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DEVELOPMENT OF STUDENT WORKSHEETS (LKPD) ON INTEGER TOPICS TO IMPROVE SEVENTH-GRADE STUDENTS' MATHEMATICAL PROBLEM-SOLVING ABILITIES AT SMP NEGERI 3 HALONGONAN

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ABSTRACT
The development of appropriate learning materials is essential to support active learning and to enhance students' understanding of mathematical concepts, particularly in problem-solving activities that require logical and systematic thinking. This study aimed to develop Student Worksheets (LKPD) on integer topics that meet the criteria of validity, practicality, and effectivity in improving seventh-grade Students' Mathematical Problem-Solving Abilities at SMP Negeri 3 Halongonan. This research applied a Research and Development (R&D) method based on the 4D development model, which includes the stages of define, design, develop, and disseminate. The participants of this study were seventh-grade students at SMP Negeri 3 Halongonan. The instruments used in this study consisted of validation sheets assessed by media and subject-matter experts, student response questionnaires, and a test measuring mathematical problem-solving skills. The results indicated that the developed worksheets achieved a validity score of 87.27% from media experts, categorized as highly valid, and 75% from subject-matter experts, categorized as valid. The practicality test showed a percentage of 67.26%, indicating that the worksheets were practical and easy to implement in classroom learning activities. The effectiveness of the worksheets was indicated by an increase in students' mathematical problem-solving skills, as reflected by an N-gain value of 0.55, classified as category. These findings suggest that the developed worksheets help students better understand integer concepts, increase learning engagement, and support the development of mathematical reasoning skills. Therefore, the developed LKPD is considered appropriate and practical to implement as a mathematics teaching medium for integer topics for seventh-grade students at SMP Negeri 3 Halongonan.

Keywords: Student Worksheets, Integers, Mathematical Problem-Solving Skills, Research and Development.

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PRELIMINARY

The learning process requires teachers to play an important role and to demonstrate professionalism in carrying out their duties (Sopian, 2016). Professional competence is one of the essential competencies that must be possessed by teachers. According to Law No. 14 of 2005 on Teachers and Lecturers, Article 10 (1) explains that the competencies mentioned in Article 8 consist of pedagogical, personal, social, and professional competencies, which are developed through professional education. (Fitri, 2021). Considering the professional competence that teachers are expected to possess, every teacher is obliged to design and

develop learning tools that are aligned with the characteristics and needs of their students (Purwandari, 2023).

Instructional materials that are designed and developed should be able to enhance students' interest and learning abilities (Nababan & Iskandar, 2019). Within the 2013 Curriculum, instructional tools include various elements such as the academic calendar, syllabus, lesson plans, student worksheets (LKPD), assessment instruments, teaching materials, learning media, and additional supporting resources. To ensure that the learning process runs effectively, teachers are expected to prepare and complete all these elements (Nasution & Oktaviani, 2020). However, some teachers still perceive instructional materials merely as administrative requirements rather than as practical guidelines for implementing effective learning (Rokhmawati et al., 2023). In addition, many teachers continue to rely heavily on lecture-based methods, which often cause students to feel bored and disengaged. If such teaching practices continue, the quality of learning and teaching professionalism may decline. In fact, instructional materials serve as the foundation for producing high-quality learning. Nevertheless, teachers' pedagogical and professional competencies remain relatively low, particularly in designing lesson plans that incorporate varied and effective instructional strategies (Siswanto, 2014).

One of the objectives of mathematics learning in the 2013 Curriculum is to develop students' competencies, including mathematical understanding skills (SC, P., Maimunah & Hutapea, 2020). Novitasari (2016) states that mathematical understanding is an essential goal in mathematics education because learning materials should not merely be memorized but understood conceptually. According to Utari (2017) mathematical understanding is crucial for solving mathematical problems, addressing issues in other disciplines, and dealing with real-life situations. However, research findings indicate that students' mathematical understanding and problem-solving abilities remain relatively low. Studies by Suraji et al (2018) and Nuraeni et al (2018) revealed that students' mathematical problem-solving skills are still inadequate. Meanwhile, Resta & Munawaroh (2018) found that students' problem-solving abilities were at a moderate level, and Apriliyanto (2019) reported that students' problem-solving skills were still low in derivative application topics. These findings highlight the need to improve students' mathematical understanding and problem-solving abilities.

