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Development of Jigsaw-Based Student Worksheets (LKPD) to Improve Mathematics Learning Outcomes of Fifth Grade Elementary School Students

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A B S T R A C T

This study produced a Student Worksheet (LKPD) developed using the Jigsaw learning model for fifth-grade mathematics in elementary schools. The product went through a validation stage, showing results in the very valid category, meaning that the LKPD is suitable for use in learning activities. Practicality tests were conducted involving both teachers and students, and the findings indicated that the worksheet is easy to understand, simple to use, and relevant to the learning objectives. In addition, the effectiveness of the LKPD was assessed by comparing student outcomes before and after implementation. The results showed a significant improvement, with the percentage of students achieving mastery increasing from 35% in the pretest to 80% in the posttest. This indicates that the LKPD successfully supports student engagement and comprehension in mathematics. Overall, the Jigsaw-based worksheet can serve as an effective learning medium that not only facilitates collaboration but also enhances student achievement in mathematics learning at the elementary school level.

1. Introduction

At the elementary education stage, children are building an important foundation for their intellectual, emotional, and social development. At this level, students are equipped with various basic skills that are useful for their future lives (Gunawan et al., 2205). One of the most emphasized skills is the ability to calculate and reason through mathematics. Mathematics is not merely an abstract science, but also serves as a means to train logical and critical thinking, as well as a practical tool for dealing with everyday problems (Susanto, 2013). Thus, students' ability to master

mathematics from an early age reflects the quality of the elementary education they receive.

Unfortunately, in practice, mathematics is often perceived as difficult and less engaging for most students. This perception directly affects their learning motivation as well as the outcomes achieved (Juskifli et al., 2025). Learning outcomes can essentially be understood as indicators of behavioral changes after a person undergoes a learning process, including knowledge, attitudes, and skills (Purwanto, 2011). In other words, success in learning mathematics is not merely about grades on a report card, but also about conceptual understanding, a positive attitude toward the subject, and the ability to solve everyday problems.

Based on initial observations in Grade V at SD Negeri 03 Koto Balingka, West Pasaman Regency, it was found that students' mathematics achievement is still categorized as low. Out of a total of 20 students, only 7 were able to reach the Minimum Mastery Criteria (KKM) score of 75, while the remaining 13 students did not meet the standard. This condition indicates that most students still face obstacles in understanding the subject matter, particularly mathematics, which is often considered difficult. The low achievement highlights the need for more appropriate learning strategies to help students better grasp mathematical concepts (Agusti 2023). Therefore, improvements in the learning process are necessary not only to make lessons more engaging, but also to support students in overcoming difficulties so that their learning outcomes can improve significantly.

The results of the daily mathematics tests show that out of 20 students, only 7 students (35%) achieved a minimum passing grade of 75, with an average score of 68, indicating that most students have not yet mastered the material and are having difficulty understanding mathematical concepts (Roy 2025). This situation highlights the need for improvements in the learning process in elementary schools. The provision of more interesting, interactive, and age-appropriate teaching materials is essential to improve student understanding. Learning media play an important role in bridging the material with student understanding; Uno (2012) emphasizes that appropriate media can create a pleasant learning atmosphere, increase motivation, and help teachers deliver material more effectively. One of the most widely used print media is LKPD, because it enables students to be more active in the learning process.

The existence of Student Worksheets (LKPD) is not merely as an exercise tool, but also as a guide for students in carrying out learning activities either independently or collaboratively in groups (Prastowo, 2011). By using LKPD, students are encouraged to be more active in discovering and constructing their own understanding. This aligns with the constructivist perspective, which emphasizes that learning is a process in which students build meaning based on the experiences they acquire (Schunk, 2012). Therefore, well-designed LKPD can facilitate meaningful learning by providing structured activities that stimulate students' thinking and engagement throughout the learning process. Recent research has demonstrated that LKPD development can significantly enhance learning outcomes, as evidenced by (Ryni & Sukarmin 2025) who found that LKPD assisted

by Augmented Reality media improved student learning outcomes in chemistry subjects.

