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Validity of Student Worksheets Based on Ethno-STEM Material on Volume of Rotating Objects

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ABSTRACT

This research aims to produce a valid Ethno-STEM-based student worksheet product with a rotating object volume material so that it is suitable for use in learning. Ethno-STEM is an innovation in mathematics learning that combines an ethnomathematical approach with a STEM approach. The research method used is Research and Development (R&D) with a 4-D development model which is modified to 3-D due to limited research time. The development stages are the defining, design, and development stages. In this research, only a product validation test was conducted. The instrument used is a validation sheet to measure the product feasibility. The result of this study indicates that the developed student worksheet product meets the very feasible criteria with an overall average of 87,11 %. This shows that the product of developing an Ethno-STEM-based student worksheet with a rotating object volume is possible and feasible to use in learning mathematics.

Keywords: *Student Worksheet, Ethno-STEM, Rotating Object Volume*

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INTRODUCTION

Mathematics is one of the compulsory subjects studied from elementary school level to college level. Because mathematics has an important role in various fields and is the basis for other sciences (Jaya et al., 2019). Mathematics is also a very important subject because it contains applied aspects and reasoning that play a role in science, technology, and culture (Fatoni & Septiadi, 2021). According to Fathani (Edi & Nayazik, 2019) Mathematics is basic knowledge that is the foundation for the development of science and technology. However, there are still many students who find mathematics difficult to learn. So that mathematics teachers have the task of striving for the success of mathematics learning by using certain learning approach methods that can change students' assumptions and mindsets towards mathematics.

In mathematics learning, teachers are encouraged to create an interesting and enjoyable learning atmosphere. A good teacher is a teacher who is able to use a variety of learning resources and not only use textbooks in delivering material (Astuti & Sari, 2017). Mathematics material will be easier to accept and understand if it is packaged in interesting content, so as to arouse students' interest in understanding the material in depth. Lack of learning motivation and level of student understanding are problems that are often encountered in mathematics learning which result in low student learning outcomes. Mathematics learning activities can be said to be successful if student learning outcomes achieve optimal results (Arifin & Sepriyani, 2019). Therefore, mathematics teacher creativity is needed in delivering material. One effort that can be made is by using an ethnomathematics approach.

Ethnomathematics is an integration between mathematics and local cultural wisdom (Royani & Agustina, 2017). By connecting local cultural wisdom with mathematics learning materials, it is expected to attract students' interest in learning mathematics, thereby facilitating understanding of the material (Silvia, 2019). In addition, the application of the ethnomathematics approach can be used by mathematics teachers as a means of introducing local culture to students and is expected to foster a sense of love for their own culture. Culture-based learning allows teachers and students to actively participate in learning based on the local culture they know, so that the learning outcomes obtained will be optimal (Setiana & Ayuningtyas, 2018). However, there are some mathematics learning materials that cannot be juxtaposed with culture. Thus, the ethnomathematics approach is still not widely applied by teachers.

In today's era of technological development, teachers are required to be able to utilize technology in learning activities. From these problems, teachers can apply the STEM learning approach. Learning with the STEM approach is a combination of science, technology, engineering, and mathematics that can help students analyze and solve a problem and be able to know the relationship between one problem and another (Ilyas, 2020). In addition, learning with the STEM approach can be applied to improve students' ability to relate the knowledge of the material obtained to everyday life (Aldila et al., 2017). Through the STEM learning approach, students not only understand the concept of the material but also understand how to relate the material learned in everyday life (Simatupang et al., 2020). After

knowing the importance of ethnomathematics and STEM, an innovation emerged that could make mathematics learning interesting, namely the Ethno-STEM approach.

Ethno-STEM is a combination of ethnomathematics learning approaches with STEM approaches. Ethno-STEM based on local culture will produce interesting learning, so that it will be more memorable for students (Sudarmin et al., 2019). The collaboration between ethnomathematics and STEM approaches is an innovation that allows a culture not only to be viewed from a mathematical perspective, but also from a scientific, technological, and engineering perspective (Ilyas, 2020). The application of Ethno-STEM is expected to support mathematics learning in terms of increasing learning motivation, understanding of the material and problem-solving abilities of students. Haggarty and Keynes (Fitriani & Saragih, 2017) stated that to improve mathematics teaching and learning, efforts are needed to improve the understanding of teachers, students, and the materials used for learning and the interactions between them. This shows that the development of teaching materials is needed in an effort to realize the success of mathematics learning.

