

## VALIDITY AND PRACTICALITY OF ENGINEERING DESIGN THINKING-BASED STUDENT WORKSHEETS

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### Abstract

This study aims to determine the validity and practicality of Engineering Design Thinking (EDT)-based Student Worksheets (LKPD). The research employed a development research method using three of the four stages in the 4D (Four-D) development model, namely define, design, and develop. The research subjects consisted of one teacher and 29 students in the implementation class. The instruments used included expert validation sheets and practicality questionnaires. The results showed that the validity score of the LKPD reached 88.61%, which falls into the "very valid" category. The practicality score based on the teacher's assessment averaged 87.5%, while the students assessment averaged 85.3%, indicating a high level of practicality. Therefore, it can be concluded that the developed Engineering Design Thinking-based LKPD meets the criteria of being valid and practical for use in the learning process.

**Keywords:** Student Worksheets (LKPD), Engineering Design Thinking (EDT), Validity, Practicality.

### INTRODUCTION

In 21st century education, the demand to form a generation that not only masters theoretical knowledge, but also has critical, creative, collaborative, and communicative thinking skills is increasing (Siswanto & Rahayu, 2025). The role of mathematics education is very important for building skills. Mathematics is seen as a means to train students in analyzing problems, making decisions, and applying knowledge in various situations in real life. However, the traditional teaching approach which tends to be teacher-centered, and problem-solving and formula memorization, is often less effective in preparing students to face the challenges of the 21st century (Siswanto & Rahayu, 2025) which should be the main focus in today's education. One effort to overcome this is the Student Worksheet (LKPD).

LKPD is one of the learning tool instruments that is often used in the learning process in the classroom by teachers (Wulandari et al., 2022) According to the opinion of (Sundari et al., 2022) LKPD is

defined as teaching materials that contain summaries and instructions for implementing a task that refers to the basic competencies that must be achieved. Based on the findings that the LKPD currently used is still simple and has not included phenomena that encourage investigation and problem-solving activities (Ardana et al., 2022). This condition causes the LKPD in circulation to only contain a list of questions without a literacy process that encourages the growth of critical thinking in students (Briyanti et al., 2020) In addition, many educators have not integrated 21st century skills in the use of LKPD, so that it becomes a factor in the low critical and creative thinking skills of students (Ina Sukmawati, 2023). This condition shows the need to develop LKPD that is innovative and in accordance with the demands of modern learning.

One approach that can be integrated is Engineering Design Thinking (EDT). EDT in mathematics learning is an approach that integrates the design process to help students develop critical thinking and creative problem-solving skills (Li et al., 2019). This

process involves a series of systematic steps such as identifying problems, brainstorming, designing, building, testing, revising, and sharing solutions that train students' ability to solve problems in real-world contexts (Nuraini, 2020). In general, the stages in EDT include *empathize, define, ideate, prototype, and test* which allow students to be actively involved in designing solutions to a problem (Naufal, 2022). Conceptually, these stages are aligned with Polya's problem-solving steps. According to Polya, there are four steps in solving a problem: 1) understanding the problem, 2) devising a plan, 3) carrying out the plan, and 4) checking back (Aini & Rosyidi, 2023).

Despite its similarities, EDT provides reinforcement for polyah. Polyah tends to be linear and focuses on problem solving. Previous research explains that solving a problem using Polya's stages is very effective for students, making it easier for students to solve a problem and reducing negligence or errors made when solving a problem (Pradana, 2024). Therefore, EDT is more interactive and emphasizes a creative and contextual solution design process that allows students to explore various possible solutions through the application of basic science, mathematics, and engineering concepts to achieve predetermined goals (Ulum, 2021). Through these stages, students are trained to analyze problems, formulate hypotheses, and propose solutions that are then tested using theory and modeling to ensure the solution's effectiveness (Widana & Sopandi, 2021). In the context of learning, EDT is a method for developing innovative solutions to complex problems by explicitly incorporating human values into the design process (Rosyda et al., 2020). This approach focuses on a deep understanding of users to create solutions that are not only functionally effective, but also meet their needs and desires (Riyadi et al., 2024).

