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Development of Student Worksheets on Spatial Structure Material Based on Candi Penataran to Support Student Learning Outcomes

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Abstract

This study aimed to develop Student Worksheets (LKPD) based on Space Building Materials with a foundation in Penataran Temple to support student learning outcomes. The research also aimed to assess the validity of the LKPD and measure the improvement of student learning outcomes after using the LKPD. The research followed the development model proposed by Richey and Klein, consisting of three stages: planning, production, and evaluation. The planning stage included needs analysis, concept development, and LKPD development planning. An initial study was conducted to understand the challenges of teaching geometry to junior high school students, and strategies were designed to improve learning outcomes. Additionally, the planning stage involved observing Penataran Temple for concept development. The production stage involved creating and developing LKPD based on the concepts and objectives developed in the planning stage. LKPDs were developed with a focus on the concepts of Penataran Temple and Flat Side Spaces. The results of the pre-test and post-test analysis showed a significant increase in the average student score. The average pre-test score was 29.86, while the average post-test score was 64.93. The results also indicated an increase in the number of students who achieved the minimum passing score (KKM) in various schools with varying KKM standards. In a broader sense, the use of Penataran Temple-based flat-sided space building LKPD demonstrated a positive impact on students' understanding of space building and local culture, as well as improving their mathematical understanding and appreciation of culture.

Keywords: Student Worksheet; Penataran Temple; Flat Surface Spatial Geometry; Learning Outcomes

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INTRODUCTION

Learning outcomes can be characterized by changes in knowledge or skills. Changes in knowledge can occur due to experiences gained during the teaching and learning process (Chandra & Hidayati, 2023). To achieve optimal student learning outcomes, a meaningful learning process is needed. Meaningful learning can be ensured by considering students' prior knowledge to produce optimal results (Wati, 2020).

Success in learning is inseparable from the support of each learning component. One of these components is teaching materials. Teaching materials are fundamental in education because they provide guidelines that help teachers convey information more effectively and help students understand learning materials (Luthfi & Rakhmawati, 2022). In achieving educational goals and meeting competency standards, learning resources play an important role. Teaching materials are considered a collection of learning materials and additional information from various sources with the aim of creating an enjoyable learning experience (Kuswari & Choiruddin, 2021). One interesting tool to engage students in independent learning

and encourage effective teacher-student interaction is the Student Worksheet (LKPD) (Teo & Goh, 2019).

The use of worksheets in teaching can improve student learning outcomes (Oktarina et al., 2019). Additionally, student worksheets are employed not only to enhance learning outcomes but also to improve students' mathematical reasoning abilities (Handayani & Mandasari, 2018) and critical thinking skills (Suanto et al., 2022). Therefore, when creating student worksheets, it is essential to include well-structured content and tasks related to the material.

However, in practice, learning geometric shapes has challenges. Challenges often faced by junior high school students involve difficulties in understanding the concept of geometric shapes (Sahara & Nurfauziah, 2021; Syafi'ah et al., 2022). Overcoming this challenge requires teaching materials specifically designed to connect geometric concepts with real experiences such as the use of local historical sites. In this case, Candi Penataran-based LKPD can be an important innovation in enriching the learning experience and increasing students' understanding of the geometry of flat-sided shapes.

Based on observations and interviews conducted with MTs Nurul Huda Ngadirejo Blitar teachers, it is known that the teacher has made LKPD, but the LKS mostly contains material and questions. The existing LKPD does not contain pictures related to local culture or objects that students encounter in everyday life. The teacher stated that the LKPD currently used was not able to relate the lesson material to the students' daily context. This reduces the relevance of the material to students' real experiences and has the potential to reduce learning motivation.

Observations at MTs Nurul Huda Ngadirejo Blitar, especially class VIII, show that students have difficulty learning the geometry of flat-sided geometric figures. This difficulty is influenced by the lack of contextual illustrations in the teaching materials used. One student stated that he had difficulty imagining geometric shapes because there were no pictures to help understand them. This difficulty indicates the need for LKPD that is more contextual and relevant to students' daily lives.

Apart from that, based on interviews with teachers at SDN 1 Blimbing, it was found that teachers used textbooks provided by the government in their learning. The teacher stated that "the existing textbooks are quite helpful, but are still lacking in providing contextual and interesting examples for students." This shows that although textbooks help teachers and students in the learning process, there are still shortcomings in providing interesting and contextual teaching materials.

Spatial geometry of flat surfaces is a branch of abstract geometry. Therefore, we need a learning approach that can connect geometry with everyday life to make it more relevant for students. One approach that can be used in teaching is Realistic Mathematic Education (RME). This approach provides students with the opportunity to construct mathematical concepts based on everyday experiences (Guarino et al., 2022).

