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Development of PMRI-Based LKPD in the Context of Lubuklinggau Local Wisdom on Pythagorean Theorem Material

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ABSTRACT

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The purpose of this research is to create a valid, useful, and potentially beneficial student worksheet for class VIII students that utilizes the material of the Pythagorean theorem in the context of Lubuklinggau local wisdom and Indonesian realistic mathematics education. The 4-D development paradigm, which comprises of the stages of define, design, develop, and disseminate, is being used in this development research project. This study involves class VIII students, math teachers, and validators (linguists, media specialists, and material experts). Techniques for gathering data include tests, questionnaires, observations, and interviews. The generated LKPD has a language validity of 0.78 in the valid category, media validity of 0.83 in the very valid category, and material validity of 0.81 in the very valid category based on the research findings. According to instructor replies, 83.33% of LKPD is extremely practical, whereas student responses (small group) are 96.66%. Meanwhile, LKPD has a potential effect on student learning outcomes of 78.8%, which is considered good. Based on these data, the mathematics worksheet developed in this research using pythagorean theorem material in the context of local wisdom in the city of Lubuk-Lingau is very valid and practical and has potential effects so that it can be used to study the pythagorean theorem.

A. INTRODUCTION

Mathematics is a science that is widely applied in everyday life. Riwayati & Destania (2019, p. 28) explain mathematics as a scientific discipline that plays a very important role in education, because mathematics can foster curiosity and improve skills, logical, rational reasoning and critical thinking so that students can apply mathematics in solving various problems in everyday life and in studying other sciences. Mathematics itself is an important subject studied at every level of education with the aim that students can think clearly, orderly, systematically, logically, scientifically and responsibly. One of the subjects discussed in mathematics learning which is closely related to everyday life, is geometry. Due to the numerous concepts it contains and how widely applied it is in daily life, geometry is a branch of mathematics that is given significant attention in the curriculum. (Rambe, et al., 2022, p. 35).

In studying the subject of geometry, students usually experience several difficulties that they have to face, namely material about the Pythagorean theorem. Students struggle to answer story problems and find formulas that highlight the fundamental ideas and principles of the Pythagorean theorem (Khoerunnisa & Sari, 2020, p. 1732). For example, students have difficulty calculating exponent numbers and determining what is known and what is asked when solving word problems on the Pythagorean theorem material (Cunha, et al., 2019, p. 90). Ritonga & Hasibuan (2022, p. 1452) stated that students are not yet optimal in understanding the concept of the Pythagorean theorem material, such as students still having difficulty determining the longest side of a triangle. According to Rohana, et al (2019, pp. 143-144), teachers must be skilled in choosing and using appropriate teaching models and techniques to create a pleasant learning environment. Apart from that, teachers should be able to develop teaching materials as learning resources to complement the elements in the Learning Implementation Plan (RPP) (Septian, et al., 2019, p. 60). However, according to Adha and Refianti (2019, p. 2), the current problem is that most teachers do not develop their own teaching materials that suit

the characteristics of their students, so the existence of printed worksheets is currently very limited and ineffective as a good learning tool in terms of appearance, content, and practicality.

According to the findings of interviews conducted with math teachers at SMP Negeri 11 Lubuklinggau, instructional resources like student worksheets (LKPD) have never been utilized in the classroom. The only learning resources available are textbooks, which do not reflect the qualities of the students. The textbook questions are also generic and have not been connected to the real-world experiences of the students. Thus, in the learning process students experience difficulties in learning the concepts or material in the textbook. In the learning process, the teacher employs the lecture learning approach, and students rely solely on what the teacher delivers and are less active in learning, resulting in students not grasping the information provided by the teacher. One of the factors causing this problem is the lack of optimal use of teaching materials and worksheets that suit the needs of students, so there is a need for innovation in the use of worksheets used in the classroom and in accordance with the demands of the current curriculum to make students more critical in solving mathematical problems. (Agitsna, et al., 2019, p. 430). Thus, teaching materials are needed to support the achievement of learning objectives that can make abstract mathematics easy to understand and can be applied in the real world. One type of teaching material that can be developed by teachers is Student Worksheets (LKPD).