Although the EDT approach has begun to be applied in learning, one of the studies (Sofiyana, 2021) designed mobile-based media on traditional Indonesian theater material. Research that specifically develops and tests EDT LKPD from the aspects of validation and practicality is still limited.

However, a development product

cannot be immediately declared fit for use without going through a quality testing process. The developed LKPD requires validation and practicality testing. Validation is needed to determine its suitability and suitability to student needs. In addition, validation is needed to identify weaknesses and deficiencies in the LKPD before use (Sofiyana, 2021). Practicality is the average of four aspects tested, namely: ease of use, learning time efficiency, attractiveness, and usefulness. The ease of use aspect meets the practical criteria by teachers and meets the very practical criteria by students. LKPD is expected to facilitate teachers in implementing learning. LKPD is designed to help teachers in carrying out the learning process more easily. On the other hand, students are expected to be able to learn independently, understand the material, and complete written assignments (Sofiyana, 2021). These two aspects are important indicators in determining the feasibility of a development product.

Although the EDT approach has a strong theoretical basis, the quality of the developed student worksheets (LKPD) still needs to be tested before being used in learning. Therefore, a validity test is needed to ensure the suitability of the content, construct, language, and presentation, as well as a practicality test to determine ease of use and implementation in learning. Based on this, this study aims to validate and test the practicality of the EDT-based student worksheets to obtain valid and practical products for use in mathematics learning.

## METHOD

This research is a Research and Development (R&D) development study, which aims to produce a valid and practical traditional woven Engineering Design Thinking (EDT) based Student Worksheet (LKPD) in mathematics learning. This research uses the Thiagarajan or 4D development model (Khadijah et al., 2022). The 4D model includes four stages of development, namely *define, design, develop, and disseminate* (Siregar et al., 2025). However, due to the limitations of the researcher, only three stages were used, without carrying out the dissemination stage (Nisfiyah et al., nd The researcher decided to use the 4D

development model because the model was considered easy to understand and suitable for the researcher's needs. At the definition stage (*Define*), the decision-making process and determining definitions in learning begins by analyzing the objectives of the material that are adjusted to predetermined limitations. Planning includes a needs analysis conducted through interviews and observations to identify difficulties in learning geometry.

*design* stage is the process of designing a picture of the learning device, including the preparation of learning objectives, the design of the structure and appearance of the LKPD, the preparation of EDT-based learning activities in the context of traditional weaving, the integration of the context of traditional weaving into mathematics learning and the design of research instruments in the form of validation sheets and response questionnaires. The development *stage* includes the development stage of the LKPD product that has been designed in the previous stage. At this stage, the LKPD product is made, validated by experts, and the product is revised based on input and comments from experts. This validation is carried out to assess the feasibility of the LKPD from the aspects of content feasibility, presentation, language, graphic feasibility, appearance and application based on traditional woven EDT. The questionnaire sheet contains question items or statements, with answer choices in the form of numeric scores based on a Likert scale. Scores range from 1 to 4, where 1 is the lowest value and 4 is the highest value.

The percentage of the results of the formula will later be evaluated using validity standards to assess whether the product that has been examined is suitable for use. This validation is carried out to determine the level of validity of the developed LKPD. Furthermore, the revised product is tested for its practicality through student responses. This research was conducted at SMP N 7 Bengkulu City, in the even semester of the 2025/2026 academic year. The research subjects consisted of expert validators, namely lecturers and teachers who are competent in the field of mathematics education and learning media, whose role is to assess the validity of the LKPD and student

response questionnaires. Students are class 7D students who play a role in providing responses to the developed LKPD.

Based on the research flow outlined above, the research benchmark begins with the need for an EDT-based Student Worksheet (LKPD) that aligns with current curriculum demands and conditions. EDT-based LKPD is one of the alternatives chosen due to its advantages and ease of use. This research is limited to the development stage, and dissemination has not yet been conducted.