More meaningful mathematics education can capture the relationship between learning experiences and the local cultural environment. The introduction of culture can be integrated into teaching by utilizing the local environment in instructional materials (Salafudin et al., 2022). The connection between mathematics and daily life or culture is known as ethnomathematics (D'Ambrosio, 1985). One cultural element that can be linked to flat surface spatial geometry, particularly, is temples. In East Java, specifically in Blitar, there is a Majapahit Kingdom heritage temple called Candi Penataran. The temple's architecture, constituent stones, and ornaments contain geometric concepts (Chandra, 2021; Munthahana & Budiarto, 2020). Geometric concepts found in the architecture of Candi Penataran include cubes, rectangular prisms, arbitrary triangular prisms, isosceles triangular prisms, frustum of rectangular pyramids, rhombus-based prisms, and cylinders The study byMunthahana& Budiarto (2020)also identified mathematical concepts present in Candi Penataran, such as spatial structure and geometric transformations.

Currently, several researchers have developed flat surface spatial geometry worksheets based on culture (Astuti et al., 2021; Noveno & Putra, 2022; Oktarina et al., 2019; Septiani & Hidayah, 2022). The cultural context used in the development of worksheets is adapted to the local culture of each researcher.Astuti et al. (2021) used the context of regional dishes from Medan. Noveno & Putra (2022) used the cultural context of traditional market snacks from Pontianak.Oktarina et al. (2019) used the cultural context of traditional houses from South Sumatra.Septiani & Hidayah (2022) incorporated the historical building LawangSewu into their teaching materials.

However, even though there are various LKPD based on local culture, there is no LKPD that integrates cultural elements from the Penataran Temple in Blitar. This research attempts to fill this gap by developing a flat surface spatial geometry worksheet based on the structure and architecture of Penataran Temple. This approach is expected to increase students' understanding of the concept of spatial geometry through a cultural context that is relevant and known to students in the East Java area, especially Blitar. By linking geometric concepts with local cultural elements, it is hoped that students can more easily understand and apply these concepts in everyday life.

Based on this background, to overcome the difficulties faced by students in understanding the geometry of flat-sided geometric figures, it is necessary to develop LKPD. This student worksheet will be based on the local culture of Penataran Temple. This student worksheet on flat-sided geometry, which is integrated with Penataran Temple culture, will be developed for junior high school (SMP) education. This student worksheet not only aims to improve understanding of geometric concepts, but also to relate learning to the cultural context known to students in the East Java area, especially Blitar. With this approach, it is hoped that students can more easily understand and apply geometric concepts in their daily lives.

Therefore, this research aims was to develop a flat-sided geometry worksheet based on Penataran Temple and assess the validity of the worksheet. Apart from that, this research also measures the effectiveness of using LKPD through improving student learning outcomes. Thus, it is hoped that this research can make a significant contribution to the learning of spatial geometry at the junior high school level and increase the connection between mathematics learning and everyday life. This ethnomathematics approach not only has the potential to improve learning outcomes but also enrich students' understanding of local cultural heritage.

METHOD

This research is development research (R&D). The research model follows Richey and Klein's steps with three main stages: planning, production, and evaluation. The first stage of research is planning which aims to determine research objectives, identify learning problems, and students' needs in understanding flat-sided geometric material based on Penataran Temple culture in student learning. This also involves formulating strategies for developing student worksheets, such as framework planning, LKPD layout and size, and LKPD design. The planning stage includes a needs analysis carried out through interviews and observations to identify difficulties in learning spatial geometry. In addition, a literature review was conducted to analyze previous research on local culture in mathematics learning to find relevant strategies.

Then the production stage is carried out to design and develop LKPD based on Candi Penataran culture which is tailored to the needs and learning objectives. The selection of cultural elements of Penataran Temple, such as building structures, ornaments, and geometric concepts contained in the temple, was carried out based on their relevance and potential for teaching geometric concepts of spatial shapes. The selection of this element also looks at the convenience of the shapes and illustrations found in Penataran Temple to facilitate students' understanding. The LKPD is designed to include descriptions and visuals that stimulate students' thinking processes in finding geometric concepts in temple elements.

The evaluation stage was carried out to assess the quality and effectiveness of Candi Penataran culture-based worksheets in supporting junior high school students' learning

outcomes. The quality of the LKPD is validated by material experts, learning experts, design experts, language experts and Islamic experts. Each validator is an expert in their field with a minimum of 2nd degree (S-2) education. The effectiveness of the LKPD was carried out through trials using pre-test and post-test results to measure improvements in student learning outcomes. After the trial, teachers and students were asked to provide feedback regarding their experience using the LKPD. This feedback is used to revise and improve the LKPD before it is distributed widely. The assessment on the validation instrument is in the form of a questionnaire with a 4 point Likert scale in Table 1 with the validity criteria interval in Table 2.