LKPD is a learning resource that helps teachers train students' skills in discovering concepts through the steps and problems provided along with assessment techniques (Purwasi & Fitriyana, 2020, p. 896). In LKPD students are directly involved in discovering a concept for themselves through a series of activities carried out, so that they are able to understand the concept without having to memorize it (Sagita et al., 2020, p. 855). According to Murwanto, et al., (2022, p. 391), the LKPD currently used on average contains material, example questions, exercises, and rarely invites students to discover concepts that are often not in line with the students' needs and conditions. Therefore, the LKPD used should be able to guide students in problems that are in accordance with the students' experiences and can help students discover concepts.

Apart from using teaching materials, efforts that can be made to overcome this problem are using a learning approach (Fauziah & Putri, 2022, p.74). The Indonesian Realistic Mathematics Education Approach (PMRI) is one possible learning strategy. PMRI is a method of teaching mathematics that makes connections between the subject and real-world situations (Adha & Refianti, 2019, p. 3). Using real-world context as a starting point for learning, 2) employing models as a link between the abstract and real world, 3) utilizing student results or strategies, 4) interaction as a key component of mathematical learning, and 5) the interconnectedness of each learning series are the five characteristics of PMRI (Fauziah et al., 2022, p. 2). Such learning makes students become learning subjects who must be actively involved in the construction of formal mathematical knowledge, namely predominantly in the process of discovering facts, concepts, operations and mathematical principles sourced from the real world (Simanullang, 2020, p. 2).

The context of local wisdom is a real context that is closely related to students' daily lives. From the perspective of mathematics education, almost all contexts in mathematics material are general in nature, even though giving mathematics questions containing local wisdom also influences the knowledge and character of students in the area (Zulfah, 2018, p. 2). Local wisdom-oriented learning is learning that teaches students to always be connected to the concrete situations they face (Mulyawati, et al., 2023, p. 279). Thus, learning mathematics with the context of local wisdom can provide meaningful learning from each existing activity so that it can be used as a learning source that is close to students' daily lives (Sa'diah, et al., 2021, p. 56). One of the mathematical materials is Pythagorean which is abstract in nature which requires learning media that is easy to understand and concrete in nature so that students can more easily understand the material provided by the teacher. PMRI-based LKPD with a local wisdom context can make it easier for students to visualize mathematical concepts in pythagorean material so that students can easily understand the material and concepts in pythagorean material. Thus, in the framework of Lubuklinggau local wisdom, the researcher plans to conduct research under the subject of creating student worksheets based on Indonesian Realistic Mathematics Education (PMRI). The pythagorean theorem is the subject of this development.

B. RESEARCH METHODS

The Research and Development (R&D) approach was employed in this study and produced PMRI-based mathematics Student Worksheets (LKPD) using the local wisdom context of Lubuklinggau on the Pythagorean theorem material. The design and development of LKPD uses a 4D development model consisting of Define, Design, Development and Dissemination. The model design used in this research is shown in the chart below.

