Volume 7, Nomor 1, Juni 2023
Numerical: Jurnal Matematika dan Pendidikan Matematika
http://journal.iaimnumetrolampung.ac.id/index.php/numerical
DOI:https://doi.org/10.25217/numerical.v7i1.

Development of Flat Solid Figure Learning Design based Rejang Lebong Ethnomathematics

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Article Info
Article History:
Received: 13-11-2022
Revised: 19-01-2023
Accepted: 30-03-2023

Keywords:
Ethnomathematics;
Learning Design;
Rejang Lebong;
Students' Mathematical Problem-Solving.

Abstract

This study aims to produce a learning design for flat-sided geometry based on Rejang Lebong ethnomathematics to improve students' mathematical problem-solving skills that are valid, practical, and effective. It is motivated by the low ability to solve students' mathematical problems. Mathematics learning carried out in schools should involve students actively. The research procedure is guided by the Plomp development design. The development model studied by Plomp is the initial investigation, development, prototyping, and research phases. In the initial investigation phase, the implementation of needs, curriculum, concept, and student analyses was implemented. In the prototype development phase, formative evaluation consists of self-evaluation, one-on-one evaluation, one-on-one evaluation, small group evaluation, and testing. Meanwhile, at the time of its application, it was tested on students of class VIII SMP to see the learning outcomes of the learning problem-solving abilities. Based on the development that has been carried out, it is obtained that the learning design of flat-sided geometry based on the Rejang Lebong ethnomathematics in the form of HLT, teacher's books, and books for class VIII SMP students are valid, practical, and effective.

INTRODUCTION

One main subject taught in formal and informal education is mathematics. Mathematics is taught from elementary school to university in formal education. The number of face-to-face hours shows the importance of mathematics. Therefore, mathematics is a subject that is never ignored at any level of education. One of the mathematics materials introduced at the elementary school level is Building Space (dimensional 3). Most elementary schools teach building space material in the fifth grade. However, it has also been taught in the second grade of elementary school, although it is primarily concerned with the structural components of space.

At the junior high school level or equivalent, learning about constructing spaces is about understanding concepts and how they can be used in everyday life. According to Fitriani and Nurfauziah [1], Abstraction is one of the essential skills in mathematics. Understanding geometry requires abstraction. By observing similarities, classifying them according to object characteristics, discovering the nature of a concept, and developing ideas from each form, students are instructed to identify conditions. Geometry has real-world applications in engineering, geography, and other

Print ISSN: 2580-3573, Online ISSN: 2580-2437

fields. This is the opinion of Van de Walle [2], stating, "scientists, architects, artists, engineers, and real estate developers are just a few examples of professions that regularly use geometry."

The material gets up the flat solid figure and becomes complex flat material for students. The reason is students Still often have no focus on learning, at least liveliness students, and results still exams Lots did not pass. This resulted in a lack of understanding. Students accept and finish related problems with the topic and get flat solid figures.

Based on the results interview researcher with several class VIII students and math teachers at MTs Baitul Makmur Curup on February 26, 2021, students experienced difficulty finishing questions and getting up the flat solid figure. Student only memorized given formula but moment faced with question student Still difficulty in finish question the. Subsequent research [3] says that Still low-ability MTs students complete matter on the material and get a flat solid figure.

Another consequence that arises from students who only memorize concepts is a students' low ability to solve problems. Fact Still Lots found low ability understanding and solving problem mathematical MTs students complete matter on the material get a flat solid figure. Armiati & Laia [4] mention that ability to solve problems will help somebody make a decision based on existing information and symptoms. Another study conducted by [5] [6] [7] said that students tend to memorize mathematical concepts without understanding their intent and content. This is based on the target material that must be achieved and does not focus on student understanding. The learning process that is not optimal, which has a low impact on students' problem-solving abilities, must be corrected in order to achieve the expected learning objectives.

In order to realize quality education, reasoning, problem-solving, and communication skills must be trained, and a solution to this problem is needed. This can be obtained with a learning process oriented to student activity, but most mathematics learning activities are still teacher-centered. In learning that previously used the same learning design as in general, namely conventional learning based on one LKS book. Therefore a learning design is needed that is developed by linking mathematical concepts and contextual problems through several activities. This is also for solving the process problem and will be developed in this design to overcome the problem.