Table 1. Questionnaire Answer Options

Answer Options	Scores
Invalid	1
Less Valid	2
Valid	3
Very Valid	4

Table 2. Validity Criteria Interval

Interval	Criteria
$75\% \leq scores \leq 100\%$	Very Valid
$50\% \leq scores \leq 75\%$	Valid
$25\% \leq scores \leq 50\%$	Less valid
$0\% \leq scores \leq 25\%$	Invalid

This research was conducted at Annuriyyah Islamic Middle School, Sukun, Malang City because this school has characteristics that are relevant to the research objectives. The school is located in an Islamic boarding school environment which has a diversity of students from diverse cultural backgrounds. Apart from that, in the Islamic boarding school environment, students tend to have limitations in studying outside the environment so there is a need for cultural introduction. In this way, it will also instill an attitude of religious moderation or respect for other religious cultures, namely temples. This research involved 14 students in the learning process by utilizing student worksheets on the geometry of flat-sided geometric shapes based on the Penataran Temple. This research provides data collection instruments which include LKPD validation sheets by experts and evaluation tools (pre-test and post-test). The pre-test and post-test were designed in the form of essay questions tailored to research needs, consisting of five questions related to the spatial geometry of flat surfaces. A subject matter expert reviews these test questions before they are officially given to students. The validity of student worksheets is determined by calculating the percentage of scores on the questionnaire through statistical analysis as part of the quantitative data analysis process.

Meanwhile, to measure student learning outcomes on flat surface spatial geometry material, comparisons were made using pre-test and post-test results which were assessed based on the achievement of learning outcome indicators. To assess the effectiveness of LKPD in supporting student learning outcomes, pre-test and post-test data were analyzed using a paired difference test (paired sample t-test) and a normalized gain test. However, before carrying out the t-test analysis, prerequisite tests are first carried out, including normality and homogeneity tests. The normality test used is the Liliefors test with the help of the Microsoft Excel application. The decision criteria taken in the Liliefors test are if the L-count is greater than the L-table then the data is not normally distributed. The homogeneity test was carried out using the F-test with the help of the Microsoft Excel application. The homogeneity test calculation process uses a significance level of 5%. The decision criteria taken in the F-test are if the F-

count is greater than the F-table then the two groups have non-homogeneous variances. The process of calculating and analyzing data in the t-test uses SPSS software, with:

H_0: There is no significant difference in the average pre-test and post-test scores in increasing student learning outcomes in using LKPD

H_1: There is a significant difference in the average pre-test and post-test scores in improving student learning outcomes in using LKPD..

RESULTS AND DISCUSSION

The results of the development of culturally-based student worksheets for junior high school students in mathematics education will be explained as follows:

Planning Stage

The first stage is planning, also known as needs analysis. The goal of this stage is to determine and define the requirements for mathematics education at the junior high school level. Determining and defining these requirements begins with an analysis of the objectives. The results of the definition phase are as follows:

Problem Analysis

The problem analysis aims to understand the initial conditions at MTs Nurul Huda Ngajum Malang, especially in class VIII. What needs to be analyzed are the teaching methods and techniques used by mathematics teachers. The mathematics teacher mentioned to the researcher that class VIII students' basic understanding of mathematics tends to be lacking. This is reinforced by data on daily test scores which on average are below the minimum passing score (KKM), especially in geometry subjects. When researchers asked mathematics teachers about the causes of students' low understanding of basic mathematics, the teacher explained that one of the factors was students' perception that mathematics was a difficult subject and was not related to everyday life.

Researchers continued to ask about the reasons behind students' perceptions that mathematics was difficult, and the teacher explained that the Student Worksheets (LKPD) that had been developed had not been able to accommodate students' academic and emotional needs. Until now, mathematics learning has been carried out using textbooks provided by the Ministry of Education. The teachers have tried to actively involve students in the teaching and learning process. With the development of culture-based geometry LKPD, it is hoped that it can change students' perceptions of mathematics, which were initially considered difficult and unrelated to everyday life, into something that is easy and very relevant to everyday life. The learning process begins with distributing LKPD to students. Students listen to the material explained by the teacher by referring to the mathematics textbook, followed by a question and answer session regarding the material and ending with practice. This has an impact on students' attachment to the subject, giving rise to the perception that mathematics and local wisdom are separate entities, mathematics does not touch cultural aspects, and vice versa.