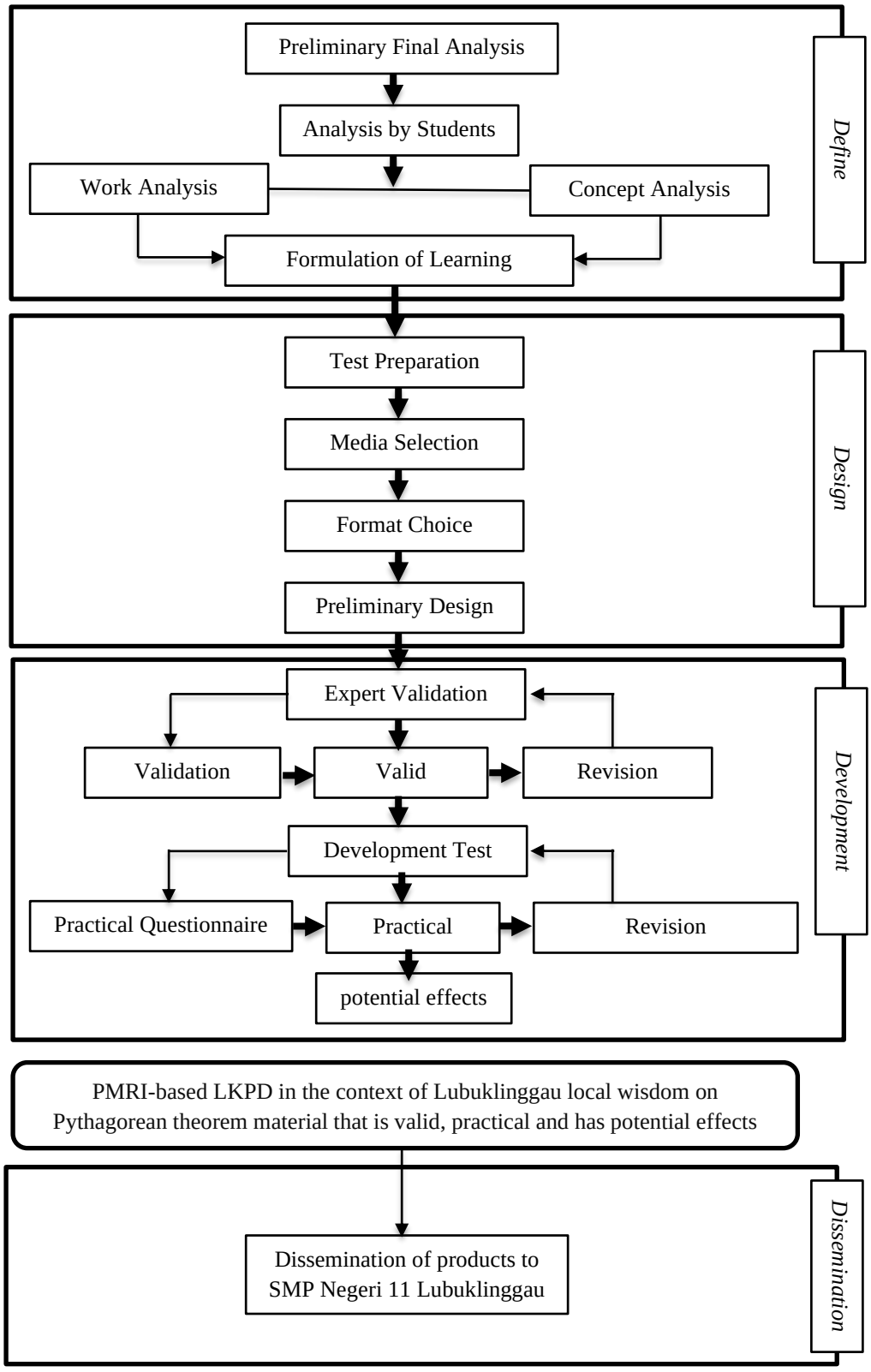


Figure 1 LKPD Development Design Chart
Modification (Amali, et al., 2019, p. 198)

Based on the chart above, the first stage to do is define. Define is the stage for defining and determining the needs faced in learning. Initial-finish analysis, student analysis, task analysis, idea analysis, and learning objective analysis are conducted during the defining stage. The second stage, namely design, is the activity of designing a product that is tailored to your needs. The design stage consists of four main steps, namely preparing the test, selecting media, selecting the format of the teaching materials being developed, and initial

planning or initial design. The third stage, namely development, is the activity of realizing the product design. The aim of the development stage is to produce a revised LKPD based on expert input/expert testing (media experts, linguists and material experts). The fourth stage, namely deployment, is the final stage of development with the 4D model. Dissemination consists of activities to spread or demonstrate products that have been tested for use by other people on a wider scale, for example in other classes.

