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Developing Electronic Student Worksheet of a Plane Solid Figure Based on Guided Inquiry for Junior High School Students

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Abstract

In complete, this research aims to produce electronic student worksheets that are valid, practical, and effective in learning material of a plane solid figure at SMP Negeri 2 Bengkulu. This research is part of the comprehensive research that only focuses on producing valid and practical electronic student worksheets based on guided inquiry learning in plane shapes. Validity is based on the assessment of material experts and media experts on the feasibility of the material content and the media side. At the same time, practicality is measured by the utilization of electronic student worksheets during learning. This research includes development research using the ADDIE model, which contains five cyclic stages, namely (1) analysis, (2) design phase, (3) development, (4) implementation, and (5) evaluation. The analysis results show a need for students for guided inquiry-based electronic worksheets by adjusting the characteristics of students whose critical thinking skills are still low. In the design, the researcher designs the product according to the analysis results, which continues with the development stage to realize the product design at the previous stage becomes the prototype. At this stage, experts also carried out validity testing and product practicality testing at the implementation stage to obtain valid and practical electronic student worksheets based on guided inquiry learning, with evaluation stages carried out at each stage.

Keywords: Students worksheet*, Guided Inquiry, Plane solid figure*

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INTRODUCTION

In the Law of the Republic of Indonesia Number 20 of 2003 it is stated that mathematics is a compulsory subject for students at the elementary and secondary levels. Through this mathematics learning, students are expected to have the ability to think critically, logically, systematically, and carefully in solving problems (Soedjadi, 2000). Students who have the ability to think mathematically will conduct testing, linking, evaluating all aspects of situations or problems, collecting, organizing, remembering and analyzing information on each of their thinking activities (Erika, 2017). The importance of the role of mathematics learning in the mindset and attitude of students turns out to require efforts that are not easy and experience many obstacles (Sulistyani & Retnawati, 2015).

According to Melianingsih & Sugiman (2015), most students answer math problems given by the teacher in the same way as the solution used by the teacher. They do not use their previous knowledge and experience to solve the problem, so that the knowledge gained by students only lasts temporarily because students only memorize and imitate the teacher, do not manipulate mathematics. This happens in every mathematical material that students learn at school, including the material for a plane solid figure. The results of the research by Sulistyani & Retnawati (2015) show that the ability of students to understand spatial shapes is still low and this can be an indication of students' low attitudes towards mathematics. From the results of the absorption capacity of the National Junior High School

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Exam for building materials for two consecutive years starting from 2010-2012, it shows that the percentage of students' absorption in terms of the area of the plane solid figure is still less than 65% and the volume of the plane solid figure still less than 75%.

The difficulties experienced by students in the plane solid figure material are generally related to the lack of students' ability to visualize the plane solid figure (Romadiastri, 2013). In line with this, according to Bell (1981) many students have difficulty in visualizing three-dimensional objects and the relationship between objects in the geometry so that students need to construct and manipulate these geometric objects. This is what makes building material a geometric material that is considered difficult and has a high level of abstraction (Nurhikmayati, 2017). Even though geometric materials are commonly found in the informal education environment of students and these materials are the key to understanding the shapes of objects that are often found by students in the surrounding environment (Andriyani & Juniati, 2019; Astutik, 2017; Fiantika, Budayasa & Lukito, 2017).

The low ability of students and their difficulty in the plane solid figure also occurs at SMPN 2 Bengkulu City. Based on the results of the initial ability test conducted by researchers in class VIII F of SMPN 2 Bengkulu City, it is known that the average value of students in the plane solid figure material reaches a score of 53.47 or below the KKM of 75. The lack of KKM in the material for plane geometry is also supported by the results of Febrianti's research (2018), which also shows that the ability to think mathematically and problem-solving is still relatively low in the matter of the plane solid figure in Bengkulu.

The low mathematical ability of students requires a solution in the form of applying appropriate learning methods, because geometry in junior high schools needs to be presented informally and intuitively (Bell, 1981). The results of researcher interviews with teachers at SMPN 2 Bengkulu City show that teachers still use expository learning which does not facilitate student activity and is not oriented to the achievement of students' mathematical abilities through meaningful learning. The tendency of the learning process for plane geometrical materials that is still teacher-centered is also in accordance with the results of Satrianawati's research (2017) which shows that learning of plane geometrical materials is still dominated by the lecture method or the provision of expository knowledge. The teacher explains the material, while the students only write what the teacher says, so that learning still takes place in one direction and does not activate student participation.