## RESEARCH RESULTS AND DISCUSSION

In this development, a product was produced in the form of interactive LKPD teaching materials based on traditional woven EDT by taking mathematics subjects with a material focus on the discussion of geometry and geometric transformations in grade VII. In developing this teaching material, a 4D or Thiagarajan model was used which went through several stages of *Define, Design, Develop, and Dissemination*, but this researcher was limited to the *Develop* stage which is presented in detail as follows:

### 1. *Define* Stage

In this stage, the author conducted observations and evaluations at SMPN 7 Bengkulu City by collecting information in the form of problems faced during the learning process so that researchers could design an appropriate product so that these problems could be overcome. Information obtained through interviews with a mathematics teacher from SMPN 7 Bengkulu City.

#### a) Initial analysis

Based on information from interviews, the learning that has been going on up to now is too much controlled by teachers. Teachers still apply traditional classical teaching methods, such as conveying ideas or steps with minimal question-answer interaction, showing example problems, and providing practical assignments. The use of LKPD in mathematics learning related to ethnomathematics has never been made by teachers. Therefore, the solution to this problem to support the learning process of teachers and students is to develop LKPD

teaching materials on geometry and geometric transformations that are linked to the culture around students, namely in the form of woven crafts.

b) Student analysis

Researchers also analyzed the characteristics of students, especially those in class VII D of SMPN 7 Kota Bengkulu. Some students in class VII D already have initial knowledge about geometric shapes when they were still in elementary school. Students' knowledge of basic geometric concepts is very important as a foundation in studying geometry material in class VIII, especially on the topic of geometric translation and transformation. Therefore, the learning activities presented in the LKPD are designed to encourage students to build their understanding independently by understanding geometric concepts with the initial knowledge they already have.

c) Task analysis

At the task analysis stage, the task is to provide tasks to be carried out by students on the geometry and geometric transformation material which is given in accordance with the achievement indicators and basic competencies in the material and can develop students' thinking skills.

d) Concept analysis

Through this LKPD, students are also guided to learn mathematics in the context of traditional weaving, so that the concepts of geometric translation and transformation can be understood more concretely and meaningfully. Challenges faced by students when learning plane figures include difficulty remembering the formulas for the area and perimeter of plane figures. In addition, students often misunderstand the difference between the area and perimeter formulas for constructing certain data. Each student has unique characteristics. During the learning process, some students are brave, but others are shy. Some students do not fully understand the material, but are reluctant to ask questions. This results in students not being accustomed to constructing their own knowledge and solving problems (Hasibuan et al., 2026).

2. Design Stage

Based on the results of initial

observations, the need to develop teaching materials for teachers to support the learning process in the classroom was identified. One of the learning innovations that can be implemented is the Student Worksheet (LKPD), especially LKPD in the context of traditional weaving using the EDT approach, which involves engineering design thinking processes such as *empathize, define, ideate, prototype, test* in making traditional weaving. The planned structure of all LKPD components developed by the researcher is as follows: This stage is intended to compile an initial plan for the LKPD learning aids. The processes involved in the design phase also include.

Researchers developed a basic plan that resulted in an initial prototype of the Student Worksheet (LKPD) using a descriptive quantitative approach using the 4D method. The LKPD was created in two main segments: the introduction and the core section. The introductory segment includes the front page; copyright page; description of core competencies, indicators, learning targets, and completion guidelines. Meanwhile, the core segment contains activities that follow the EDT stage. The following is an illustration of some of the elements in the LKPD.

3. Develop Stage

The validation process is carried out to assess the feasibility of the LKPD. In this activity, validators are involved in determining the feasibility score. The assessment results, suggestions, and input from the validators are then used as the main basis for revising and improving the quality of the LKPD. The instrument used is a design validation questionnaire. The validation of the LKPD based on traditional woven EDT aims to facilitate

critical thinking skills, carried out by two validators. Para

The validator covers aspects such as the suitability of content, presentation, language, graphic suitability, appearance, and implementation.