Teaching materials are one of the important factors in the success of the learning process because they affect student learning outcomes (Aldila et al., 2017). There are several teaching materials that can be used in learning, including; modules, Student Worksheets (LKS), textbooks, and other teaching materials (Widodo et al., 2021). One of the teaching materials that is often used in schools is the Student Worksheet which is now often called the Student Worksheet. The Student Worksheet (LKPD) is a sheet containing brief material and a collection of assignments that are worked on by students along with instructions and steps to complete them. LKPD is one of the learning resources that can facilitate teachers in the learning process and help students be independent and increase interest and activeness in completing learning tasks given by teachers (Warni et al., 2022). The use of LKPD can train students to learn independently and solve problems independently by developing the concept of the material that has been obtained (Aprilianti & Astuti, 2020).

The development of this LKPD contains the material on the volume of rotating objects which is part of the main material on integrals and is one of the materials taught at the high school level. Integral material is very important to be mastered since high school because it is the basic material in learning mathematics at the college level (Wahyuni et al., 2019). Initial abilities in understanding integral material must be explored so that students can more easily understand the learning material on the volume of rotating objects related to integrals (Rahmi et al., 2020). However, there are still many students who find it difficult to understand the material on the volume of rotating objects. This is because students' conceptual understanding is still lacking and they have difficulty in understanding the steps to solve and applying them to practice questions related to the volume of rotating objects. By developing an Ethno-STEM-based Student Worksheet with the material on the volume of rotating objects, it is hoped that it can help facilitate students and teachers in the process of learning mathematics activities, especially on the material on the volume of rotating objects. Ethno-

STEM is something new and interesting and has not been widely researched, thus encouraging researchers to try to conduct research related to Ethno-STEM.

METHOD

This research is a type of research and development or called Research and Development (R&D). This study aims to produce teaching material products in the form of Student Worksheets (LKPD) based on Ethno-STEM with the material of the volume of rotating objects. The development model used is the 4-D development model (Four-D) developed by Thiagarajan, Semmel, and Sammel (1974) and modified into 3-D. According to Trianto (Rahmawati et al., 2019) the 4-D development model is a model that can be used to develop learning devices. The 4-D development model in this study was modified into 3-D, so that the stages carried out were limited to the development stage (Develop). The dissemination stage (Disseminate) could not be carried out in this study due to time constraints.

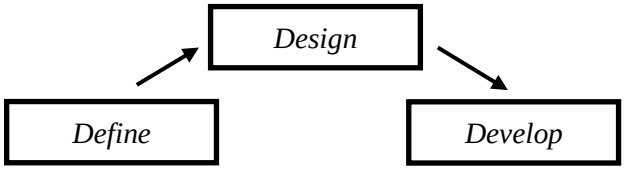


Figure 1. Research Stages Flow

The data collection technique used is an assessment instrument to measure the feasibility of the product in this study, namely in the form of a LKPD validation sheet to measure the feasibility of the LKPD product. In this study, only product validation tests were carried out by experts and product improvements were made. The data analysis technique applied is qualitative descriptive data analysis. The data obtained from the validation instrument is in the form of quantitative data. which is then processed to determine the level of validity of the LKPD product being developed.

Table 1. Product Validity Criteria

Skor	Criteria
0% - 39%	Very Less Eligible
40% - 55%	Less Eligible
56% - 65%	Quite Eligible
66% - 79%	Eligible
80% - 100%	Very Eligible

Source: (Destino et al., 2019)

RESULTS AND DISCUSSION

The product developed is an Ethno-STEM-based Student Worksheet with the material of rotating object volume. The development process applies a 4-D development model by carrying out stages that are limited to the Develop stage. Thus, only 3 stages were carried out in this study. The results of the stages of development research are as follows:

Define Stage

The Define stage is the initial stage in this development research. At this stage, an analysis is carried out to identify problems and learning needs. There are 5 steps of analysis at this stage,

• Front-End Analysis, researchers view LKPD as one of the important teaching materials for use in learning activities in schools and is very relevant to the 2013 curriculum, so it is necessary to develop a LKPD that can help teachers in delivering material and encourage learning interest and student activity due to lack of participation and interest in learning mathematics.

• Student analysis, it is known that students consider LKPD more practical to use than other printed books and there are problems that must be solved by students that can help in understanding the concept of the

material. In addition, there are still many students who have difficulty in determining the solution to the volume of a rotating object using definite integrals and difficulty in describing a rotating object.