One alternative learning method that focuses on the process and activates student participation through inquiry and discovery activities for achieving higher understanding is the guided inquiry method (Hilman & Retnawati, 2015). Inquiry makes students learn directly and builds students' skills needed to add new knowledge and understanding (Vajoczki et. al., 2011). With the inquiry method, students find and use various sources of information and ideas to increase their understanding of a problem, topic, and problem. The purpose of inquiry activities is to help students acquire the ability to solve problems rationally and systematically, and to build valuable research skills, so that they can better prepare for lifelong learning (Spronken-Smith et al., 2007; Zarrillo, 2012). This is because, exploration in inquiry is an experience and exploration that involves students in the learning process (Coffman, 2009).

In addition to the learning method that still does not focus on the achievement of students' mathematical abilities, the learning of the plane solid figure at SMPN 2 Bengkulu City is also still not centered on the topic, so that the needs that should be met in the learning process become a study that underlies the need for the development of teaching materials of a plane solid figure material. From the results of the initial observations of researchers at SMPN 2 Bengkulu City, it was found that teachers still used printed book teaching materials which were distributed to students at the beginning of the semester by coming to school. This creates its own difficulties for students when carrying out online learning which has

implications for less active student learning activities due to their lack of understanding when asked to use these teaching materials at home.

The need for learning media or teaching materials to support increasing student learning activities can be in the form of worksheets that provide student guidance (Atika & Amir, 2016). According to Trianto (2013) teaching materials in the form of a series of student activities in conducting investigations and problem solving are Electronic Student Worksheets (e-LKPD). While Putriyana et al (2020), Umriani (2020) explained that the e-LKPD guides the work of students so that it makes it easier for them to achieve learning goals in electronics using either a desktop computer, notebook, smartphone, or mobile phone and Haqsari (2014) e-LKPD becomes One of the important tools in online-based learning.

Based on the problems above, researchers are interested in conducting research by developing an e-LKPD based on guided inquiry. It is hoped that the e-LKPD to develop the plane solid figure will help students who so far have not focused on the topic of the plane solid figure at the research school. Therefore, this study aims to develop an e-LKPD to the plane solid figure based on guided inquiry for class VIII junior high school students.

RESEARCH METHOD

This research is Research and Development (R&D) using the ADDIE development model which includes the stages of analysis, design, development, implementation and evaluation (Branch, 2009). This research was conducted at SMP Negeri 2 Bengkulu City. The test subjects in this study were students of class VIII. Due to the limited time for face-to-face meetings during the pandemic, the researchers did not conduct a limited trial of the product. The researcher immediately conducted a field trial on all 17 students in the class.

The development procedure carried out includes the analysis, design, development, implementation, and evaluation stages. In the analysis phase, the researcher conducted 2 (two) needs analysis, namely material analysis, curriculum, situation and condition analysis and student characteristics analysis. At the stage of material and curriculum analysis, the researcher examines the material for the flat side and the curriculum used by the school, as well as the competencies that students must achieve before the product is developed. The Basic Competence (KD) of the flat-sided building material used by the teacher is compared to the KD contained in the curriculum. The comparison results are also related to the obstacles faced by teachers and students in achieving KD, so that researchers can formulate Competency Achievement Indicators (GPA) that are suitable for guiding learning objectives after the product is developed. In the analysis of situations and conditions, the researcher analyzed the methods and learning media used by the teacher during the learning to construct flat-sided spaces. From here it will be known the constraints and suitability of learning media to achieve the learning objectives that have been formulated.

The design stage contains product designs/designs that were developed based on the previous stage, namely the selection of the flat-sided building material and its elements according to the demands of competence; applied learning strategies; e-LKPD design is in accordance with the characteristics of students and also the preparation of validation instruments in the form of material experts, media experts and student response questionnaires. At the development stage, the researcher realized the prototype of the product design and then carried out a product validation assessment by two material experts and media experts. The validation results from these experts will be used as product validity criteria. At the implementation stage, researchers conducted trials on products that had met the valid criteria. The product trial was carried out in learning the material for building flat sides. Furthermore, the practicality of the product was assessed by students through filling out a response questionnaire. The next stage is evaluation. At this stage the researchers conducted observations and collected data for product improvement and refinement based on the results of the evaluation during observing and collecting field data.