Similar to MTs Nurul Huda Ngajum Malang, the teaching of basic mathematics for grade IX students at SMP Islam Annuriyah is also inadequate. This is evidenced by the daily test score data, which averages below the minimum passing grade (KKM), especially in geometry. When the researcher asked the mathematics teachers about the reasons for the students' low understanding of basic mathematics, the teachers explained that one of the factors is the students' background in a pesantren environment, where mathematics is seen as unrelated to everyday life. Additionally, students lack motivation because they find mathematics difficult as santri (students in a pesantren). Furthermore, at SMP Islam Annuriyah, only the provided Student Worksheets (LKS) from the school are used, so innovative learning resources are less accessible to students.

Curriculum Analysis

Curriculum analysis is crucial in the planning stage of developing culture-based geometry student worksheets. Teachers must be able to determine the appropriate materials to

be taught using the developed student worksheets. Components related to the curriculum, particularly subject matter and competencies to be achieved, are considered based on the 2013 curriculum and independent learning curriculum. The characteristics of the independent learning curriculum are implemented to prepare Indonesian generations who have faith, productivity, creativity, innovation, and affective qualities, capable of contributing to community life, the nation, and global civilization. Based on this description, one way to respond to issues in line with the demands and challenges of the independent learning curriculum is to develop culture-based geometry student worksheets aimed at enhancing cognitive and affective abilities in junior high school students.

Student Worksheet Needs Analysis

The step of analyzing and organizing the needs of student worksheets determines the quantity or number of student worksheets required. In this stage, the sequence of student worksheets is determined so that they can be used effectively, systematically, and constructively. Curriculum analysis is carried out by analyzing the curriculum used, namely the independent learning curriculum initiated by the Ministry of Education and published by BSNP (National Center for Education Standards). This is done to ensure that the developed student worksheets can be beneficial to various schools and are not tied to a specific school's curriculum. The aspects analyzed in the curriculum include the expected basic competencies and indicators that students must achieve regarding the topics of flat surface spatial geometry. Once the curriculum analysis has been conducted, the creation of a student worksheet needs map becomes more straightforward. Additionally, in the creation of the student worksheet needs map, an analysis of learning resources to be used in teaching is included.

Student Analysis

In this stage, the researcher conducted observations and discussions with mathematics teachers. Based on the observations, it was found that the basic knowledge of students at MTs Nurul Huda Ngajum Malang was quite good. However, many students still considered mathematics to be a difficult and irrelevant subject, as they felt it had no connection to their religion and culture. Students also had a tendency to become easily bored with teaching and learning activities and were less active in seeking various information related to the material being taught. Often, teachers had to repeat the material to ensure that students remembered what they had learned, and the intellectual abilities of the students were quite diverse or heterogeneous due to students at MTs Nurul Huda Ngajum Malang coming from different formal education backgrounds.

Not much different from MTs Nurul Huda Ngajum, students at SMP Islam Annuriyah also had a tendency to become bored with learning activities. They lacked enthusiasm in participating in lessons. One of the factors contributing to this was that students in the pesantren environment had activities from morning until ten at night. Therefore, there was a need for innovation in learning, especially in mathematics, which could be related to culture to improve student learning outcomes. Additionally, students in pesantren environments, with limited opportunities to leave the pesantren, were not fully aware of the cultural aspects related to mathematics in Indonesia.

Learning Material Analysis

The analysis of learning material involves selecting and systematically detailing relevant teaching materials to be used. The teaching material used in this research is geometry, specifically, flat surface spatial geometry, including cubes, rectangular prisms, prisms, and pyramids.Once the main concept of the material has been analyzed, an outline of the material to be included in the student worksheet is developed. After the material outline is established, indicators and learning objectives for geometry in the eighth grade are formulated.

Production Stage

Based on the findings of the preliminary study, a design for teaching materials in the form of culture-based geometry student worksheets (LKPD) was developed. The goal of this phase is to prepare a prototype of culture-based geometry LKPD to facilitate student understanding of mathematics in the learning process. This phase includes the following steps:

Selection of Appropriate Media

Educational media serves as a tool to effectively transfer material to students so they can understand, receive, and master the material clearly and easily. Media used in the LKPD are aligned with the core competencies, indicators, and main topics. The images presented are adjusted to the characteristics of students' daily lives and Indonesian culture, ensuring that the learning objectives are achieved according to the indicators.

Format Selection

Format selection is done by examining various RME-based student worksheet formats that support student learning outcomes in mathematics education. The LKPD culture-based geometry background includes font size 14 for the body text, main titles in Chewy font size 57, sub-chapter titles in Chewy font size 70, images of temples, mathematical illustrations related to students' daily lives associated with Candi Penataran, and other designs to enhance the appearance of the LKPD.