• Task analysis, where researchers analyze the basic competencies that must be achieved by students in the main material of the volume of rotating objects according to the 2013 curriculum by being given a problem related to the real world. The tasks given are in the form of activities or descriptive questions that must be done to train students' skills in solving a problem.

• Concept analysis, identifying the concept of the material on the volume of rotating objects and basic competencies and competency standards in accordance with the 2013 curriculum.

• Analysis of the formulation of objectives, it was found that the objectives achieved must refer to the indicators of competency achievement in the material on the volume of rotating objects.

Design Stage

In the design stage, the researcher makes an initial draft of the Student Worksheet referring to the previous stage. The design of the Ethno-STEM-based Student Worksheet with the material on the volume of rotating objects is adjusted to the LKPD compilation format. The design of the LKPD and the layout of the writing and images are considered so that they can attract students' enthusiasm for the material. The contents of the LKPD are adjusted to the basic competencies of the material on the volume of rotating objects that will be achieved by students who are developed based on Ethno-STEM. Pay attention to the use of language in the LKPD by adjusting the level of students' abilities so that the information provided can be received well and clearly.

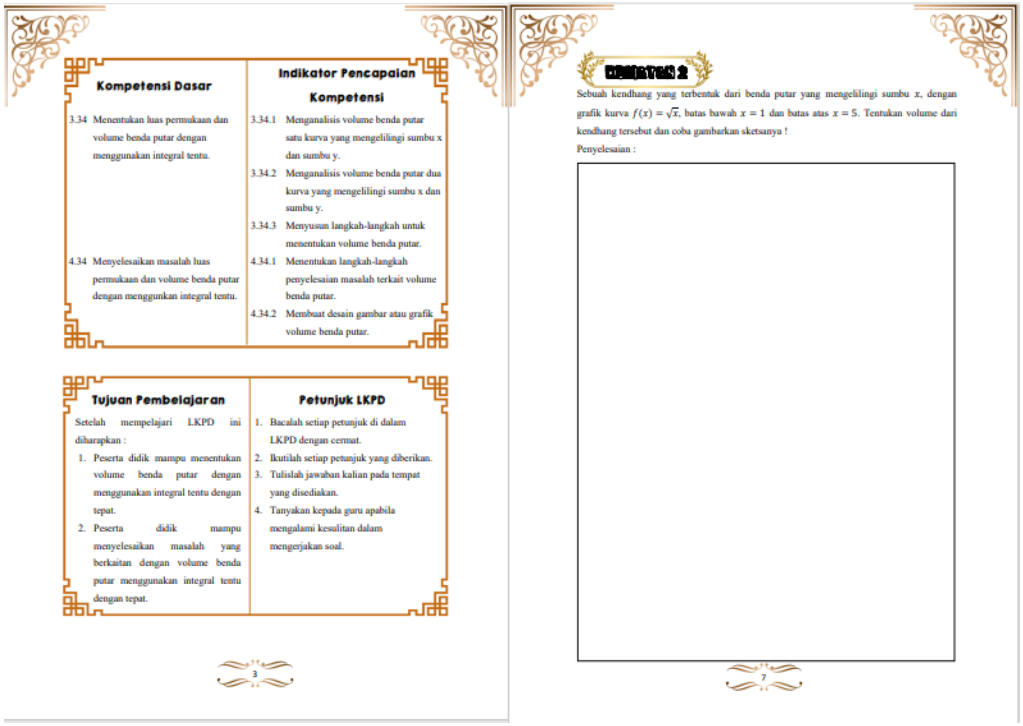


Figure 2. Initial Design of Ethno-STEM Based Student Worksheet

Development Stage (Develop)

The development stage consists of two steps, namely expert assessment and development trial. In this study, only expert assessment was carried out and could not carry out a development trial that included a test of practicality and product effectiveness. Expert assessment was carried out by submitting the initial draft of the LKPD and validation instruments to the validator, namely a mathematics education lecturer and a grade XII high school mathematics teacher. The validators consisted of two material experts. This expert assessment aims to determine the validity of the product and suggestions and input from experts on the LKPD being developed so that the product is more appropriate and feasible to use.

The data from the expert assessment results were then analyzed to determine the feasibility criteria of the LKPD product being developed. This study used qualitative descriptive data analysis techniques. After obtaining the results of the feasibility assessment, improvements were made to the LKPD product according to the suggestions and input from each validator to produce the final design of the LKPD product.