To optimize its use, Student Worksheets (LKPD) can be combined with the Jigsaw learning model. This model is one form of cooperative learning that emphasizes both individual responsibility and group collaboration (Wulandari et al., 2025). Through this approach, each student is assigned to study a specific part of the material, and then present it back to their peers in the original group. In this way, every member acts not only as a learner but also as a teacher for their group (Isjoni, 2009; Rusman, 2016). The advantage of the Jigsaw model is that it promotes equal mastery of the material, increases speaking activity, and develops students' social skills. Moreover, cooperative learning models have been proven effective in various contexts, as shown by (Khayyirah et al. 2024) who demonstrated that STAD-type cooperative learning assisted by game-based applications improved students' cognitive learning outcomes.

A number of previous studies have also demonstrated the effectiveness of the Jigsaw model and LKPD in enhancing learning outcomes, especially in mathematics. (Kasim 2022) found that the Jigsaw model significantly improved elementary students' mathematics achievement, as cooperative interaction helped students understand concepts more deeply. Similarly, (Suryadi et al. 2020) reported that the Jigsaw model enhanced both mathematical performance and student confidence, indicating that active involvement contributes to better learning outcomes. In addition, (Amin et al. 2022) showed that Jigsaw learning increased students' motivation and mathematical problem-solving abilities. Research by (Mustikawati & Nurhikma 2024) also confirmed that the Jigsaw model strengthened collaboration skills and learning outcomes among elementary students. On an international scale, (Azizi et al. 2024) found that the Jigsaw model reduced students' mathematics anxiety and improved learning performance, demonstrating its effectiveness across diverse educational contexts. Furthermore, (Gunawan et al. 2026) found that implementing Problem Based Learning model successfully improved learning outcomes of fourth-grade students, suggesting that active learning approaches are beneficial at the elementary level. Mustika et al. (2024) also revealed that applying the TPACK approach through the PBL model increased student learning activity in mathematics learning in elementary schools.

Although previous studies consistently show that both Jigsaw learning and LKPD are effective in improving students' understanding and performance, research specifically focusing on developing Jigsaw-based LKPD for mathematics in elementary school remains limited. The need for innovative learning materials is also supported by (Putri et al. 2025) who developed a Problem Based Learning teaching module to facilitate mathematical reasoning skills, demonstrating the importance of well-designed instructional materials. Additionally, (Oktama et al. 2026) successfully developed interactive media using Augmented Reality applications to improve student learning outcomes in mathematics learning in Grade V elementary school, indicating the potential of technology-enhanced learning materials. Therefore, a development study in this area is needed to fill the gap and provide innovative learning materials that can support the learning needs

of elementary school students. Such development is expected to integrate cooperative learning principles with structured instructional materials to enhance students' active participation. Moreover, the resulting LKPD can serve as a practical reference for teachers in implementing more engaging and effective mathematics instruction at the elementary level.

Considering the problems observed in the field and the gaps found in previous studies, this study is directed toward developing Jigsaw-based Student Worksheets (LKPD). The designed LKPD is expected to meet the criteria of being valid, practical, and effective so that it can make a meaningful contribution to improving the mathematics learning outcomes of fifth-grade elementary school students. The validity aspect focuses on the suitability of the content, language, and presentation with the learning objectives and student characteristics. The development process will follow systematic procedures as recommended by (Dewi et al. 2024), who emphasized the importance of implementing discovery learning modules to improve students' cognitive learning outcomes and scientific attitude. Practicality refers to the ease of use of the LKPD by both teachers and students during the learning process. As demonstrated by (Rizqi et al. 2025), effective learning models such as Team Games Tournament can enhance both numeracy skills and learning motivation of elementary school students, highlighting the importance of engaging instructional materials. Effectiveness is measured based on improvements in students' learning outcomes and active participation in mathematics learning. Through this development, the LKPD is expected to support more interactive, collaborative, and meaningful mathematics instruction in elementary schools.