Initial LKPD Plan

In this design stage, the researcher has already created an initial product (prototype) or product design. This stage is conducted to create the culture-based geometry LKPD, focusing on Candi Penataran, and to simulate the use of the model and geometry LKPD in a small-scale setting. After aligning the core competencies with the indicators in the previous stage, the LKPD design is carried out. The structure of the LKPD development in this research includes the following components:

a) Introduction
   i. Title: Candimathis: (Creative Activities On Numerical And Geometric Discoveries In Mathematics)
   ii. Research Tittle: Development of Student Worksheets on Flat Surface Spatial Geometry Based on Candi Penataran to Support Student Learning Outcomes
   iii. List of Competency Objectives: Includes Core Competencies, Basic Competencies, Indicators, and Learning Objectives.

b) Core

The core section of this development model consists of several elements, including:

   i. Motivation
   Before getting into the core material, the LKPD provides literacy about Candi PenataranBlitar.
   ii. Material Description
   The material description provides introductory material for each learning activity. After presenting the introductory material in the culture-based geometry LKPD, constructive mathematical learning steps are presented, starting with presenting a problem where the problem presented is a flat surface spatial geometry problem.
   iii. Learning Activities
   The learning activities in the culture-based geometry student worksheets integrated into Islamic mathematics education are directed toward RME-based learning. The main learning activities ask students to solve real-life problems from their daily lives.

c) Conclusion

The concluding section in this development model includes a final test. The final test is used to assess student learning outcomes using the culture-based geometry student worksheets. The test consists of questions that cover all learning outcome indicators.

d) Validation Section

The development phase aims to produce LKPD that has been revised based on feedback from expert validators in the fields of content, construction, and language. This stage consists of two parts: 1) Validation conducted by experts on the developed product, and 2) development testing conducted with ninth-grade students at MTs Annuriyyah Malang.

Validation by Experts

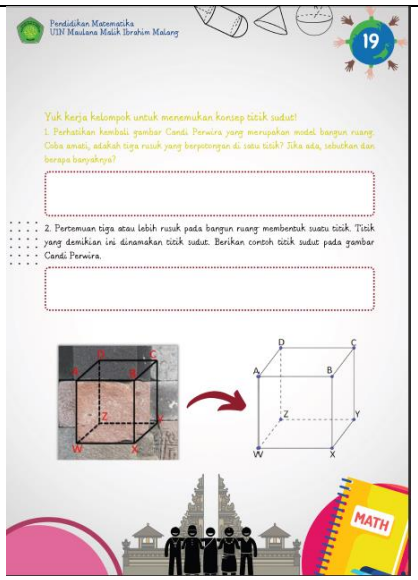
Validation is conducted to assess the suitability of a research instrument. In this research, the research instrument being validated includes the content, language, design, teaching approach, Islamic aspects, practicality, and the test instrument itself. The LKPD is validated by one content expert, Dr. Patma Sopamena, M.Pd.I, M.Pd.; one teaching expert, Dr. Patma Sopamena, M.Pd.I, M.Pd.; one design expert, Ibrahim Sani Ali Manggala, M.Pd.; one Islamic expert, Budi Prasetyo Margono, M.Pd.; one language expert, Mohammad Khikam Zahidi, M.Pd.; and one practitioner, Faizal Chanda, S.Pd. Additionally, the test instrument in this research is validated by Prof. Dr. H. Turmudi, M.Si, Ph.D. The goal of this step is to receive feedback and evaluation from experts on the LKPD that has been designed. Subsequently, the feedback and suggestions from the validators are used to revise the first prototype. Improvements to the first prototype are based on the feedback and guidance of the validators, leading to the creation of the second prototype. The evaluation of the LKPD involves providing the LKPD materials that have been developed, along with a LKPD feasibility assessment sheet. The evaluation of the LKPD, including the first prototype and the second prototype, is conducted in two stages.

Table 3. Validation Results of Student Worksheets and Instruments

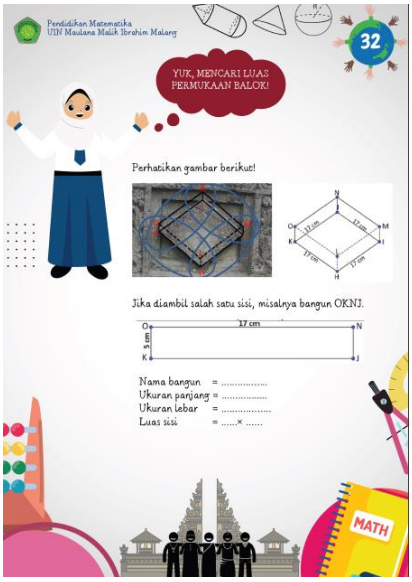
Assessment Aspect	Assessment Results	Category
Content	77,94%	Very Valid
Teaching	97,2%	Very Valid
Language	88,63%	Very Valid
Design	82,5%	Very Valid
Islamic Aspect	100%	Very Valid
Practitioner	93,75%	Very Valid
Test Instruments	78,57%	Very Valid