The validity test is carried out using a questionnaire given to the validator to assess the validity of the LKPD that has been developed. For validators, the experts consist of language experts, material experts and media experts who are lecturers at PGRI Silampari University. Calculate the total score for each validator for each aspect assessed using the following formula:

$$V = \frac{\Sigma S}{n(c-1)}$$ (Chia, et al., 2023, p. 60)

Information:
V = Validation
S = Score =r − lo
lo = Minimum validation assessment score
c = Maximum validation evaluation score
r = The validator's number
n = number of questions

Change the average score of all aspects into a qualitative value according to the assessment criteria described in table 1 below:

Table 1. Valid Criteria

Intervals	Category
$0,80 < V \leq 1,00$	Very Valid
$0,60 < V \leq 0,80$	Valid
$0,40 < V \leq 0,60$	Fairly Valid
$0,20 < V \leq 0,40$	Less Valid
$0 < V \leq 0,20$	Invalid

Modification (Anshary & Edidas, 2018:4)

Based on table 1, the PMRI-based LKPD in the context of Lubuklinggau local wisdom is said to be valid if the average score obtained is V > 60.

By giving teachers and students reaction questionnaires to the LKPD that was being designed, the practicality test was conducted. Calculate the average score of the practicality questionnaire results for each aspect assessed using the following formula:

$$P = \frac{\sum x}{N} \text{ x } 100\ \%$$ (Sriwijayanti, et al.,2020, p. 98)

Information:
P = Percentage of product practicality
$\sum x$ = The total score given by the teacher and students
N = Maximum total score

Change the average score of all aspects into a qualitative value according to the assessment criteria described in table 2 below:

Table 2. Practical Criteria

Intervals	Category
$\rho \geq 80$	Very Practical
$60\ 80 \leq \rho <$	Practical
$40\ 60 \leq \rho <$	Quite Practical
$20\ 40 \leq \rho <$	Less Practical
$\rho < 20$	Very Less Practical

Modification (Yani, et al., 2023, p. 56)

Based on table 2, the PMRI-based LKPD in the context of Lubuklinggau local wisdom is said to be practical if the percentage of product feasibility obtained is $p \geq 60$.

To ascertain whether the LKPD being produced has the ability to affect student learning outcomes, the learning outcome test is employed. Calculate the percentage of classical completeness using the formula:

$$P = \frac{The\ number\ of\ students\ who\ completed}{the\ number\ of\ students}\ x\ 100\%$$ (Yani et al., 2023, p. 53)

Information :

P = percentage of classical completeness

The table below shows the ability categories of student learning outcomes.

Table 3. Categories of Classical Completeness

Score Range %	Appropriateness
$\boldsymbol{\rho \geq 80}$	Very good
$70\ 80 \leq \boldsymbol{\rho} <$	Good
$60\ 70 \leq \boldsymbol{\rho} <$	Pretty good
$50\ 60 \leq \boldsymbol{\rho} <$	Not enough
$\boldsymbol{\rho < 50}$	Very less

(Norsanty & Chairani, 2016, p. 19)

Based on table 3, the PMRI-based LKPD in the context of Lubuklinggau local wisdom is said to have a potential effect with classical completeness reaching $p \geq 70$.

C. RESULTS AND DISCUSSION

The definition stages include initial final analysis, student analysis, task analysis, idea analysis, and learning objective analysis. So it is discovered that: 1) the curriculum used is the 2013 Curriculum, but the learning process is still dependent on the teacher; 3) the teaching materials used are only textbooks; 4) students only rely on the information provided by the teacher without seeking out other learning sources; and 5) students struggle to solve problems in the Pythagorean theorem material because they do not understand the concept.

The design stage includes four steps: 1) test preparation, 2) media selection, 3) format selection, and 4) basic design. In the first stage, preparing the test, the author develops story questions that will be utilized in the LKPD; story questions are always tied to local wisdom contests that occur in everyday life. In the second stage, media selection, the LKPD was chosen as a medium for imparting learning material to students, and the LKPD was written using PMRI in the context of Lubuklinggau local knowledge, resulting in an early draft of the LKPD. Figure 2 shows the product design outcomes.