The instrument used in this study consisted of a validity assessment questionnaire instrument consisting of a product assessment sheet by material experts, media experts and student response questionnaire sheets. The validity and practicality of the product in the form of a guided inquiry-based flat-sided e-LKPD was obtained through data analysis of the results of expert assessments of the product at the development stage and the results of student response questionnaires at the implementation stage. The expert validation score data obtained is in the form of a Likert scale score. Classifying the assessments given by material experts, media experts and student responses using the classification of validity and practicality criteria as shown in Table 1.

Table 1. Classification of Validity and Practicality Criteria

Score Range	Qualitative Criteria
$\bar{X} > \bar{X}_i + 1.80\ SB_i$	Very good
$\bar{X}_i + 0.60\ SB_i < \bar{X} \leq \bar{X}_i + 1.80\ SB_i$	Good
$\bar{X}_i - 0.60\ SB_i < \bar{X} \leq \bar{X}_i + 0.60\ SB_i$	Enough
$\bar{X}_i - 1.80\ SB_i < \bar{X} \leq \bar{X}_i - 0.60\ SB_i$	Less
$\bar{X} \leq \bar{X}_i - 1.80\ SB_i$	Very Less

(Widoyoko,2018)

Description:
$\bar{X}$: avarage score
$\bar{X}_i$: ideal average
$\bar{X} = \frac{1}{2} \times$ (Ideal maximum score + Ideal minimum score)
SB_i: Ideal Standart Deviation
$SB_i = \frac{1}{6} \times$ (Ideal maximum score − Ideal minimum score)
Ideal maximum score = number of criteria items × highest score
Ideal minimum score = number of criteria items × lowest score

The developed e-LKPD is declared valid if the average score of the assessment results of material experts, media experts and student responses meets the minimum "good" criteria.

RESULTS AND DISCUSSION

The development of e-LKPD to build a plane solid figure based on Guided Inquiry is carried out using the ADDIE development model which consists of five stages, namely; analysis, design, development, implementation and evaluation. In the analysis stage, the researchers found that teachers at SMPN 2 Bengkulu City said that the curriculum and teaching materials for a plane solid figure were contained in the 2013 curriculum (K-13). However, in learning there are still many students who have difficulty understanding the surface area and volume if given a different question from what the teacher has explained.

Based on the results of interviews with VIII grade mathematics teachers at SMPN 2 Bengkulu City, it is known that teachers still use an expository learning approach, in which the delivery of a plane solid figure construction material is carried out with lectures and students follow any information conveyed by the teacher on the blackboard. The teacher when explaining the material on the plane solid figure in class directly gives the formula without giving an explanation of the origin of the formula, so that students do not experience the discovery process. As a result, students do not have direct experience in the learning process, teachers also often do learning with the lecture method, so that students

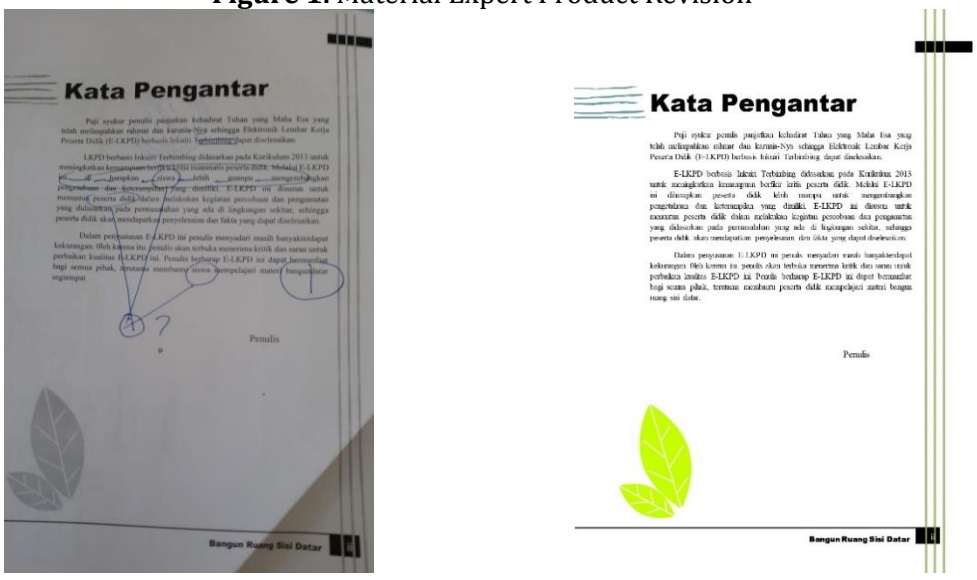
have difficulty solving/solving contextual problems in the plane solid figure material. So that students do not have direct experience in the learning process.

