expert lecturer) gave a percentage score of 72% with eligible criteria. Validator 3 (Mathematics teacher) gave a percentage score of 84% with eligible criteria.

It can be concluded that the assessment of the three validators was obtained with an average percentage of 78.7% with eligible criteria. The three validators concluded that the lesson plans could be used after revision. From the assessment of the validators, criticism and suggestions were obtained that was used as consideration for revising the lesson plan. The validator's criticisms and suggestions were as in the following table:

It can be concluded that the assessment of the three validators was obtained with an average percentage of 79% with eligible criteria. The three validators concluded that the LKPD could be used after revision. From the assessment of the validators, criticisms and suggestions were obtained that will be used as consideration for revising the LKPD. The validator's criticisms and suggestions were as in the following table:

Table 4.9
LKPD Revised based on the Validator Results

Before Revision (Draft I)	After Revision (Draft II)
Adjust the stages of asking questions on the LKPD with the lesson plan.	At the questioning stage, the LKPD was not given material, only given time or space or a place to ask questions about the material.
Pay attention to every letter in the sentence, don't let there be typos such as the word "peralatan" (the letter n mistyped as m)	Pay attention to every letter in the sentence so that there are no typos

The picture of LKPD after revision :

Picture 4.2 LKPD after revision

The screenshot shows a worksheet with the following content:

	Pulpen	Buku Tulis	Penghapus	Pensil
Reyhan	2	10
Tina	3	3
Sehun	5	7	1	...

Data tersebut, dapat disajikan kembali tanpa harus di dalam tabel seperti berikut dengan syarat susunan bilangan itu diletakkan di dalam kurung biasa "[]" atau kurung siku "[]". Bentuk penulisan berikut dinamakan matriks,

$$\begin{bmatrix} 2 & \dots & 2 & \dots \\ \dots & \dots & \dots & 3 \\ \dots & 7 & \dots & 2 \end{bmatrix} \text{ atau } \begin{pmatrix} \dots & 10 & 2 & \dots \\ \dots & \dots & \dots & 3 \\ \dots & 7 & 1 & \dots \end{pmatrix}$$

Matriks tersebut terdiri dari 3 baris dan 4 kolom. Ordo dari matriks tersebut adalah 3×4

Ayo Kita Menanya

Berdasarkan hasil pengamatan kalian, tuliskan pertanyaan-pertanyaan yang mungkin akan kalian tanyakan pada kolom berikut. Kemudian diskusikan pertanyaan tersebut dengan teman-temanmu!

LKPD KURIKULUM 2013 | MATEMATIKA | 4



Suatu hari Reyhan, Tina, dan Sehun pergi ke toko peralatan tulis yang berada dekat dengan rumah mereka untuk membeli peralatan sekolah. Setibanya mereka disana, Reyhan membeli 2 pulpen, 10 buku tulis, 2 penghapus, dan 1 pensil. Sedangkan Tina, ia membeli 4 pulpen, 15 buku tulis, 3 penghapus, dan 3 pensil. Kemudian, Sehun membeli 5 pulpen, 7 buku tulis, 1 penghapus, dan 2 pensil. Barang-barang yang telah mereka beli di toko peralatan tulis tersebut, dapat kita tulis kedalam bentuk tabel. Perhatikan tabel berikut ini dan lengkapi titik-titik tersebut dengan jawaban yang tepat dan sesuai!

Students’ Responses

In this student response, the researcher gave a questionnaire to 10 students. The following were the results of student responses::

Table 4.10
The Recapitulation of Student Response Results

No	Question	Student Codes									
		1	2	3	4	5	6	7	8	9	10
Material/Content											
	The pictures presented and the reading text can be read clearly	3	5	5	4	5	5	4	4	4	4
	The language used is easy to understand	5	4	4	4	5	3	4	3	3	5
	The layout and spacing on the LKPD is correct	3	5	5	4	4	2	5	4	4	4
	The material contained in the LKPD is easy to understand	5	4	4	4	5	4	4	4	4	5
	Encourages the enthusiasm of student for learning	3	5	5	5	5	4	5	5	5	5
Media											
	Interested cover	5	4	4	5	4	5	4	3	3	5
	The colour used is attractive	3	5	5	4	5	4	5	3	3	5
	The pictures and the font style is attractive	5	4	4	5	5	4	4	5	5	5
	Encourage students to have one	3	5	5	4	5	5	4	4	4	5
	Score	35	41	41	39	43	36	39	35	35	43
	Mean	3,9	4,6	4,6	4,3	4,8	4	4,3	3,9	3,9	4,8
	Total score	387									
	$K = \frac{F}{N \times I \times R} \times 100\% = \frac{387}{5 \times 9 \times 10} \times 100\% = \frac{387}{450} \times 100\% = 86\%$										

From the table above, it can be seen that the LKPD based on the scientific approach has been assessed with a response score of 387 and the percentage is 86%, thus the LKPD based on the scientific approach is categorized as **very good**.

It was found that the LKPD in this development research was developed with a 4-D model with the Define, Design, Develop, and Disseminate stages. However, this research was carried out only up to the development stage.

The development stages started from the defining stage. The defining stage aims to determine and define the requirements for the learning process. This stage consists of front-end analysis, student analysis, concept analysis, task analysis, and specification of learning objectives. Front-end analysis is used to determine the general problems faced in mathematics learning activities. Student analysis is used to determine student characteristics, and task analysis aims to detail Core Competencies (KI), Basic Competencies (KD), and Competency Achievement Indicators (IPK) to be used. Concept analysis is an analysis of the main concepts contained in the matrix material, while the specification of learning objectives aims to formulate learning objectives that must be achieved by students during the learning process in accordance with Core Competencies (KI), Basic Competencies (KD), and Competency Achievement Indicators (IPK).

The next stage is designing. The selection of formats and media for the materials and production of the initial version underlies the main aspects of the design stage. The learning instrument used in this study was in the form of lesson plans and LKPD based on a scientific approach. In addition, research instruments were also designed to measure the quality of the developed lesson plan and student worksheet.

The final stage of this research is development. This research instrument is used to measure the eligibility of LKPD. Based on the results of the LKPD assessment from the validator of material expert lecturers and mathematics teachers, the percentage of eligibility scores was 73% and 83% with eligible and very eligible criteria. Then media validation by media expert lecturers is seen from the aspect of simplicity, cohesiveness, emphasis, balance, shape and colour. The percentage of eligibility score is 82% with very feasible criteria. Based on this description, it can be concluded that the LKPD based on the scientific approach developed by the researcher is eligible to use.

The results of data analysis on LKPD obtained from student responses get a percentage of the feasibility score of 86% with very good criteria.

4. CONCLUSION

Based on the results of the research that has been carried out, it can be concluded as follows: The eligibility of LKPD based on a scientific approach to matrix material in high school gets an average score of 4.13 with a percentage of eligibility criteria of 82% which includes in very decent criteria. Meanwhile, based on the assessment of material experts as a whole, the average score was 3.69 with a percentage of 73% of the eligibility criteria included in the eligible criteria. For mathematics teachers, an average score of 4.17 was obtained with a percentage of eligibility score of 83% with very decent criteria. Based on this description, it can be concluded that the LKPD based on a scientific approach to the matrix material developed by researchers is eligible as a learning medium.

The response of students to the scientific approach LKPD on matrix material in high school gets an average score of 4.3 with a percentage of eligibility score of 86% which includes very good criteria.

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