2. Methodology

This study employs a Research and Development (R&D) approach, referring to the 4-D model, which consists of the stages of definition, design, development, and dissemination. The research was conducted at SDN 03 Koto Balingka, West Pasaman Regency, during the odd semester of the 2024/2025 academic year. The subjects of the study were all fifth-grade students, totaling 20 learners, consisting of 8 male and 12 female students. This research design was selected to produce a learning product that is systematically developed and empirically tested. The R&D approach allows researchers to evaluate both the quality of the product and its effectiveness in improving learning outcomes (Ryni & Sukarmin 2025).

The research process followed the steps of the 4-D model. In the Define stage, a needs analysis was carried out to describe the actual learning conditions. The Design stage was used to develop the LKPD in accordance with the learning objectives. The Development stage involved producing the product, which was reviewed and validated by experts to ensure its quality. Finally, in the Dissemination stage, the product was introduced to teachers and students so that it could be utilized in the learning process. Each stage was implemented sequentially to ensure that the developed LKPD met the criteria of validity, practicality, and effectiveness. The application of the 4-D model also ensured that the learning materials were aligned with students’ needs and classroom conditions.

The research instruments in this study consisted of several key components. The validation sheets were completed by material experts and media experts, who assessed aspects such as content feasibility, presentation, language use, and the design of the LKPD. In addition, teacher and student response questionnaires were used to determine the practicality and ease of use of the LKPD in the learning process. Meanwhile, a learning outcome test in the form of evaluation questions was administered to students with the aim of measuring their improvement in skills and understanding after using the LKPD during the teaching and learning process.

Data were collected using several techniques, namely initial observation to identify the learning conditions, expert validation to assess validity, questionnaires to evaluate practicality, and learning outcome tests to measure effectiveness. Data analysis was carried out by calculating the average scores from the validators' assessments, which were then classified into the categories of very valid, valid, fairly valid, or invalid. The level of practicality was obtained through questionnaires completed by teachers and students, calculated in the form of percentages, and then interpreted into the categories of very practical, practical, fairly practical, or less practical. Effectiveness was measured through students' learning outcomes, where a student was considered to have achieved mastery if they obtained a minimum score of 75 in accordance with the Minimum Mastery Criteria (KKM). Meanwhile, the level of classical mastery was used as an indicator to determine the effectiveness of the developed LKPD.

3. Results and Discussion

To determine the quality of the Jigsaw-based LKPD developed in this study, a series of assessments were conducted, including validation, practicality testing, and effectiveness measurement. These three components are essential in development research because they provide a comprehensive evaluation of whether the product is theoretically sound, feasible to use in the classroom, and capable of improving learning outcomes. Therefore, the results of this study are presented in three main parts, beginning with the validation results to assess the accuracy, appropriateness, and feasibility of the LKPD before being implemented in the learning process.

Validation Results of LKPD

The validation process was carried out to ensure that the Jigsaw-based LKPD meets the criteria of high-quality learning materials before being implemented in the classroom. Two validators with expertise in learning content and media assessed the LKPD using a structured validation instrument. The results are presented in Table 1. The validation focused on key aspects, including content relevance, clarity of language, presentation structure, and visual appearance. This process was essential to ensure that the LKPD is appropriate for fifth-grade students and aligned with the learning objectives.

Table 1. Validation Results of the LKPD

Aspect	Average Score	Criteria
Content	3.6	Very valid
Language	3.5	Very valid
Presentation	3.4	Valid
Appearance	3.6	Very valid
Average	3.53	Very valid

The content aspect received a high score (3.6), indicating that the material contained in the LKPD is aligned with the competencies of the fifth-grade mathematics curriculum. The concepts, examples, and tasks provided in the LKPD follow the material structure expected in Curriculum 2013 and present content that matches students' cognitive development. This is important because inappropriate content often leads to misconceptions or learning difficulties. In addition, the content encourages students to actively explore mathematical concepts through cooperative problem-solving activities. The integration of Jigsaw elements ensures that each student is responsible for mastering a specific part of the material. This approach supports deeper conceptual understanding rather than rote learning. Therefore, the content validity of the LKPD plays a crucial role in supporting meaningful mathematics learning.