Table 2. Validity Assessment Results

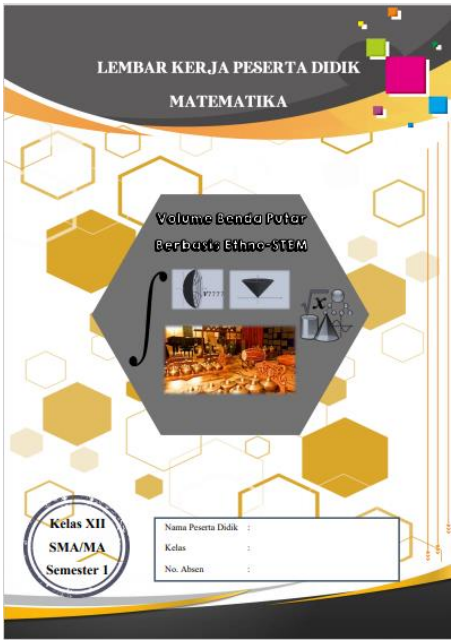
No.	Assessment Indicators	Skor	Criteria
1.	Component Completeness	85,56 %	Very Worthy
2.	Content Suitability	84,55 %	Very Worthy
3.	Language	88,33 %	Very Worthy
4.	LKPD Appearance	90 %	Very Worthy
Presentation		**87,11 %**	**Very Worthy**

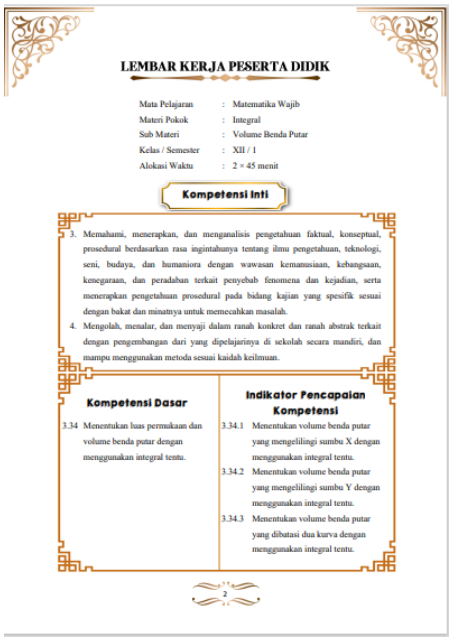
Based on the results of the feasibility assessment, the overall average percentage was 87.11%, indicating that the Ethno-STEM-based Student Worksheet with the material on

the volume of rotating objects developed met the criteria of being very valid and feasible for use in mathematics learning. After the validation assessment, there were suggestions and input from the validator. The researcher made improvements to the LKPD product that was developed to produce the final design or final LKPD.

Table 3. Suggestions for Improvement of Final LKPD Results

Assessor	Before Revision	After Revision
Validator I	It would be even better if STEM was included in the instructions for using LKPD to solve problems in each activity in LKPD.	Bringing up STEM in the LKPD usage instructions for solving problems in every activity in the LKPD.
Validator II	The problem-solving area should be provided with lines or boxes (not empty/plain) to make it easier for students to sketch the image.	Adding checkered lines in the work area makes it easier for students to sketch rotating objects.