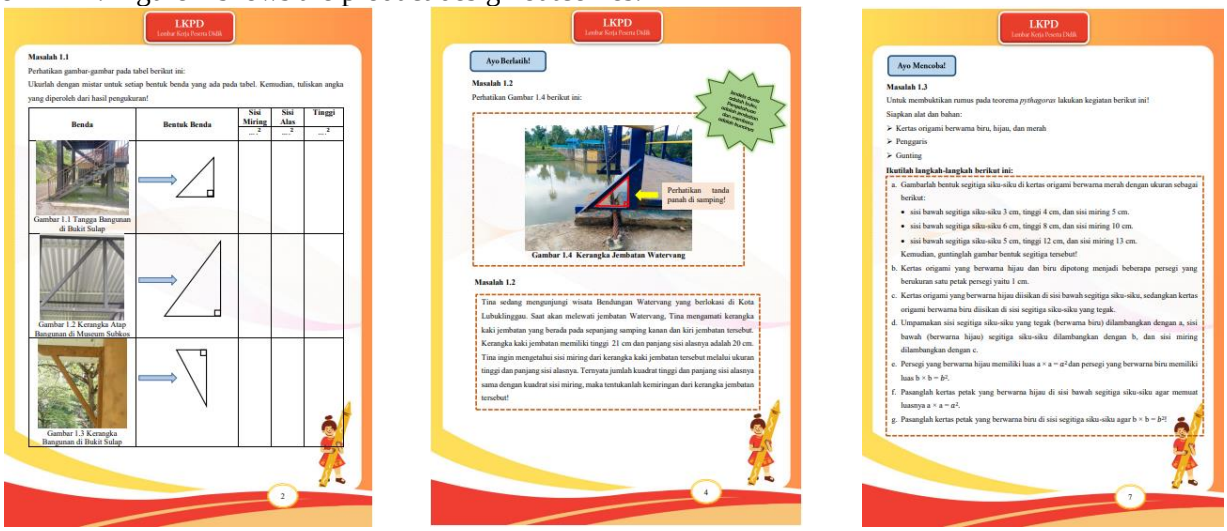


Figure 2 Results of LKPD Products Based on PMRI

Based on Figure 2, it can be seen that the LKPD developed contains the characteristics of PMRI, so that in each exercise 1 they discover the concept of the Pythagorean theorem themselves through measuring objects in the shape of right triangles, exercise 2 is a contextual presentation of the problem which they are then asked to solve it with the Pythagorean theorem formula, exercise 3 is a proof of the Pythagorean theorem formula where they will compare each size of the right triangle they obtained with other students and discuss it, apart from that in each practice question they will be asked to conclude what they got from results of working on questions.

The development stage was carried out to produce PMRI-based LKPD based on the local wisdom of Lubuklinggau City that is valid, practical and has potential effects.

1. Validity Sheet Analysis

The validator's assessment of PMRI-based LKPD includes several aspects, namely format/construction, language and content. Based on the PMRI-based LKPD validation carried out by media validators, a score of 0.83 was obtained in the very valid category, the results of the language expert validator obtained a score of 0.78 in the valid category, and the results of the material expert validator obtained a score of 0.81 in the very valid category. The assessment results are presented respectively in tables 4 and 5.

Table 4. Comments and Suggestions from the Three Validators

Validator	Comments and Suggestions
Media Expert	Pay attention to the choice of background color and text color Add sequence numbers to the concept map Improve image quality
Linguist	Correct the use of punctuation and use of capital letters
Materials Expert	Ensure PMRI principles and characteristics appear in LKPD activities

Data from validation results by the three validators (media experts, language experts, material experts) can be seen in table 5 below:

Table 5. Expert Validation Results

No	Assessment Aspects	Total score	Max Score	Percentage	Category
1	Media Expert	42	48	0.83%	Very Valid
2	Linguist	30	36	0.78%	Valid
3	Materials Expert	65	76	0.81%	Very Valid

In general, the assessment of the draft LKPD by experts was "LKPD can be used with revisions according to suggestions" so that the average score obtained from the three validators was 0.81.