In addition to observing the learning approach/model used by the teacher, the researcher also observed the teaching materials used by the teacher. From the observations made by the researchers, it was found that the teaching materials used by the teacher were in the form of books compiled by the Ministry of Education and Culture. So that it does not require students to carry out the discovery process and there is no set of tasks that contain students to think critically. So that students do not have direct experience in working on the questions. During a pandemic like what is happening now, where the frequency of face-to-face contact is not as much as learning as usual. Students who only do learning with a time that is only 2 x 30 minutes which can usually be 3 x 45 minutes in one meeting, students need electronic teaching materials as learning companions that not only contain material and a collection of formulas, but can be studied anytime and anywhere independently. independent. Therefore we need a teaching material in the form of electronic LKPD. Based on the above analysis, the researchers developed a flat-sided e-LKPD with guided inquiry learning that contains the syntax, namely orientation, formulating problems, formulating hypotheses, collecting data, testing hypotheses, conclusions as a substitute for the expository method to facilitate students who have characteristics like above.

At the design/design stage, the researcher took several steps as follows; 1) Design components of teaching materials developed: KD and GPA compiled in this study. 2) Syntax of Guided Inquiry Learning Model; Presentation of material that contains the learning stages of the Guided Inquiry learning model which includes: Problem orientation, Formulating problems, Formulating hypotheses, Collecting data, Testing hypotheses, Formulating conclusions.

At the development stage, the researchers realized the e-LKPD design that had been validated by material expert validators and media experts. The revision of the e-LKPD was then improved based on the input and suggestions of material experts as shown in Figure 1.

Figure 1. Material Expert Product Revision



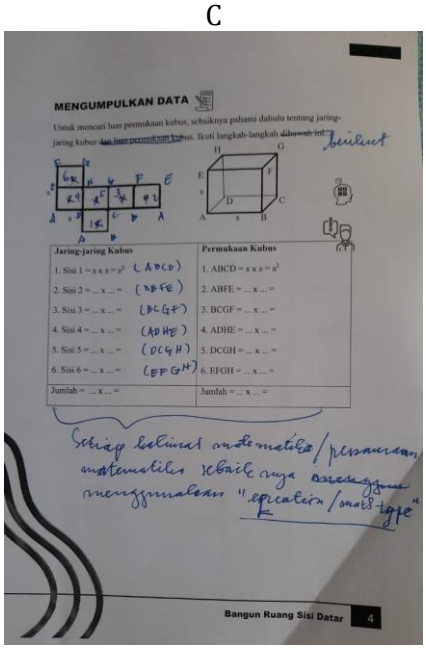
(a) (b)


Materi
Peta Konsep
Bangun Ruang Sisi Datar
Luas Permukaan
Volume
Kubus
Balok
Bangun Ruang Sisi Datar

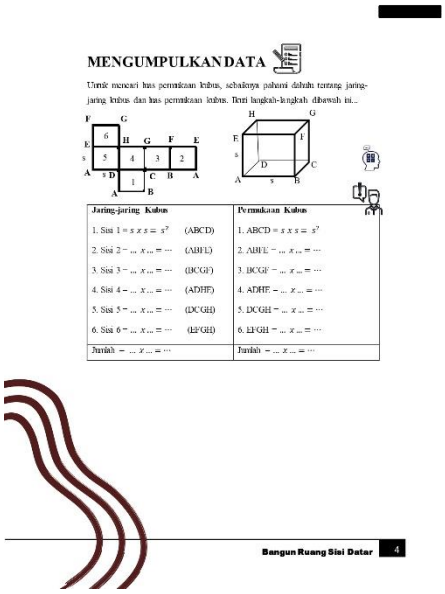
C


Materi
Bangun Ruang Sisi Datar
Luas Permukaan
Volume
Kubus
Balok
Bangun Ruang Sisi Datar viii