In the mathematics learning process, teachers need to motivate students and guide them through problem-solving activities. Guidance can be delivered orally or in written form; however, written guidance is often more effective because students can revisit and

study it repeatedly (Handayani & Rahayu, 2020). One form of written guidance that supports students' learning is the Student Worksheet/*Lembar Kerja Peserta Didik* (LKPD). LKPD is a learning material that functions as a supporting instructional tool (Septian, 2019). It contains structured tasks and instructions designed to promote students' active participation, independence, and problem-solving skills. Based on this perspective, LKPD can be considered an important supporting instrument in the learning process.

Observations conducted at SMP Negeri 3 Halongonan indicated that the learning process still relies heavily on textbooks covering both semesters within a single volume. Some students reported difficulties in understanding mathematics lessons due to limited conceptual comprehension. One contributing factor is the unattractive design and thickness of the textbooks, which reduce students' motivation to read and learn independently.

Seventh-grade students often encounter difficulties in understanding integer concepts for several reasons. First, negative numbers are abstract concepts that are challenging to comprehend, such as understanding why -7 is smaller than -3. Second, number lines as visual aids are not always used effectively, leading to confusion in determining directions during addition and subtraction operations. Third, students frequently make mistakes in mixed operations, particularly when distinguishing between number signs and operational symbols. Fourth, multiplication and division sign rules are often memorized without conceptual understanding, making them easily forgotten. Fifth, students rarely relate integers to real-life contexts such as temperature or financial transactions, causing the material to appear irrelevant. Finally, limited practice and insufficient problem-solving strategies result in students being less accustomed to thinking logically and systematically when solving integer problems.

Previous studies (Suraji et al., 2018; Nuraeni et al., 2018; Resta & Munawaroh, 2018; Apriliyanto, 2019) indicate that students' mathematical problem-solving skills remain relatively low. In addition, although several studies have developed LKPD as instructional materials, most of them do not specifically focus on integer topics or systematically integrate structured mathematical problem-solving steps (understanding the problem, planning, solving, and reviewing) into the worksheet design. Furthermore, limited research has examined the validity, practicality, and effectiveness of LKPD on integer material at the junior high school level, particularly in the context of SMP Negeri 3 Halongonan, the proposed solution is the development of LKPD to improve students' mathematical problem-solving skills with the indicators of understanding the concept of integers, comparing integers, and ordering integers.. The use of LKPD in learning integer topics helps students

engage actively in learning activities such as observing, calculating, and drawing conclusions independently. LKPD also presents contextual problems related to daily life, enabling students to recognize the relevance of learning integers. Furthermore, LKPD encourages active, independent, and critical thinking through step-by-step problem-solving tasks. For teachers, LKPD facilitates the evaluation process because students' responses can be used directly to assess their level of understanding. Therefore, this study was conducted "The Development of Student Worksheets (LKPD) on Integer Topics to Improve Mathematical Problem-Solving Skills of Seventh-Grade Students at SMP Negeri 3 Halongonan."

METHODS

This study employed a Research and Development (R&D) approach, which is a method focused on producing particular products and examining their effectiveness. To develop a particular product, research involving needs analysis is conducted. Furthermore, to ensure that the product can function effectively and be widely implemented in society, additional research is required to evaluate its effectiveness (Sugiyono, 2015a).