Based on the table above, the validation results obtained, it can be seen that a score of 371 has been obtained from a maximum score of 420 with a feasibility

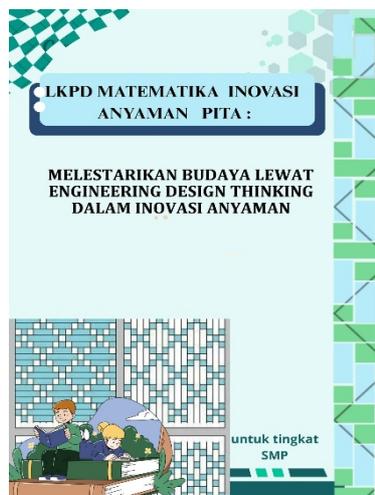
percentage of 88.61%. The value obtained from validation by the validator is in accordance with the criteria that have been set, so the LKPD is included in the very valid criteria and is suitable for use in the learning process. These results indicate that the LKPD developed has met quality standards, both in terms of language, design, and its suitability with the EDT approach. During the validation process, the researcher received suggestions from the validator for slight improvements. Some suggestions and input provided by the validator include: the product that has been designed is validated by expert lecturers according to their fields. The teaching materials provided to the validator at the development stage have been changed

according to feedback from the validator. The suggestions and feedback provided by the validator are presented in.

**Table 1.** Validator suggestions and feedback

No	Expert Name	Expert Advice
1.	Expert I	<ul style="list-style-type: none"> <li>On the cover, there is no information provided about what learning this LKPD is for and the sentence "mathematics learning" has been revised to "Anayaman innovation"</li> <li>It is necessary to add problems that students will solve at the empathize stage and add woven images at the empathize stage.</li> <li>Improvements in the define stage in the problem formulation section</li> </ul>
2.	Expert II	It is ready to use

Based on the validation results, the researchers revised the product they developed based on the validator's suggestions and input. The following shows the *design* after the product revisions.