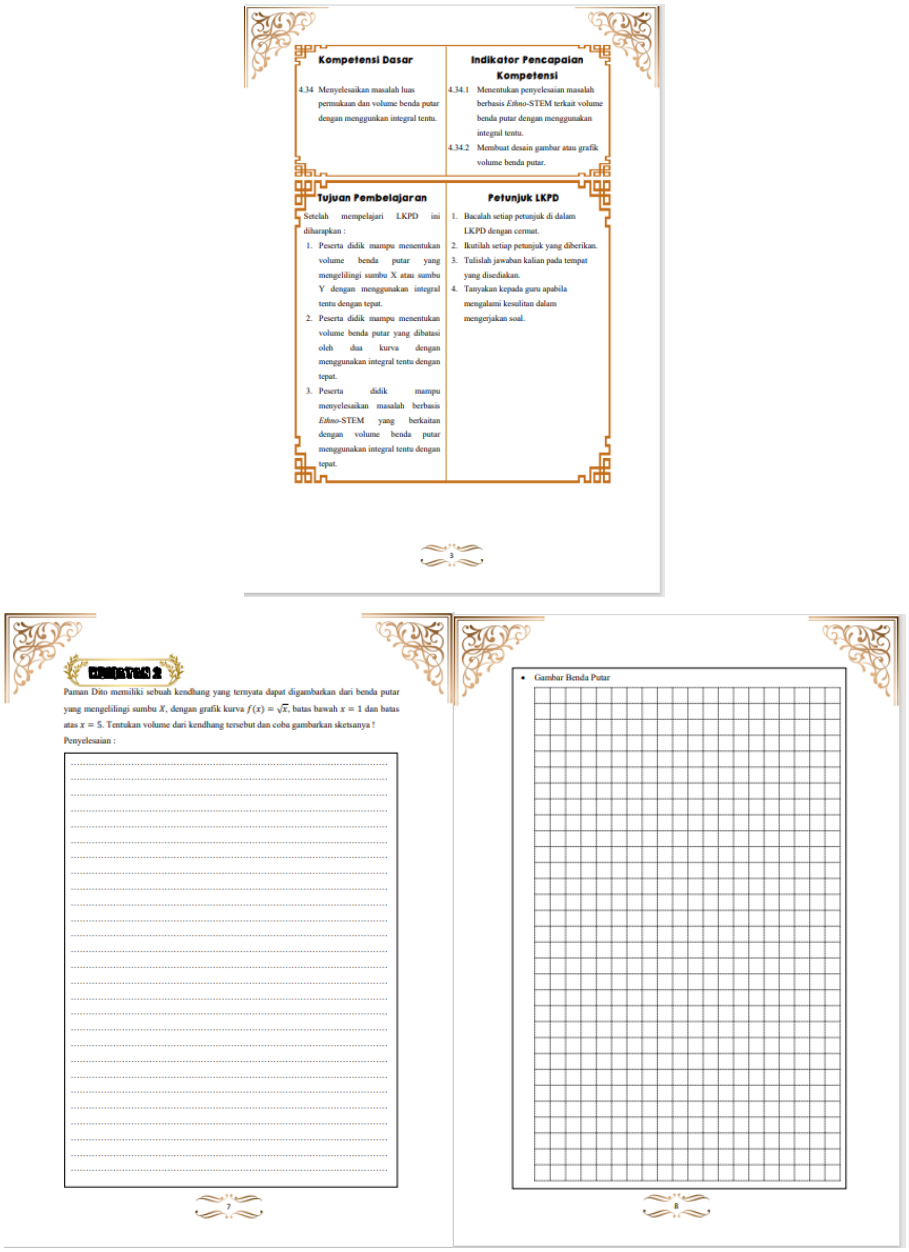


Figure 3. Final Design of LKPD Product

The LKPD product that has been improved according to the suggestions of the expert validator can be said to be valid. Furthermore, the LKPD product is tested for its practicality and effectiveness so that it can be implemented in learning. The results of the development of this Student Worksheet are expected to facilitate teachers and students in learning mathematics. Learning with an ethnomathematics approach can improve learning outcomes and student activity. This is in line with research (Santoso et al., 2020) that the use of ethnomathematics-based LKPD can improve learning outcomes and student activity in learning. In addition, in this era of technological development, learning with a STEM approach is highly recommended. According to research (Niam & Asikin, 2021), it was found that the application of STEM aspects in mathematics learning is very

important as indicated by increased critical thinking skills, science skills, concept mastery, and mathematical connections of students. Based on the effectiveness of learning with ethnomathematics and STEM approaches obtained from previous research, the use of Ethno-STEM-based LKPD is expected to attract students' interest and help in understanding the material as well as being a teaching material for teachers in learning activities.

CONCLUSION

Based on the results and discussions, the development of the Ethno-STEM-based Student Worksheet product has been carried out smoothly. The LKPD product already contains all the elements contained in the LKPD and has brought up Ethno-STEM in the activities in the LKPD. Based on the expert assessment data collected in the product validity test, it can be concluded that the product resulting from the development of the Ethno-STEM-based Student Worksheet with the material on the volume of rotating objects meets the criteria of being very feasible with an overall average of 87.11%. So after improvements were made, the LKPD product that was developed is possible and feasible for teachers to use in mathematics learning. This study still has many shortcomings, namely the absence of a test of the practicality and effectiveness of the product. The researcher hopes that this research can be continued by further researchers regarding the development of Ethno-STEM-based teaching or learning materials.

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