R&D emphasizes the development of useful and beneficial products in various forms as extensions, additions, and innovations of existing products (Putra, 2015). The outputs produced in this research consisted of instructional devices, namely Lesson Plans (RPP) and Student Worksheets (LKPD), designed using a Problem-Based Learning (PBL) approach on ratio and scale materials, with a focus on enhancing students' problem-solving abilities. This study applied the 4-D (Define, Design, Development, Dissiinate) research and development model introduced by Tiagharajan & Semmel (1974). The 4-D development model is composed of four main phases: Define, Design, Develop, and Disseminate. The participants involved in this research were 30 seventh-grade students of SMP Negeri 3 Halongonan, located in Sipaho Village, Halongonan District, Padang Lawas Utara Regency, North Sumatra, in the 2025/2026 academic year. This research utilized a Research and Development (R&D) approach to design and produce appropriate instructional materials. The data collected consisted of qualitative as well as numerical data. Qualitative information was collected from feedback provided by the academic supervisor, expert validators, and mathematics teachers regarding the developed instructional materials, while quantitative data were in the form of numerical scores from expert validation, student response questionnaires, learning implementation observation sheets, and students' mathematical problem-solving tests (Putro, 2016).

The research instruments included instructional material validation sheets, student response questionnaires, observation sheets on the implementation of learning activities, and students' mathematical problem-solving tests. The validation sheet will be distributed to students and teachers to be completed, and the results will be calculated to obtain the final score. These instruments were used to facilitate systematic, practical, and comprehensive data collection to produce high-quality research data (Sugeng, 2014). The gathered data were subsequently examined using qualitative and quantitative analysis methods aligned with the research objectives.

Qualitative data analysis was conducted descriptively by processing suggestions and feedback from expert validators and teachers to improve the instructional materials during the revision stage (Sugiyono, 2015). After the validation sheet is given to the experts, their suggestions and comments will serve as qualitative data. Meanwhile, quantitative data analysis involved processing numerical data to determine the quality of the instructional materials in terms of validity, practicality, and effectiveness. Validity, practicality, and effectiveness will be obtained at the development and dissemination stages. The validity of the instructional materials was calculated using a Likert scale of 1–5.

Table.1 Likert Scale Scoring Criteria

Criteria	Score
Excellent	5
Good	4
Fair	3
Poor	2
Very Poor	1

With the formula:

$$V = \frac{\sum \text{Obtained Scrore}}{\sum \text{Maximum Score}} x\ 100\% \quad (1)$$

Table. 2 Validity, Practically, Effectiveness Criteria

Value	Indicators
81-100%	Very valid
61-80%	Valid
41-60%	Moderately valid
≤40%	Invalid

(Akbar, 2013)

RESULT AND DISCUSSION

Define

The initial analysis stage showed that the teaching of integer material in Grade VII at SMP Negeri 3 Halongonan was still teacher-centered and relied solely on printed textbooks without the support of student worksheets (LKPD). As a result, students' activeness and mathematical problem-solving abilities had not developed optimally. The learner analysis indicated that students still experienced difficulties in understanding integer concepts, particularly negative numbers, mixed operations, and solving word problems. In addition, students' learning independence was relatively low; therefore, LKPD was needed to help students learn actively, systematically, and independently.

The task and concept analysis revealed that learning activities should be designed to train problem-solving skills through stages such as understanding problems, determining strategies, performing calculations, and rechecking results. The integer material includes definitions, comparisons, ordering, and integer operations presented systematically and contextually. Based on core competencies, basic competencies, and learning indicators, the learning objectives focus on students' ability to understand integer concepts, distinguish between positive and negative numbers, perform operations, and apply them in mathematical problem solving.

Design

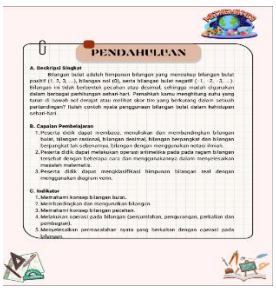
This study aims to stage is to produce the initial design of the learning media, referred to as the preliminary draft. The teaching material selected to support learning on integer topics is the Student Worksheet (Lembar Kerja Peserta Didik/ LKPD). The use of LKPD is expected to help students understand integer concepts more easily and effectively, while also encouraging active participation and independent learning during the instructional process.