2. Practicality Sheet Analysis

The teacher practicality test was carried out by the class VIII mathematics teacher at SMP Negeri 11 Lubuklinggau. The results of the analysis of teachers' practical responses to the developed LKPD are presented in table 6 below:

Table 6. Results of the Teacher Practicality Response Questionnaire

No	Assessment Indicators	Maximum Score	Score Given
1	Material Aspects	48	42
2	Evaluation Aspect	12	11
	Amount	**60**	**53**
	Percentage of product suitability	**83.33%**	
	Criteria	**Very Practical**	

The teacher's positive answer to the LKPD was 83,33% with very practical criteria, according to the table above, which represents the practicality test that junior high school mathematics instructors conducted based on the findings of the teacher practicality questionnaire calculation. There are two components to the teacher practicality test: the assessment component and the content component.

Small group trials were carried out by 9 students taken heterogeneously, who had low, medium and high levels of ability. Before being given the student practicality questionnaire, nine students were asked to study the LKPD first independently within 35 minutes. After that, each student was given a practicality questionnaire consisting of 20 statements which aimed to determine students' practical responses to the LKPD being developed. Table 7 below displays the findings from the examination of the practical responses provided by the students to the designed LKPD:

Table 7. Results of Student Practicality Response Questionnaire

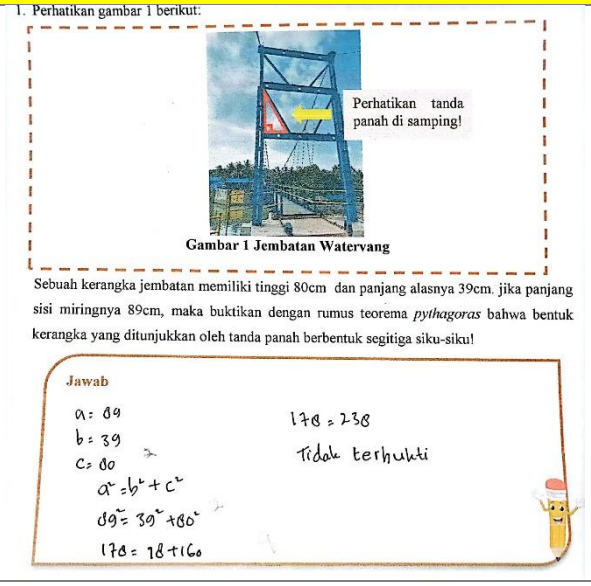
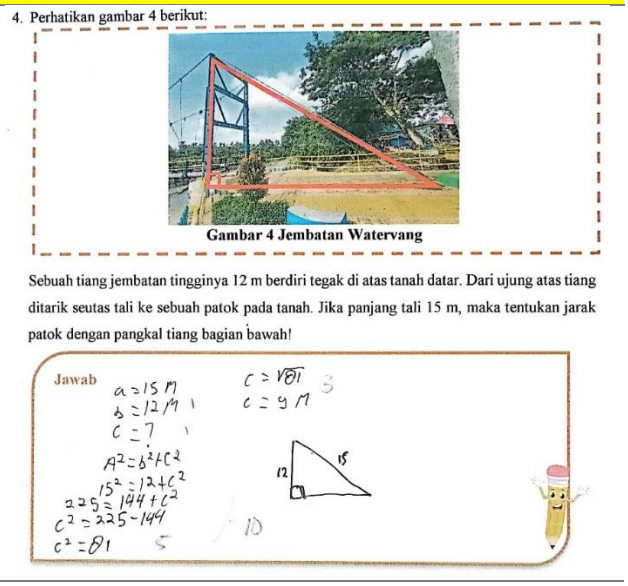
No	Assessment Indicators	Maximum Score	Score Given
1	Aspects of Material Presentation	90	84
2	Benefit Aspect	90	90
	Amount	**180**	**174**
	Percentage of product suitability	**96.66%**	
	Criteria	**Very Practical**	

Based on the results of the student practicality questionnaire calculations, it shows that students' positive response to LKPD was 96.66% with very practical criteria as reviewed by 9 students. The practicality test for students consists of 2 aspects, namely the material presentation aspect and the benefits aspect. So it can be used in large group trials without changes.