**Figure 1 . .** EDT-Based LKPD Front Page *Design*

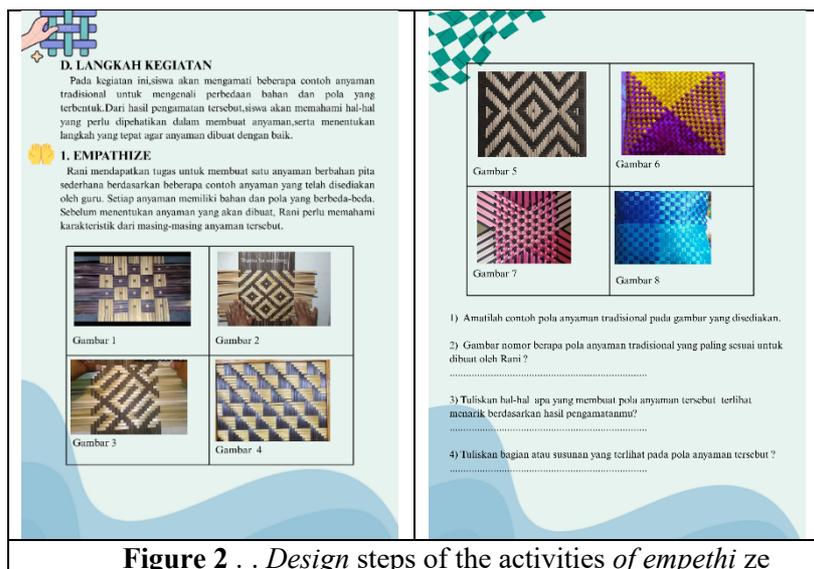


Figure 2 . . Design steps of the activities of *empathize*

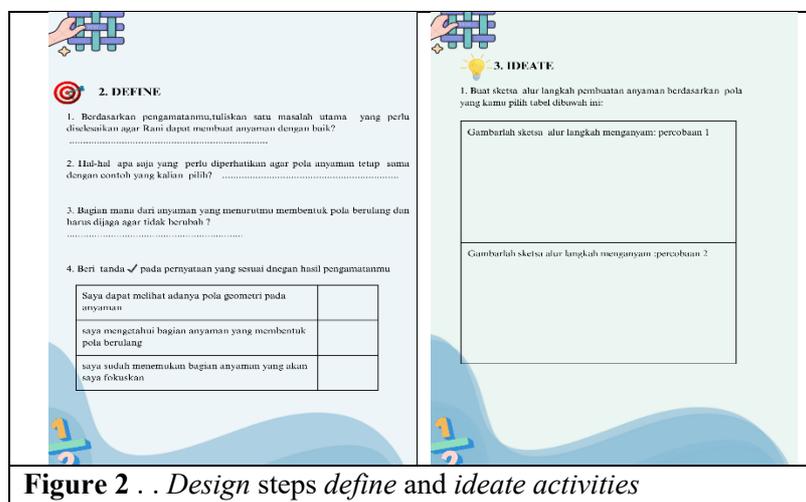


Figure 2 . . Design steps *define* and *ideate* activities

After the student worksheets were revised based on the validator's suggestions and comments, the next step was to conduct a field test. The researchers conducted the field test at SMPN 7, Bengkulu City. The subjects were 29 students and one mathematics teacher. The field test was conducted in a seventh-grade classroom at SMPN 7, Bengkulu City. The field trial was conducted in 3 meetings, at the first meeting a brief explanation of traditional weaving was given, the second meeting was given LKPD in the context of Traditional Weaving and students were asked to complete the LKPD up to the steps of the *empathize, define, and ideate stages* , the third meeting students continued the activities of the *prototype and test stages* . The material was presented by providing 8 pictures of weaving, which were related to the material in order to be able to increase students' interest. After the LKPD was improved according to the validator's suggestions and comments. For the validation of the feasibility of the content, 82.2% was obtained in the very valid category.

The results of the presentation validation obtained 83.3% in the very valid category. The results of the linguistic validation were 92% in the very valid category. The results of the Graphic Feasibility validation obtained 90% in the very valid category. The results of the Display validation obtained 87.1% in the very valid category. The results of the application validation obtained 92% in the very valid category. The linguistic validity of EDT-based teaching materials is categorized as very valid because the sentences in EDT-based teaching materials follow the rules of Indonesian grammar. The ideas in EDT-based teaching materials are structured in an orderly manner, the language used in EDT-based teaching materials is simple and takes into account the level of development of students.

Systematically, starting from understanding the instructions for use to following the steps for making traditional weaving. This activity triggers the activeness of students, especially for those who previously did not understand the material, to discuss how to weave and determine the arrangement of the weave to form geometric patterns such as translation or transposition. After the weaving activity was completed, students were given a questionnaire on the practicality of the LKPD they had done. to evaluate their learning experience. The data from the questionnaire was then analyzed to obtain an overview of the practicality of students towards the LKPD with the EDT approach. This aims to measure the extent to which the integration of weaving culture and mathematical concepts of Geometry and geometric transformation can help students understand the material through real products that are developed.

Then the validity of the graphical feasibility has also met the very valid category because the text can be read well, the selection of background graphics is very appropriate, and the colors and graphics are very appropriate. The type of font used is appropriate so that the writing can be read well, and the supporting images are in accordance with the material. The clarity of the instructions on the EDT-based teaching materials and ease of use. Based on the validity results, it was obtained that this EDT-based teaching material is in accordance with the provisions and is valid for use in the learning process.

In the practical stage, it was carried out through the distribution of questionnaires to educators and students who had previously practiced the use of Engineering Design Thinking (EDT)-based LKPD. This practicality test involved experienced educators and 29 students. The overall average score obtained from the educator questionnaire was 87.5% while from the student questionnaire it was 85.3% from the student questionnaire with the practical category. This shows that this EDT-based LKPD is considered valid and practical by educators and students. The development of EDT LKPD is able to ease the task of teachers in preparing learning while answering the needs of the digital era with the pressure of innovative

technology. The developed EDT LKPD has a validity score of 8.66%, which is very valid, making it worthy as an attractive alternative learning resource. The EDT approach supports creative problem solving, in accordance with the needs of 21st-century learning.

## CONCLUSION

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