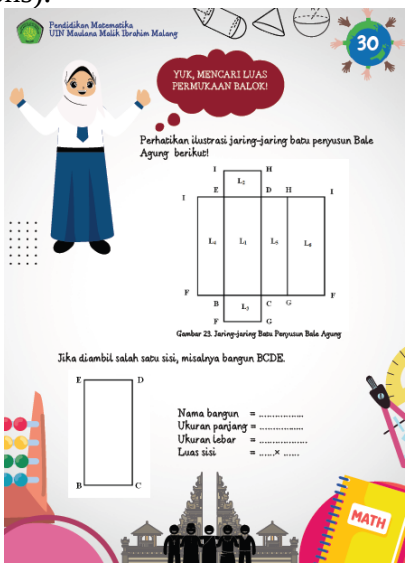
Table 4. Student Worksheet

Before Revision	**After Revision**
	
Clarifying the issues used in conveying concepts to students	



Eliminating repetitive parts to avoid redundancy in conveying the material as well as images (illustrations).





The mesh diagrams in the surface area of the rectangular prism material are replaced with the same mesh diagrams as the previous image (the stone structure of Bale Agung).

Adding illustrations for the complete form of a truncated pyramid (a pointed pyramid) on the 'Umpak’

Based on the data provided, in Stage 1, the average assessment score falls into the "good" category. However, based on feedback from the validator, some improvements are needed in certain parts of the student worksheets. The improvements made to the student worksheets based on the Stage 1 assessment can be seen in Table 2. After these improvements, a Stage 2 assessment was conducted on the prepared student worksheets, resulting in an average assessment score categorized as "very good." Therefore, it can be concluded that the developed student worksheets for Flat-Sided Space Construction based on Candi Penataran meet the criteria for being highly valid. There is no further need for revisions, and limited testing can proceed. The appearance of the student worksheets before and after the revisions can be seen in Table 4.

Evaluation Stage

The validation process has been completed, revised, and deemed suitable for testing with students at SMP Islam Annuriyah Malang who have studied the topic of "Two-Dimensional Shapes" in grade IX. Before conducting the trial, students were given a pre-test to assess their initial abilities before using the culturally-based Candi Penataran-themed worksheet (LKPD). The results of the pre-test can be found in the appendix attached to this report. This trial aims to determine the effectiveness and attractiveness of the developed product and whether it can be used as a reference for student learning, as assessed through a questionnaire filled out by the students.

The trial of the developed and improved culturally-based Candi Penataran-themed LKPD took place following the validation process's conclusions. The final validation stage involved implementing the Candi Penataran-themed LKPD in Class IX A at SMP Islam Annuriyah Malang. This activity represents the last step in determining the suitability of the developed LKPD. Each student received the LKPD for their learning, and they were then asked to complete the activities and exercises within the LKPD. Subsequently, students were given a test to assess their learning outcomes. The results of this assessment will serve as criteria for the effectiveness of the developed LKPD.

The evaluations conducted by subject matter experts, educators, designers, language experts, Islamic scholars, and practitioners, as well as the student test results, indicate that the "Two-Dimensional Shapes" LKPD meets the criteria for validity. Therefore, the LKPD can be utilized in mathematics education, with the hope that it will assist students in enhancing their learning outcomes. Table 5 shows the results of the pre-test and post-test for the students.

Table 5. Student Pre-test and Post-test Results

Name	Pre-Test	Post Test
S1	0	86
S2	0	61
S3	33	64
S4	59	63
S5	59	63
6	15	46
S7	59	41
S8	18	81
S9	27	84
S10	0	84
S11	39	64
S12	59	86
S13	9	86
S14	41	0

Table 5 shows significant variations in student achievement between the Pre-test and Post-test. Some students experienced remarkable improvements in their understanding of the material, such as Subject 1, who initially scored 0 on the Pre-Test and increased to 86 on the Post-Test. Additionally, Subject 8 also demonstrated significant improvement, with a Pre-Test score of 18 and a Post-Test score of 81. On the other hand, there were some students who recorded a decline in their results, such as Subject 7, who decreased from a Pre-Test score of 59 to 41 on the Post-Test. Furthermore, some students achieved stagnant scores, like Subject 14, who maintained a score of 41 on both tests. Further analysis of this data can provide deeper insights into the use of LKPD in supporting students' learning outcomes in the topic of Two-Dimensional Shapes.

Based on Table 5, it can be seen that there was only one student who did not experience an increase in learning outcomes after implementing the developed LKPD. Even though some students still have not demonstrated completeness of the KKM, almost all students have experienced quite significant improvements in their mathematics learning outcomes..