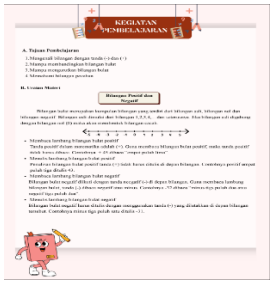
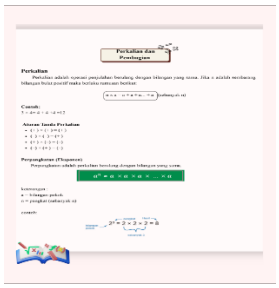
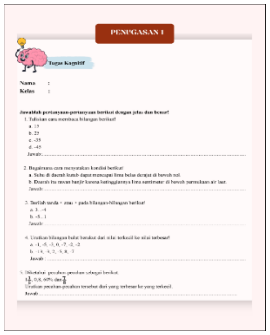
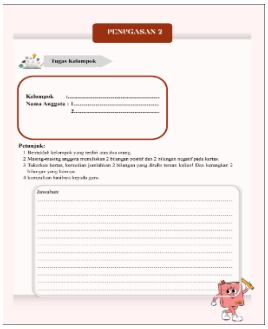
The LKPD format was determined According to the results of the initial analysis, learner analysis, and the basic competencies of Grade VII integer material. The worksheet was designed as a printed learning medium with a systematic and easy-to-understand structure. It consists of several main components, including the cover, LKPD identity, usage instructions, learning objectives, material summaries, example problems, problem-solving-based activities and exercises, and evaluation sections. The content is arranged sequentially from simple to more complex concepts to support gradual learning.

In terms of design, the LKPD uses simple and communicative language, readable font sizes, and an organized and visually appealing layout. The problems are presented in contextual situations related to students' daily lives to enhance conceptual understanding

and mathematical problem-solving skills. All activities and exercises follow the steps of mathematical problem solving: understanding the problem, planning the solution, implementing the solution, and reviewing the results.

Table. 3 Initial Product LKPD

Product	Explanation
	**Front Cover of the Student Worksheet (LKPD)**
	**Preface Page of the Student Worksheet (LKPD)**
 	**Introduction and Instructions for Using the Student Worksheet (LKPD) for Teachers and Students**

Product	Explanation
    	**Presentation of the Integer Concepts Explanation Section**
 	**Presentation of the LKPD Task/Assignment Section**

Develop

The objective of this stage is to produce the final draft of the Student Worksheet (LKPD). The activities carried out at this stage are as follows:

a. Expert Validation

The initial draft of the Student Worksheet (LKPD) was first validated by experts. The validations used in this study included material expert validation and language expert validation. After the validation process, the LKPD was Revised in accordance with the feedback and recommendations from the experts to produce the final draft of the LKPD.

b. Revision 1

After revising the initial A draft developed based on the feedback and recommendations from media and material expert validators, the LKPD was re-consulted with the validators to determine whether the developed product had met the validity criteria. If the validators considered the revisions sufficient, the LKPD could then be used in the next stage, namely the practicality test with students.

Table 4. Outcome of Media Expert Evaluation

No	Indicator	Point	Proportion	Classification
1	Appearance Aspect	18	90%	Very valid
2.	Technical Aspect	13	86%	Very valid
3.	Interactivity Aspect	17	85%	Very valid
	Obtained Score	48	87,27%	Very valid
	Maximum Score	55		

Based on the results of the media expert validation analysis, a total score of 48 out of a maximum score of 55 was obtained, resulting in a percentage of 87.27%. These results indicate that the overall media expert validation across all indicators falls into the category of "very feasible/very valid." The findings demonstrate a very high level of quality, meaning that the developed LKPD meets the requirements as a learning material and is considered suitable for implementation in the teaching and learning process.

However, The instructional media expert also provided several suggestions and recommendations for improving the LKPD. A summary of the media expert's comments and suggestions is presented in the following table.

Table 5. Suggestions/Comments from the Media Expert Validator

Validator's name	Suggestions/Comments
Siti Salamah Br Ginting, M. Pd. Lecturer	1. Revision of font types (for both the titles and the main content of the LKPD). 2. Times New Roman is considered too formal, which may reduce students' interest in reading and engaging with the LKPD..