Design intended learning is channel learning (learning trajectory), known by the designation hypothetical learning trajectory (HLT). HLT is a channel consisting of learning from objective learning, activity learning, and learning process hypothesis To predict How understanding students want to grow develops in context activity Study. Innovative learning is needed so that mathematics education can be more fun. This goes the opinion [13] in teaching mathematics. The teacher should start by digging for knowledge of informal math already obtained by students from life inhabitants around the place his stay

Math is one form of culture integrated into each element of life public. Then Princess [15] put forward that ethnomathematics bridges culture and education. Source Study mathematics can utilize culture as a learning medium. Bishop continued this opinion in Nuh and Dardiri [16], which states that ethnomathematics can be divided into six basic activities that can always be found in several cultural groups. Sixth, activities between calculating, determining location, measuring, designing, and playing while explaining learning that connects with culture in mathematics education are one of the innovations for the assumption that mathematics is rigid and introducing a culture that students do not widely know. Every Region has different cultures,

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which will give A results in different thoughts too, and here it is location creativity somebody integrates it in mathematics. With thereby past ethnomathematics, yes serve to learn more math fun, okay bring closer as well as present to students about culture, yes makes learning more meaningful, and can increase motivation student as well as make student become interested in Study math.

Based on the description above, innovation in learning must be carried out to improve students' abilities, especially mathematical problem-solving abilities. With hook culture, local into the teaching materials on the material get flat solid figure is one method from innovations made.

METHOD

Based on the desired goal achieved, this study includes research development Plomp & Nienke Nieveen [19] state that design research consists of development and validation studies. Development studies aim to develop innovative and relevant interventions For practice education. Validation studies It means To develop accompanied by validating the theory. Use of development models This Plomp aims to produce HLT, teacher's books, and textbooks for valid, practical, and effective students. Teerd Plomp develops a plump model. The Plomp model consists of 3 stages: (1) stage investigation, beginning complete analysis of needs and context, Prototyping is done activity design, development, and evaluation formative, stage evaluation is carried out the semi-summative evaluation.

RESULTS AND DISCUSSION

Research has contributed to developing design learning mathematics through HLT, Teacher Books, and Books Student-based Rejang Lebong ethnomathematics. Research on ethnomathematics has also been done by some researchers earlier, like Marsigit [20], who developed device form-based modules, syllabi, lesson plans, and worksheets, while in this research, they developed design learning-based math ethnomathematics.

1. Results of the Initial Investigation Stage (*Preliminary Research*)

On February 26 and 27, 2021, researchers conducted information-gathering activities by interviewing junior high school mathematics students and teachers and observing how students learned mathematics. From the results of interviews with students, students have little desire to discuss math problems. Students stated that the mathematics they had studied before was boring because it contained formulas that were difficult to understand. This is because the teacher usually only presents the formulas used in the examples, causing students to become uninterested, according to the results of interviews with math teachers at MTs. Baitul Makmur Curup, the teacher, explains the surface area of the flat solid figure with student activities, such as making flat solid figures (cubes, cuboids, prisms, and pyramids) using cardboard and predetermined sizes. This activity is in response to the challenges faced by students in learning flat-sided geometry to date. So that students know the flat solid figure and the nets they find. On the flat side, the material volume only utilizes LKS from the teacher's handbook as a guide.

Only the volume formula for the flat solid figure is shown on the worksheet and used in the example questions. The analysis revealed that students need a learning design that can

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encourage students to actively participate in developing flat solid figure ideas. Using an ethnomathematics -based learning design to improve students' problem-solving skills is one way to involve students in solving contextual problems. Therefore, worksheets were made to help grade VIII junior high school students improve their abilities to solve mathematical problems by drawing relationships between the cultural problems of Rejang Lebong and flat solid figure materials.

The curriculum chosen was based on the curriculum used in the school where the research was conducted, namely MTs Baitul Makmur Curup. The material on flat side shapes does not contain many everyday problems or problems presented. Therefore, it is essential to provide students with worksheets on how to build a flat solid figure so they can better understand concepts, participate in daily activities, and learn more about Rejang Lebong culture. According to the findings from the analysis, Rejang Lebong ethnomathematics was used to modify real-world problems at the start of each indicator.

The concept analysis aims to identify basic ideas related to flat side spaces by determining the main ideas included in the flat VIII grade junior high school student material and then systematically describing and rearranging these ideas. The idea that the surface area of cubes, blocks, prisms, and pyramids is more significant than their volume is one of the many ideas that make up the material of a flat solid figure. Based on the concept analysis findings, flat-side geometry begins with the surface area formulas for cubes, beams, prisms, and pyramids. Teacher and student books teach surface area by presenting problems and concluding flat shapes' volume and surface area (cubes, cuboids, and pyramids). The problem is based on Rejang Lebong's ethnomathematics.