Discussion

The stages used in this development process utilize three phases developed by Richey and Klein: planning, production, and evaluation. During the analysis phase conducted before the research, it was identified that students faced difficulties in solving problems related to flat geometry materials. Therefore, the researcher chose to develop a culture-based Student Worksheet (LKPD) on the subject of flat-sided spatial geometry to assist students in understanding mathematics through cultural integration.

At the planning stage, it was discovered that during the learning process, students experienced difficulty in solving flat geometric problems. This is in line with the research results of Fauzi and Arisetyawan (2020), Fitriyani et al. (2023), Indrayany and Lestari (2019), Mariam et al. (2018), and Nur Choiro Siregari (2016) who showed that there were obstacles for students in solving geometric problems. Researchers obtained information that one factor in low student learning outcomes is students' perception that mathematics is a difficult subject and is not related to everyday life. This is supported by research by Jalal (2022) which states that 50% of students consider mathematics lessons to be quite difficult, 25% consider them difficult, and another 25% consider them easy. Research by Amallia and Unaenah (2018) states that students' difficulties in understanding mathematics are caused by several factors such as low interest in learning, the perception that mathematics is difficult, and the large number of formulas used. A needs analysis is also carried out on the material that will be developed in the LKPD.

One of the information obtained is that students/students think that mathematics is far from everyday life. Even though mathematics material, especially geometry, is widely available in everyday life. Apriani and Saputro (2023) stated that geometric concepts can be applied in everyday life, as well as in everyday life which can be used as a learning medium. Research by Sundari and Siregar (2023) states that traditional games can be used as a medium for mathematics learning in the form of LKPD which can increase the effectiveness of mathematics learning.

The choice of local wisdom or cultural context is done so that learning becomes more meaningful for students. In addition, the use of cultural context can be an alternative form of cultural recognition and preservation. Sakdiyah and Annizar (2021) stated that mathematics learning connected to culture can create interesting learning so that students can grasp meaning contextually according to students' experiences. In line with Sakdiyah and Annizar (2021), Marsigit et al. (2018) said that things that are concrete and related to students' daily experiences, such as local culture, can be used as interesting learning resources. Marsigit et al. (2018) developed mathematics learning based on Prambanan Temple, Kraton Temple, and Borobudur Temple as a mathematics learning innovation.

Then the planning stage in this research includes developing a framework and ideas for creating culture-based LKPD on flat-sided geometric shapes. The design is carried out to provide an understanding of the appearance and content of the LKPD that will be created and developed. The instrument design aims to create validation questionnaires for experts, including subject matter experts, learning media experts, design experts, language experts, Islamic experts, practitioners, as well as pre-test and post-test instruments. Components in the Candi Penataran-based flat-sided geometric LKPD developed in this research include the LKPD cover, foreword, table of contents, core competencies and basic competencies, competency achievement indicators, RME learning steps, instructions for use, student activities in the form of information, examples questions, and exercises, as well as a list of references. This design is prepared so that researchers have an idea of the appearance and content of the LKPD that will be created and developed (Nisa et al., 2022; Septiani & Hidayah, 2022). Instrument design was carried out to compile a description of the validation questionnaire from experts that had been conceptualized (Nisa & Marhayati, 2022).

The production stage involved the creation of LKPD based on Penataran Temple culture for flat-sided spatial geometry material. This production process begins with designing the LKPD format and selecting content that is appropriate to the local cultural context. The development of LKPD is based on contextual education principles that integrate cultural elements into learning, such as the use of pictures and stories related to Penataran Temple. The selection of these design elements is supported by educational theory which states that contextual learning can increase student understanding and engagement.

After the LKPD product has been developed, the next step is to validate it by involving several experts. Validation aims to determine the strengths and weaknesses of the LKPD and obtain input or suggestions for improving the LKPD being developed. Validation also determines whether the LKPD is suitable for use in the learning process based on expert assessments. The results of the expert assessment show that the LKPD is very valid with the following details: material experts gave an assessment of 77.94%, learning experts 97.2%, design experts 82.5%, language experts 88.63%, Islamic experts by 100%, and practitioners by 93.75%. Apart from that, the validation results of the pre-test and post-test instruments were 78.57%, indicating that the instruments were very valid. This assessment indicates that the LKPD developed is of good quality and can be implemented in the learning process. In line with research by Putri dan Ananda (2020) who developed local wisdom-based LKPD for fourth grade elementary school students and carried out a validation stage to assess the validity of the LKPD. Another study by Suanto et al. (2022) who developed LKPD based on problem-based learning to improve critical thinking skills in elementary school students and carried out a validation stage to assess the validity of the LKPD.