Table 6. Revision Results Based on Suggestions from the Media Expert

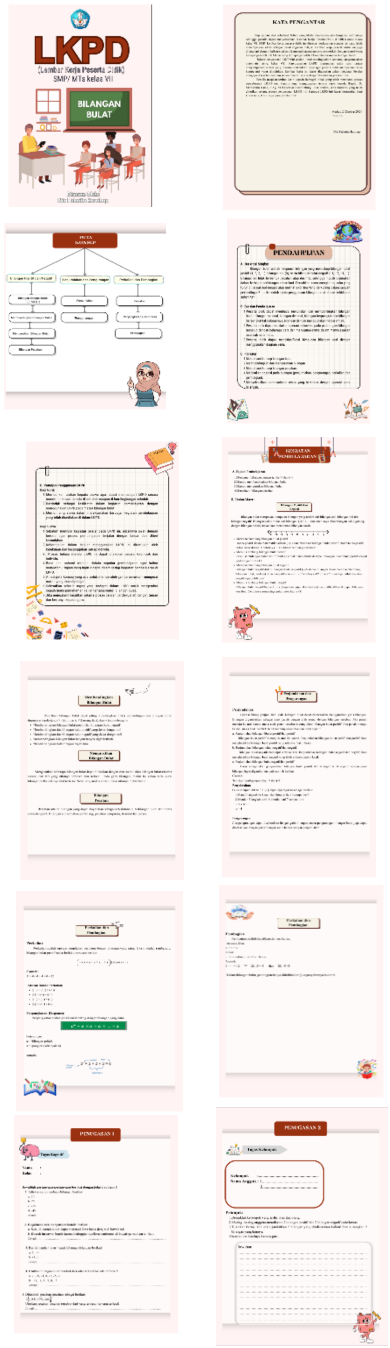
Before Revision	After revision
	

Table 7. Outcomes of The Subject Matter Expert Assessment

No	Indicator	Point	Proportion	Classification
1.	Material Feasibility	11	75%	**Valid**
2.	Presentation Appropriateness	12	80%	**Valid**

No	Indicator	Point	Proportion	Classification
3.	Language Appropriateness	16	80%	**valid**
4.	Alignment with Mathematical Problem-Solving Skills	6	60%	**sufficiently valid**
	Obtained Score	**45**	**75%**	**valid**
	Maximum Score	**60**		

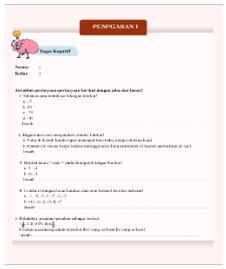
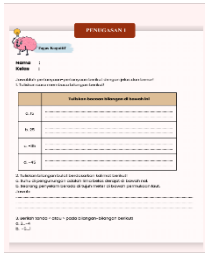
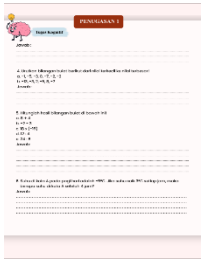
According to the results of the subject matter expert evaluation, a score of 45 out of a maximum score of 60 was obtained. Therefore, the LKPD is categorized as suitable for use in the learning process, with revisions made according to the suggestions and feedback provided by the subject matter expert, as shown in the table below.

Table 8. Suggestions/Comments from the Language Expert Validator

Validator's name	Suggestions/Comments
Rusi Ulfa Hasanah, M. Pd. Lecturer	**1.** The use of the number line does not yet include illustrations or an explanation of how it is used. **2.** Problem-solving questions should be added

Table 9. Revision Results Based on Suggestions from the Language Expert

Before Revision	After Revision
	

Practicality Test of the LKPD

The practicality test was conducted after the validation by experts and after the product was declared valid. This practicality test was carried out by administering a student learning response questionnaire after the learning process using the developed product. The practicality test was given to 30 students at SMP Negeri 3 Halongonan.