d


MENGUMPULKAN DATA
Jaring-jaring Kubus
Permukaan Kubus
Bangun Ruang Sisi Datar 4

(e)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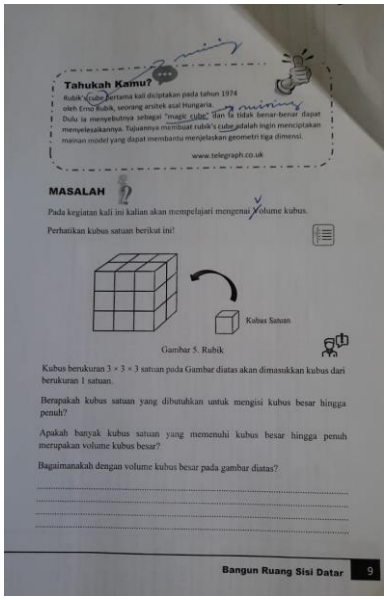
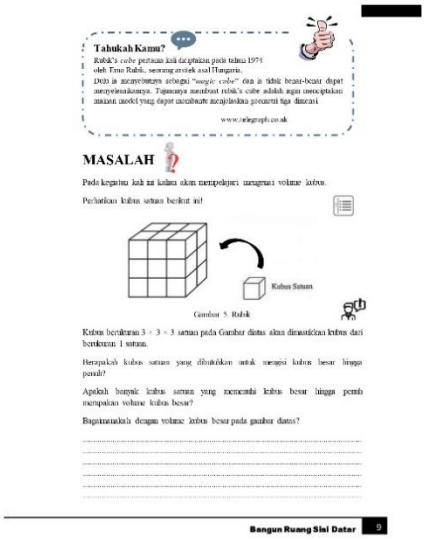
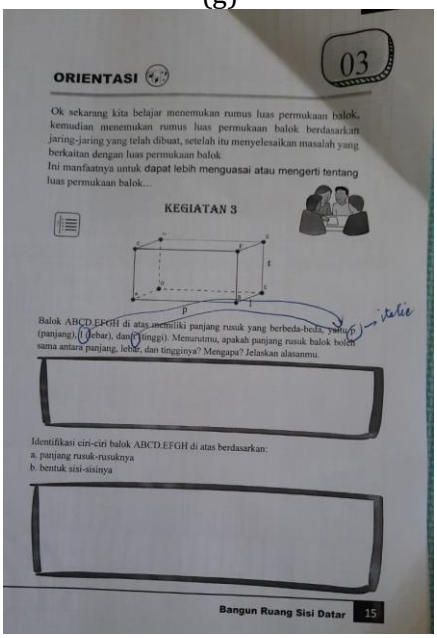
(f)



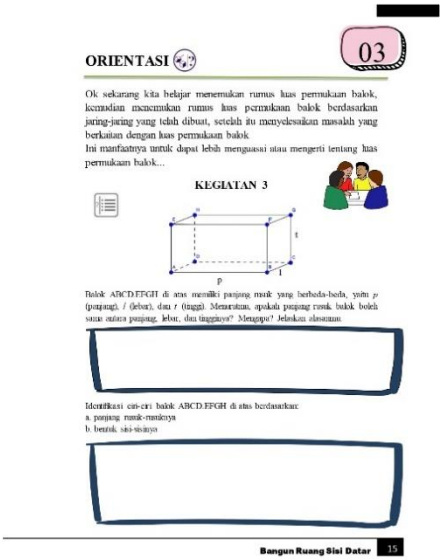
(g)



(h)



(i)



(j)

Figure 1. Writing errors in the content of the Preface (a) (b), Concept map turned into material (c) (d), Every math sentence/mathematical equation use equations/math type (e) (f), Writing words using English written in italics (g) (h), Writing p, l, t in italics (i) (j).

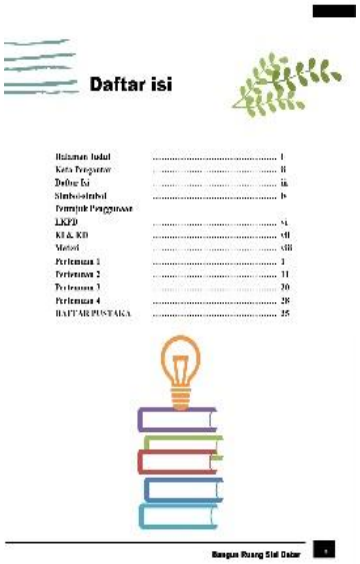
The revised e-LKPD that has been improved based on input and advice from media experts can be seen in Figure 2.