Based on input from experts, several revisions were made to improve the quality of the LKPD. For example, feedback from design experts suggests eliminating repetitive sections to avoid redundancy and improve clarity of instructions. Learning experts provide suggestions for adding more contextual examples that relate to students' daily lives, while language experts emphasize the importance of using language that is simple and easy for students to understand. Islamic experts provide input regarding the integration of Islamic values in the cultural context of Penataran Temple.

This revision not only corrects existing deficiencies, but also strengthens elements that support learning effectiveness. By eliminating redundancy, LKPD becomes more efficient and focused. The addition of contextual examples helps students connect geometry concepts to their real-world experiences, increasing relevance and engagement in learning. Simplifying the language ensures that all students can understand instructions clearly, while the integration of Islamic values provides an additional dimension that enriches the learning material. Overall, validation and revisions carried out based on input from experts show that the LKPD based on Candi Penataran culture is not only valid but also adapted to the needs and learning context of junior high school students. The implementation of LKPD is expected to improve student

learning outcomes in understanding the geometry of flat-sided shapes in a more relevant and meaningful way.

The evaluation stage includes an assessment of the products that have been created and developed. The purpose of this evaluation stage is to find out whether culture-based LKPD on spatial geometry is feasible and interesting for use in learning. The results of the assessment by subject matter experts, learning media experts, design experts, linguists, Islamic religious experts, and practitioners resulted in the conclusion that culture-based geometry LKPD is valid for use in learning and can support student learning outcomes. After the product is valid, then the product is used in mathematics learning. The use of the product shows that LKPD can improve student learning outcomes in flat-sided geometric geometric material.

This research shows that the use of the Penataran Temple-based flat-sided geometry worksheet can improve students' mathematics learning outcomes. The research results showed that there were significant differences between the group of students who used LKPD and the group of students who did not use LKPD. The pre-test average was 29.86 and the post-test average was 64.93, which shows an increase in the average score in class IX A. In addition, many students who completed also experienced improvements with different KKM levels. Previous research results show that integrating culture in mathematics learning can increase students' understanding and enthusiasm in understanding mathematical concepts (Mariska et al., 2024). Hutagalung (2017) used Toba culture to improve students' ability to understand mathematical concepts with the result that culture-based mathematics learning had an average of 0.7675 higher than students taught through conventional learning with an average of 0.2973 at a significance level of 0.000. The research results of Sutrimo et al. (2019) shows that the use of Jambi culture-based LKPD can improve students' mathematical creative thinking abilities and can broaden students' insight regarding culture and traditions in everyday life. Therefore, the use of Candi Penataran-based LKPD can be an effective alternative in improving students' mathematical learning outcomes

CONCLUSION

The development of this Student Worksheet (LKPD) resulted in the creation of the Candi Penataran-based "Student Worksheet Geometry Building Flat Side Spaces" as a mathematics companion book that discusses the topic of flat geometry for junior high school students (class VIII). This introduces one of Indonesia's cultural treasures, Candi Upgrading. The development of LKPD based on the geometric culture of flat-sided geometric shapes for junior high school students includes planning, production and evaluation stages that receive valid assessments from experts. The scores given by experts in the fields of teaching, content, media, Islamic integration, language, design and practitioners were 77.94%, 97.2%, 88.63%, 82.5%, 100%, 93, respectively. 75%, and 78.57%. Thus, the LKPD is considered very valid with an average score of 88.37%.

This LKPD can create student interest and increase students' insight into cultures and traditions that can be related to mathematics subject matter and the effectiveness of the LKPD seen from the product developed can improve student learning outcomes, namely with pre-test and post-test results. The results obtained are in the medium category for the N-gain test and it can be said that the LKPD developed has good effectiveness.

The results of this development can contribute to the diversity of mathematics companion books and become a reference for teachers and students in class VIII. Overall, this research makes a significant contribution to the development of culture-based teaching materials that can be implemented in the mathematics curriculum. The emphasis on using local cultural contexts such as the Penataran Temple shows that mathematics learning can be made more relevant and interesting for students. Wider implications for educational practice include increasing students' conceptual understanding, strengthening cultural values, and providing effective tools for teachers in teaching mathematics.

RECOMMENDATION

This research is only limited to developing student worksheets on flat figures with flat sides for class VIII SMP. Apart from that, this research is limited to the context of Blitar Temple Upgrading only. So the researcher suggests other researchers to continue research in the field of ethnomathematics for other cultures, be it temples, games, artifacts, dances, etc. which can be used for mathematics learning, especially in increasing students' understanding of mathematics. In addition, it is hoped that the media developed will not be limited to only flat geometry topics (cubes, rectangular prisms, prisms, and pyramids) but explore more complex concepts to make it easier for students to develop their mathematical understanding.

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