3. Assessment of Potential Effects

The field test for this study was conducted with 33 students from class VIII.3 at SMP Negeri 11 Lubuklinggau, with the goal of determining the possible influence of LKPD on student learning outcomes. In large group trials, students begin by practicing questions on LKPD I, LKPD II, and LKPD III. After completing the learning activities, students will be given an essay test in the LKPD competency test part to determine the viability of a research-developed LKPD. Table 8 shows instances of how students answered essay test questions:

Table 8 .Work on Potential Effects Questions for Student A and Student B

Peserta Didik A	Peserta Didik B
	

Based on table 8, student A performed well on the questions, but there were a few errors when operating the numbers for reasonably big values. Meanwhile, student B clearly understands the concept and can apply it to test questions. The application of PMRI-based LKPD in the context of local wisdom makes passive learning conditions lively and creative. Aside from that, it can promote student participation through discovery activities, which transition students from receiving overall information from the teacher to discovering their own information. Using a context that is familiar to kids might also assist them understand the Pythagorean theorem information. Table 9 shows the following data on student learning outcomes:

Table 9. Student Learning Results

	Mark < 68	Mark ≥ 68
The number of students	7	26
Completeness	Not Completed	Complete
Percentage	**21,2%**	**78,8%**
Category	**Baik**	

Based on table 9, it is possible to conclude that the LKPD can help students discover concepts by presenting problems first, because 26 students are classified as complete and 7 as incomplete. As a result, it is possible to conclude that the LKPD produced has a positive impact on student learning outcomes.

Based on the description above, it was found that the quality of the PMRI-based Student Worksheets in the context of Lubuklinggau local wisdom in the Pythagorean theorem material in terms of validity and practicality aspects can be categorized as valid and practical and has potential effects. Previous research was conducted by Adha & Refianti (2019:7) which involved 23 students in a field test trial. It was obtained that 11 students (47.82%) were in the very good category, 5 students (21.73%) were in the very good category. good, 4 students (17.39%) in the quite good category and 3 students (13.04%) in the poor category, so it can be concluded that the product developed has a potential effect because the students can solve the questions on the LKPD well . Similar findings were also obtained by Saputri et al (2022:2959) who developed LKPD based on local wisdom which had a potential effect on student learning outcomes with a completion percentage of 83%.

The product dissemination stage is carried out by spreading the product being developed within a wider scope. In this research, the distribution stage was carried out in two schools, namely SMP Negeri 11 Lubuklinggau and SMP TQ Irsyadul Ibad. Distribution was carried out to mathematics subject teachers as many as 6 copies of PMRI-based LKPD in the context of Lubuklinggau local wisdom on the Pythagorean theorem material.

D. CONCLUSIONS AND RECOMMENDATIONS

According to the findings of the LKPD study, media specialists scored 0.83, language experts 0.78, and material experts 0.81. The teacher practicality test resulted in an 83.33% score, whereas the students' practicality score was 96.66%. LKPD is able to help students discover concepts by presenting problems first, as evidenced by the data analysis results, which show that 26 (78.8%) students are labeled as complete and 7 (21.2%) as incomplete. As a result, the PMRI-based LKPD in the context of Lubuklinggau local knowledge in the Pythagorean theorem material created can be classified as valid, practical, and potentially beneficial to the learning process. Further study ideas include incorporating PMRI-based LKPD from Lubuklinggau City Local Wisdom into other mathematical learning tools.

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