The language aspect (3.5) shows that the LKPD uses simple, concise, and communicative sentences that are suitable for the reading ability of elementary school students. The clarity of instructions also contributes to reducing confusion during learning activities. This is in accordance with Prastowo's (2011) principle that LKPD language must be age-appropriate to avoid cognitive overload. Clear language also helps students focus more on understanding mathematical concepts rather than interpreting instructions. Moreover, the use of familiar terms makes it easier for students to engage in group discussions. This supports smoother interaction among group members during the Jigsaw process. As a result, effective language use enhances both comprehension and collaboration.

The presentation aspect, although slightly lower (3.4), still meets the "valid" category. This indicates that the structure and sequence of steps in the LKPD are logical and easy to follow, but still have room for improvement, such as providing more guided examples or smoother transitions between group and individual tasks. Despite this, the presentation already reflects the main stages of the Jigsaw learning model. The division between expert group activities and home group discussions is clearly identified. This structure helps students understand their roles during the learning process. With minor refinements, the presentation aspect can further enhance learning effectiveness.

The appearance aspect (3.6) shows that the LKPD is visually appealing. The design includes illustrations, layout balance, and color composition that help maintain students' attention. According to Uno (2012), visual appeal is a key characteristic of quality learning media because attractive designs can increase motivation and engagement. Visual elements also support students in understanding abstract mathematical concepts more concretely. A well-organized layout prevents students from feeling overwhelmed by the material. Additionally, consistent visual design

helps students navigate the worksheet more easily. Thus, the appearance aspect contributes positively to students' learning comfort.

Overall, the average score of 3.53 indicates that the LKPD is highly valid, meaning it is feasible to be used in classroom learning without major revisions. This finding is consistent with Masruroh (2024), who found that Jigsaw-based LKPD also achieved high expert validation scores, emphasizing that LKPD designed with cooperative elements tends to meet pedagogical standards more effectively. The high validity score confirms that the LKPD has met expert expectations in terms of content, language, presentation, and appearance. This suggests that the product is ready to proceed to the practicality and effectiveness testing stages. Furthermore, strong validation results increase teachers' confidence in using the LKPD in real classroom settings. Consequently, the validated LKPD has the potential to support improved mathematics learning outcomes as shown in Figure 1.