Distribution questionnaire to 32 students made as reference For analysis characteristics student when designing book used student. Interested book Student Aimed at students who can imagine learning and build knowledge If problems presented relevant to student life daily. Rejang Lebong culture is connected with the book to be designed here. Writing style liked by students. Letters the used. To know what you like students, as well in graphics, for them to read the designed book with friends and easily understand by teachers and students. Students like a book with an illustration. The goal is to determine whether the student-like thing is pictured and made to sheet Work student. Questionnaire characteristics students disclose that 29 students like book pictures and three students No like book pictorials. Attractive book interest student aims to measure the student's enthusiasm book to be developed. Based on Rejang Lebong ethnomathematics, used as a base for designing a book on building side flat. Then, this book is expected to help the student develop knowledge and draft flat solid figures with objective learning.

2. Results of the Development Stage (*Prototyping Phase*)

At this stage, the book is made with the learning with Hypothetical Learning Trajectory (HLT) channel. Then, problem-related context with culture local Rejang Lebong (Ethnomathematics) was added to HLT. Then, some activities will help the student understand the wide surface side flat. Besides, HLT was used in books developed and given to teachers and students to see how much this book can help them study how to build ideas on flat solid figures. Previously, technology education, language, and mathematics experts will

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first validate the product. If the validator is necessary to make a change, the result validation will change.

An objective book used in this study, primarily related to geometry side flat, is a must-understood student after finishing problem math. At the start of learning, goals are set, and then a series activity predicts the response students and questions trigger, anticipating teachers against answering students. Book be equipped material find a formula for the volume of a cuboid and a cube, find the prism volume formula, find the pyramid volume formula, find the formula wide surface get flat, look formula wide surface prism, book cover, preface, learning objectives, activities, tools and materials, time allocation, related questions with ethnomathematics, teacher anticipation of answers student, test understanding, key answers, and scores.

To obtain a valid student book, then it must be validated. Two steps are taken in validating the book: self-evaluation for construct validity and discussion with experts for content validation. After doing a self-evaluation, they have made improvements to the book. The next activity, this book, is validated by the validator. Based on the validator's suggestions, improvements were made.

Before being presented to experts, the results of the draft book were evaluated alone. Error typing, usage sign read in a sentence, clarity image used, suitability material, suitability picture with the problem, order activity, suitability of the problems listed in teaching materials, and questions exercise everything checked return moment evaluation alone. Repair did self-evaluation against HLT and book students who have designed. For improvement, experts or competent experts are consulted and discussed. Ideas from the validator will be used as material. For the study, repeat the book that has been planned. At this stage, it should generate a sound or excellent book.

This study has five validators: three lecturers of expert education math, one lecturer of expert technology education, and one lecturer of expert linguistics. Validation sheet material, graphics, and language are three component-based instruments evaluation form sheet validation work. Content math, graphics, and language tested its validity as part of the validity test. In the analysis validation book, three mathematicians produce results with an average score of 3.42, and the category is very valid—experts in language and technology education. Then give results scores 3,4, and 3 with outstanding category. Book-based ethnomathematics on building flat solid figures found an outstanding category.

In prototype 1, the validator stated results valid or very valid teaching materials; prototype 2, namely one-to-one evaluation, is the next stage. In the first cycle of developing the Plomp model stage, the experiment gives LKS to three students at MTs Baitul Makmur Curup with various abilities, high, medium, and low, based on Rejang Lebong ethnomathematics. The designed book will be reviewed or observed in this evaluation. Inflexible hints understood students, complex sentences understood students understood and observed response students to solving problems contextual in the book provided students. The researcher observes the direct activity of students in one-to-one evaluation.

Teacher and student books load several pieces of information, i.e., name writer (Agung Setia Budi), Logo of Padang State University (UNP), and SMP/MTs Class VIII. The draft cover has been revised by researchers (self-evaluation) so that obtained cover book in Figure 1

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Figure 1. Initial Cover Design for Teacher and Student Books

Cover image above load the pictures contained in existing problems in activity (a) ethnomathematics of house roofs representing the Rejang Lebong custom form prism, (b) image prism, (c) ethnomathematics bay tat cake represents form cubes and blocks, (d) pictures cube, (e) fig beams, (f) ethnomathematics of the roof of the Jamik mosque represent pyramids, and (g) pictures pyramid.