Table 10. Results of Student Response Questionnaire Analysis

No	Description	Result
1	Number of respondents	**30 students**
2	Total score obtained	**2018**
3	Maximum score	**3000**
4	Average percentage	**67,26%**
5	Practicality category	**practical**

Based on the data from the analysis of the student response questionnaire, a total score of 2018 out of a maximum score of 3000 was obtained, with a percentage of 67.26%. This indicates that the developed LKPD meets the criteria of being "practical" and is interesting to use in the learning process. These results show that 20 indicators received positive evaluations, indicating that the quality of the developed LKPD has met the criteria as a practical teaching material for use in the teaching and learning process.

Effectiveness of the Student Worksheet (LKPD)

At the stage of testing the effectiveness of the Student Worksheet (LKPD), this study involved one class consisting of 30 students. To examine the effectiveness of the LKPD in improving students' mathematical problem-solving skills, the researcher employed a pre-test and a post-test. The tests were conducted in Grade VII at SMP Negeri 3 Halongonan. After administering the pre-test and post-test, the students' learning outcomes obtained from both tests were analyzed to determine the extent to which the LKPD was effective in improving students' mathematical problem-solving skills. The effectiveness analysis was

carried out using the N-Gain calculation. The results of the N-Gain test are presented in the following table.

Table 11. N-Gain Score Analysis Results of Grade VII SMP Negeri 3 Halongonan

No	Description	Result
1	Number of respondents	**30 students**
2	Average pre-test score	**52,63**
3	Average post-test score	**77,6**
4	Average gain score	**24,2**
5	Maximum score (100-Pre)	**44**
6	Average N-Gain score	**0,55**
7	N-Gain category	**Medium/effective**

Based on the data above, the average students' learning outcome before using the LKPD was 52.63, while the average score after using the LKPD in the learning process increased to 77.6. The results also show an average N-Gain score of 0.55, indicating an improvement in students' learning outcomes. Furthermore, the improvement in students' learning outcomes before and after using the LKPD falls into the "medium" improvement category based on the classification proposed by Richard R. Hake (1998). It can be concluded that the LKPD is proven to be effective For implementation in the learning process, as it can improve students' learning outcomes.

Disseminate

The dissemination phase represents the concluding stage of the 4D development model, which aims to distribute the developed product so that it can be used more widely. At this stage, the LKPD that has been declared valid, practical, and it is presented to relevant stakeholders, such as mathematics teachers, to inform them about the product and encourage its use in the learning process., such as mathematics SMPN 3 teachers. The dissemination is carried out by providing the LKPD to teachers For implementation in the learning process, either in other classes or as a learning reference. In addition, the results of the LKPD development, matter expert with a percentage score of 75%, while the media expert assessment resulted in a percentage score of 87.27%, categorized as "very feasible." can also be disseminated through teacher discussion forums, seminars, or research reports. However, due to limitations in time and cost, the dissemination stage in this study was conducted on a limited scale, only within the school where the research was carried out.

CONCLUSION

Based on the implementation of the research at SMP Negeri 3 Halongonan and the analysis of various data obtained during the research process, the researcher concludes that the development of the Student Worksheet (LKPD) to improve the mathematical problem-solving skills of Grade VII students at SMP Negeri 3 Halongonan yielded the following results:

The developed Student Worksheet (LKPD) obtained a "feasible" criterion from the subject matter expert with a percentage score of 75%, while the media expert assessment resulted in a percentage score of 87.27%, categorized as "very feasible." With an overall average score of 81.13%, the LKPD is declared feasible and appropriate for use in the learning process to improve students' mathematical problem-solving skills.

The practicality of the LKPD was evaluated using a student response questionnaire. The results showed a percentage score of 67.26%, which falls into the "practical" category. Therefore, the LKPD can be categorized as practical for use in the learning process.

The effectiveness of the LKPD was measured using the N-Gain test, which falls into the "medium" category, indicating an improvement in students' learning outcomes. The N-Gain value obtained was 0.55. Therefore, it can be concluded that the LKPD is adequately effective in enhancing students' mathematical problem-solving abilities

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