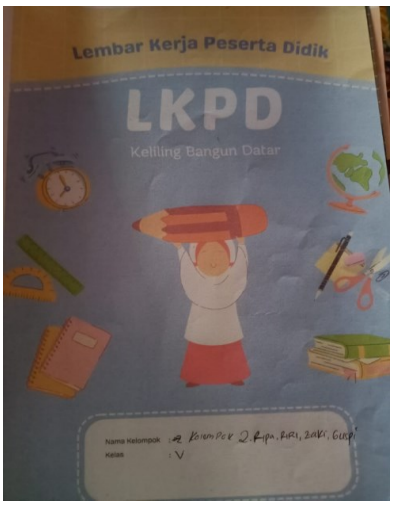

Figure 1. Cover LKPD

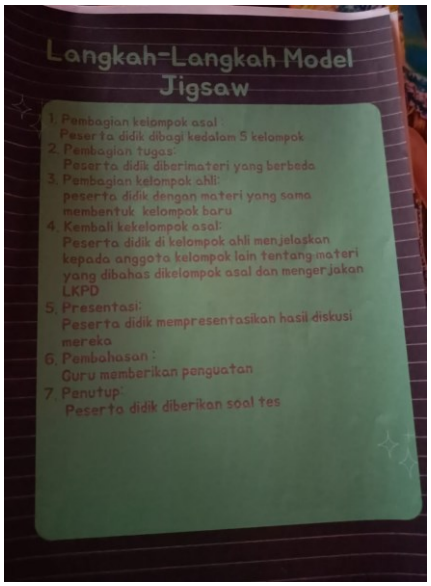

Figure 2. Jigsaw Model Steps

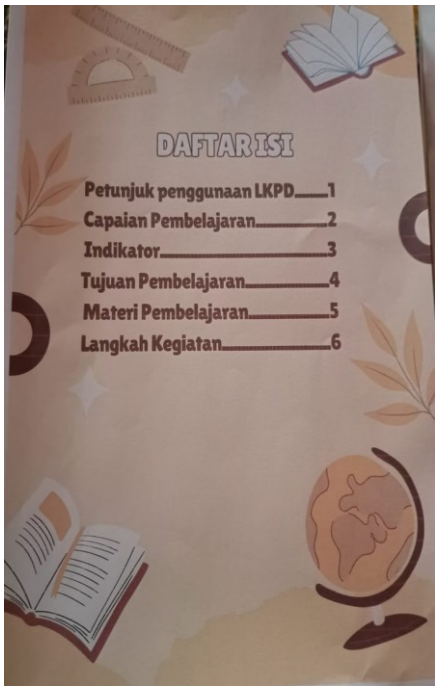

Figure 3. Table of Contents LKPD

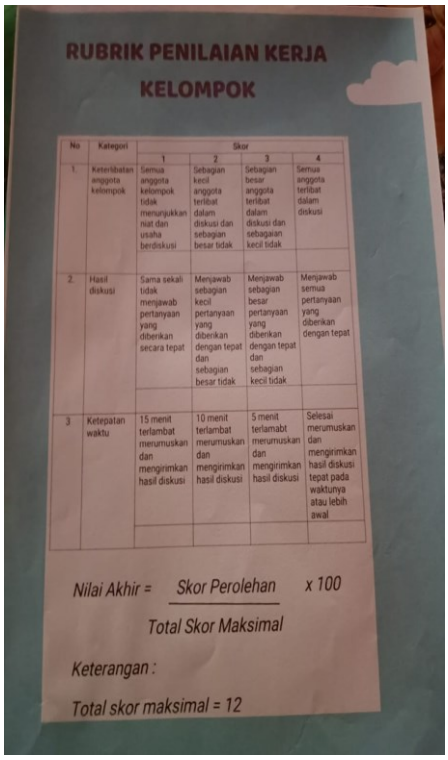

Figure 4. Group Work Assessment Section

This appendix shows the quality of the design, presentation structure, and suitability of the content of the LKPD that has been assessed by experts. This visual evidence and validation documents reinforce that the LKPD truly meets the eligibility criteria

as teaching material before being implemented in the classroom. The appendix also provides detailed information on the strengths and areas for improvement identified during the validation process. Through this documentation, readers can clearly observe how expert feedback contributed to the refinement of the LKPD. In addition, the appendix serves as supporting evidence to ensure transparency and credibility of the research findings. Thus, the inclusion of this appendix strengthens the trustworthiness of the developed LKPD as a validated learning resource.

Practicality of LKPD

The practicality of the LKPD was tested through questionnaires completed by teachers and students after the LKPD was used in the learning process. The questionnaires were designed to capture users' perceptions regarding the ease of use, clarity of instructions, and suitability of the LKPD with classroom learning conditions. Teacher responses focused on the feasibility of implementing the LKPD within the allocated learning time and its compatibility with the Jigsaw learning model. Meanwhile, student responses reflected their level of understanding, interest, and comfort when using the LKPD during group activities. The results of these assessments provide important insights into the usability of the developed LKPD in real classroom settings. A summary of the practicality test results can be seen in Table 2.