Objective learning load about what you want to achieve in each meeting and inform the students. Objective learning that has been formulated also loads ABCD components (Audience, Behavior, Condition, Degree). Teaching tools and materials aim To know. What just the necessary tools and materials in activity learning and customizing with material to be discussed? Allocation time load time used For reaching objective learning. Objective learning, tools and materials, and allocation inside the time book are looked at in Figure 2.

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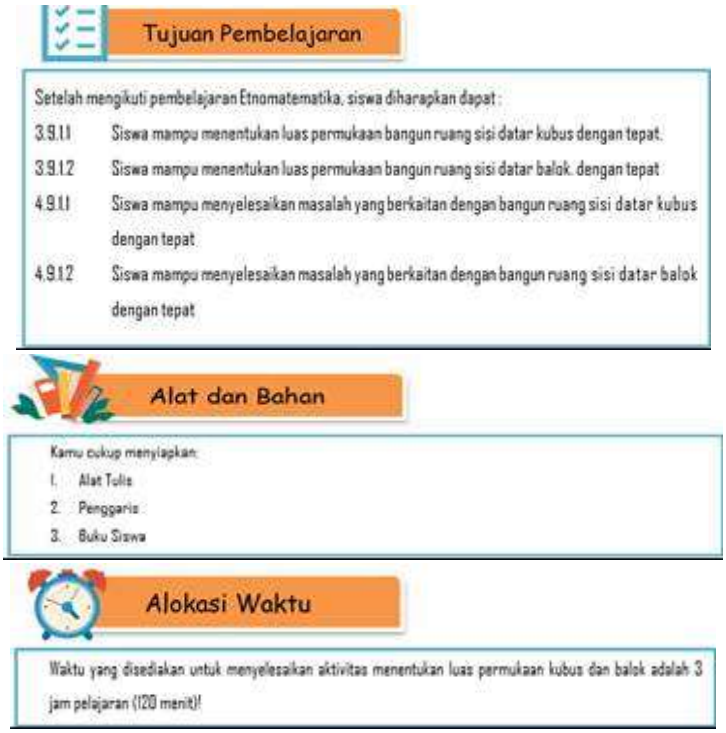

Figure 2. Learning Objectives, Activities, Tools and Materials, Time Allocation

Material Planning, learning load stages, and learning-based ethnomathematics to be implemented in learning. Activity learning is a description short about the activity student in learning each meeting. Know the material load explanation of the material to be discussed. Planning learning, learning activities, and knowing material in the teacher's book looks in Figure 3.

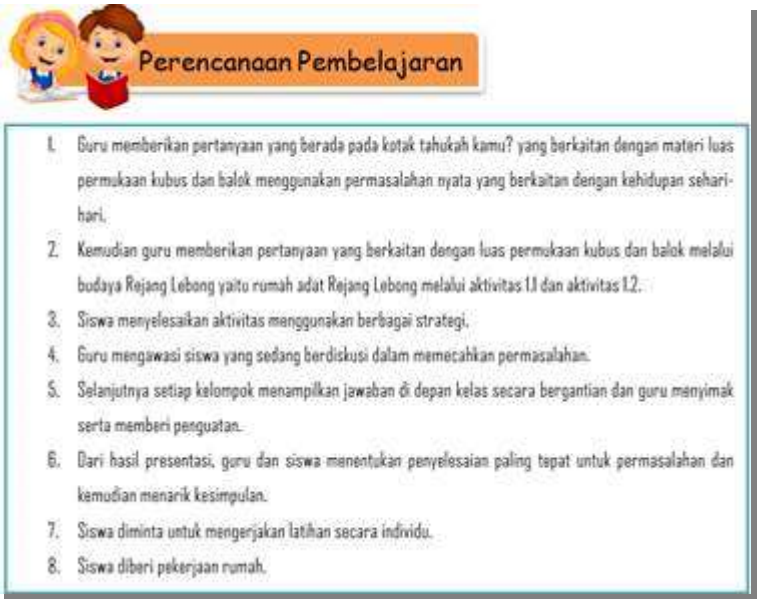

Figure 3. Planning learning

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Figure 4. Activities learning,

The subsection will discuss information about object ethnomathematics at each meeting. Furthermore, in the box, also load questions about the problem of getting up flat solid figures based on ethnomathematics in Figure 5.

Figure 5. " Did you know You " in the Teacher and Student Book

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Problem load problems found in Rejang Lebong ethnomathematics. The problem in this activity is finding a draft to get a flat solid figure through roof shape custom the shaped prisms, cake bay represents form blocks and cubes, and the Jamik mosque where is the mosque's roof represents form pyramid. This activity involves the teacher allowing students to find drafts through problems in Rejang Lebong ethnomathematics—problem ethnomathematics in the book in Figure 6.