Table 2. Practicality Questionnaire Results of the LKPD

Respondents	Average Score	Percentage	Category
Teacher	3.7	92.5%	Very Practical
Students	3.6	90.0%	Very Practical

The teacher response score of 92.5% indicates that the LKPD provides substantial support in classroom implementation. Teachers reported that the LKPD increases time efficiency because instructions and tasks are already organized systematically, reducing the need for lengthy explanations. In addition, the clearly printed Jigsaw steps make it easier for teachers to manage group activities, ensuring that the flow of learning remains structured and controlled. The LKPD also assists teachers in delivering material more effectively, as it contains examples and guided exercises that align with the learning objectives, thus minimizing the need for teachers to prepare additional resources. From the students' perspective, the practicality score of 90% demonstrates that the LKPD offers several benefits that positively affect their learning experience.

Students felt more engaged because the activities encouraged interaction and active participation within their groups. The explicit and concise instructions, complemented by supportive illustrations, made it easier for students to understand each step of the activity. Moreover, the LKPD fostered greater independence, allowing students to complete tasks more confidently, especially during expert-group discussions in the Jigsaw model. These findings are consistent with Uno's (2012) explanation that effective learning media should simplify the tasks of both teachers and students. They also reinforce the results of Dewi Sekar's (2024) study,

which found that Jigsaw-based LKPD received high practicality ratings due to its ability to promote collaborative learning and meaningful student engagement.

The practicality of the LKPD implementation is further illustrated through classroom documentation. Figures 5 and 6 show students actively using the LKPD during mathematics learning activities, while Figure 7 depicts the Jigsaw group activity in which students collaborate and share understanding within their groups. These visual representations support the questionnaire results by demonstrating students' engagement, interaction, and active participation throughout the learning process. In addition, the images indicate that students are able to follow the learning instructions independently with minimal guidance from the teacher. This suggests that the LKPD is practical and easy to use in real classroom settings.

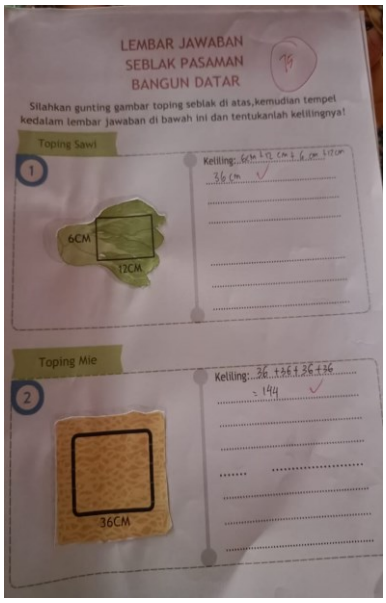

Figure 5. Use of LKPD in the Classroom

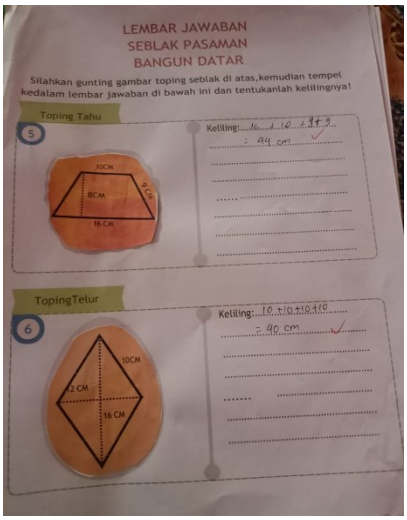

Figure 6. Use of LKPD in the Classroom

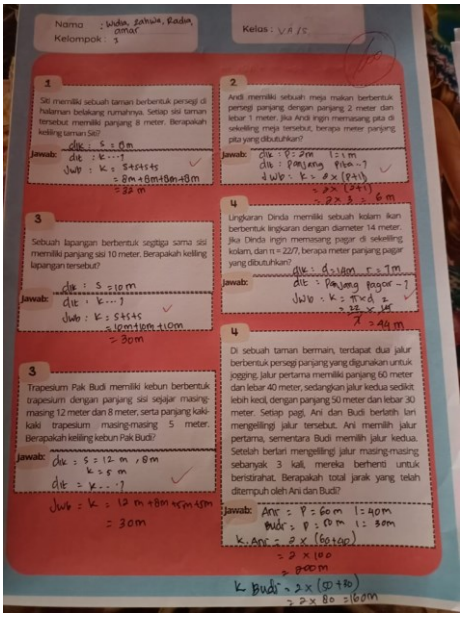

Figure 7. Jigsaw Group Activity

This appendix shows how LKPD is used in the learning process. Photos of student participation show that LKPD is not only practical to use, but also creates an active, enjoyable learning atmosphere that is easy for both students and teachers to understand. The documentation illustrates students' involvement in completing tasks, discussing materials, and sharing ideas within their groups. It also reflects the smooth implementation of the Jigsaw learning model supported by the LKPD. Furthermore, the appendix provides visual evidence that students are able to engage collaboratively and independently during the learning activities. Thus, these photographs strengthen the findings of the practicality test results.

Effectiveness of LKPD

The effectiveness of the LKPD was measured through the improvement of students' mathematics learning outcomes. Students were given a pretest to assess their initial understanding of the material before the implementation of the LKPD. After the learning activities using the Jigsaw-based LKPD were completed, a posttest was administered to measure changes in students' achievement. The comparison between pretest and posttest scores was used to determine the extent to which the LKPD contributed to learning improvement. The results of the tests before (pretest) and after (posttest) using the LKPD are presented in Table 3.

Table 3. Student's Learning Outcomes (Pretest and Post**test)**

Category	Number of Students	Percentage
Pretest		
Achieved (≥ 75)	7	35%
Not Achieved (< 75)	13	65%
Posttest		
Achieved (≥ 75)	16	80%
Not Achieved (< 75)	4	20%

The increase from 35% to 80% mastery demonstrates a significant improvement in students' learning outcomes, indicating that the combination of LKPD and the Jigsaw model effectively enhances mathematical understanding. This improvement can be attributed to several interconnected factors. The Jigsaw model requires students to actively engage by explaining material to their peers, a process that deepens conceptual understanding because students must reorganize information and articulate ideas clearly, as emphasized by Schunk (2012). Additionally, the structured activities provided in the LKPD support this process by guiding students step by step, enabling them to focus on collaborative learning and problem-solving. The social interaction inherent in the model acts as a cognitive stimulus, encouraging students to construct knowledge more meaningfully.

In addition, the structured design of the LKPD supports step-by-step problem solving, making mathematical concepts more accessible and reducing anxiety often associated with mathematics. The Jigsaw structure also ensures equitable participation, as each student is responsible for mastering and teaching a specific subtopic, preventing passive involvement. These findings align with the results of Masruroh (2024), who reported that Jigsaw-based LKPD significantly improves students' conceptual comprehension in mathematics, as well as Dewi Sekar (2024), who found that such LKPD increases student motivation and learning achievement. More broadly, the results reinforce cooperative learning theory, which states that active, student-centered learning environments foster better retention, deeper understanding, and improved academic performance.

4. Conclusion

This study produced a product in the form of a student worksheet designed using the Jigsaw learning model for fifth-grade mathematics in elementary school. The product underwent several stages of testing, namely expert validation, practicality testing through teacher and student responses, and effectiveness testing based on the learning outcomes achieved. Several important findings were obtained from this series of tests. First, the Jigsaw-based LKPD developed was declared highly valid by the validators, indicating that the content, design, and suitability of the material to the basic competencies were appropriate for use in learning activities. Second, in terms of practicality, this LKPD received very positive responses from teachers and students due to its ease of use, clarity of instructions, and relevance of the material to learning needs. Third, in terms of effectiveness, Jigsaw-based LKPD proved to be able to improve student learning outcomes, as seen from a significant increase in the percentage of learning completeness from 35% on the pretest to 80% on the posttest. Thus, it can be concluded that this Jigsaw-based LKPD is feasible, practical, and effective for use as an alternative learning medium for mathematics in elementary schools, and it is hoped that it can enrich the variety of learning strategies and contribute to improving the quality of the learning process, especially in mathematics.

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