Figure 6. " Related problems " box with ethnomathematics on Teacher and Students Book

Predict student, and teacher anticipation only found in the teacher's book. Predictions answer students to load the possibilities of answers that will write down students For the finished problem in the book. At the same time, the teacher's anticipation is the questions to be given to students. For delivering student For find concept. Predictions answer student and teacher anticipation was apparent as follows.

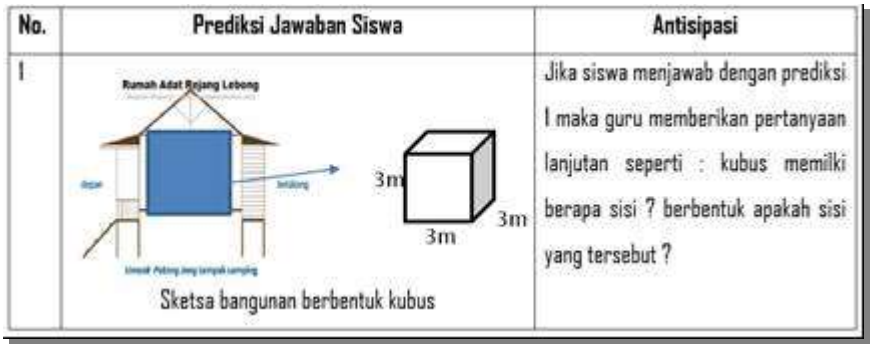

Figure 7. Predictions answer students and the anticipation given by the teacher

Figure 7 contains predictions and anticipations in the teacher's book. Predictions of the landscape can be seen in the teacher's book in the appendix.

The understanding test is activities performed in each end containing meeting questions, exercise load problem ethnomathematics crumbs Lebong on the material gets up flat solid figure. Furthermore, student researchers provide a question homework inside

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to increase understanding. Test existing understanding in the book included form training and homework in Figure 8.

Figure 8. Comprehension Test in the Column Practice and Assignments

Overall, students can use this book well without the researchers' help. After this stage was completed, the researcher used informal interviews to see the student books used by the three students. The three students answered according to the predictions designed during the one-to-one process evaluation. In general, students have participated in the Rejang Lebong ethnomathematics- based flat-sided spaces geometric subject.

After the one-to-one stage evaluation, the revised book will be tested in small groups in response to comments and suggestions. The product was tested on six students from class VIII MTs Baitul Makmur Curup: two high-ability students, two medium-ability students, and two low-ability students. Two different groups of six students were formed using various group criteria. Six meetings were used to evaluate this small group. The design trial stage, which is the second stage of the Plomp development model, is the design trial stage.

Students are given a questionnaire at the end of the small group meeting to determine the product's usefulness. Student responses to the Small Group Evaluation were all positive. The analysis shows that the overall practicality percentage is 85.14 percent, placing it in the convenience category. This shows that students can practically utilize the Rejang Lebong ethnomathematics-based flat-sided spatial topic worksheets.

Evaluate how well it works with students in small groups by testing their ability to solve math problems at the end of the lesson in the last meeting. The effectiveness test in small groups was carried out to see the increase in ability and students' abilities to solve math

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problems. The test is a tool to determine students' proficiency level on the flat solid figure and questions related to the students' ability to solve mathematical problems. After being tested, the students' average ability to solve problems was 71.31 percent which was included in the excellent category. It shows that students can understand questions, and Rejang Lebong ethnomathematics-based books can help them understand the concept of flat solid figures and improve their problem-solving ability.

CONCLUSION

Based on research results that have been done, learning design gets up flat solid figure based Rejang Lebong ethnomathematics fulfill valid and practical criteria with fulfill aspect validity as following: valid characteristics and criteria. Appropriateness content includes suitability with SK and KD, grow flower child, requirements teaching materials, and substance truth elements of teaching materials language, such as; legibility, clarity information, compliance to rule excellent and correct Indonesian, and usage efficiency language, everyone necessary. With fulfill aspect practicality convenience user; time implementation must short, fast, and precise; interesting; easily understood; and have the exact equivalent to be used as replacement or variation. The ability of the student to finish problem mathematics is influenced positively by learning design to get flat solid figure-based Rejang Lebong ethnomathematics. With a score of 73.98 percent and category well, the average indicator ability solving problem mathematical student show matter such, with thus learning design get flat solid figure flat based Rejang Lebong ethnomathematics can be said to be effective and can be used.

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