Figure 2. Media Expert Product Revision

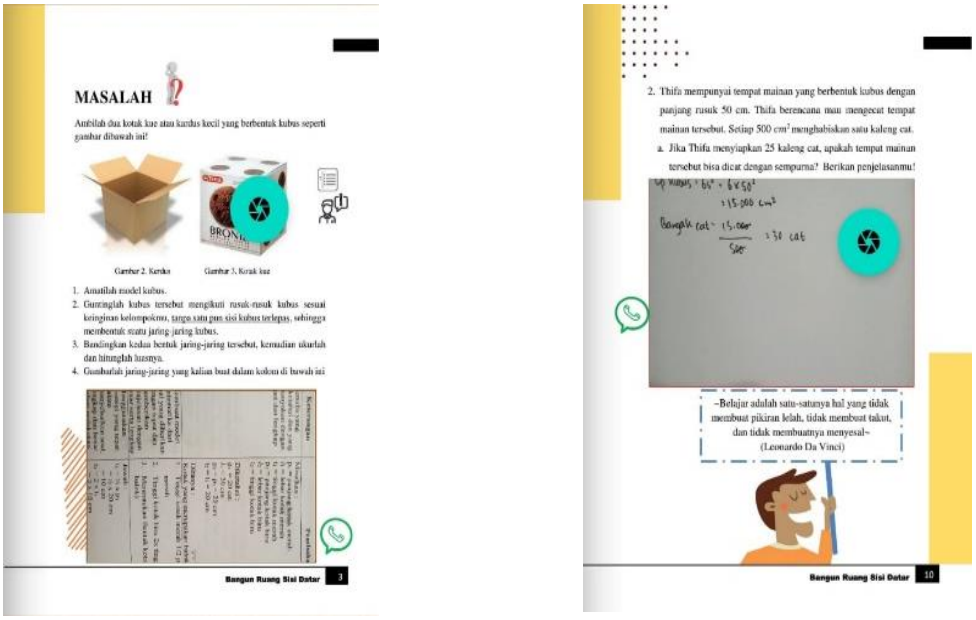
(a)

(b)

c



d



(e) (f)

Figure 3. The cover doesn't fit because there is a curved side space (a) (b), Change the font in the table of contents to a more readable font (c) (d), Reverse photo displaye (e) (f),

Researchers realized the e-LKPD design that had been planned at the design stage into a product of teaching materials. First, the worksheet design designed through Microsoft Word 2013 was converted in PDF format. In addition, researchers also make learning videos that are part of development that uses references from YouTube. Files that are already in PDF format are then imported (inserted) into the Flip PDF Corporate Edition application system and the project file is published by converting it in HTML 5 format, so that it becomes an LKPD which is developed into an electronic LKPD.

In order to adjust the characteristics and functions of the e-LKPD material for flat-sided construction based on Guided Inquiry as interactive teaching materials for students, which does not eliminate the characteristics of the LKPD, additional features are needed that support these characteristics and functions. Therefore, the researcher uses the FAPA book extender application which is an application to expand the functionality of Flip PDF Corporate Edition on Android devices. So that the results of the Flip PDF Corporate Edition publication can be read by apk. FAPA book extender, the researchers made book configs tailored to the needs of the developed e-LKPD. Display of e-LKPD which is already an application. It can be used both online and offline. The resulting e-LKPD product is in the form of a prototype that will be validated by material experts and media experts. The results of material expert validation can be seen in Table 2.

Table 2. Material Expert Validation Results

No.	Aspect	Validator		Total Score
		1	2	
1	Kelayakan Isi	16	14	30
2	Kebahasaan	25	23	48
3	Penyajian	21	18	39
4	Pembelajaran Inkuiri Terbimbing	4	4	8
	Avarage Total Score	66	59	62,5
	Category		Good	

In Table 2, it can be seen that the total score of material expert 1 is 66 in the "Good" category, while the total score of material expert 2 is 59 in the "Good" category. The average score of the two material experts is 62.5 with the "Good" category. Based on the results of material expert validation, it was found that the developed e-LKPD was declared valid or feasible to use in terms of material. The results of media expert validation can be seen in Table 3.

Table 3. Media Expert Validation Results

No.	Aspect	Validator		Total Score
		1	2	
1	Ukuran e-LKPD	10	9	19
2	Layout	20	22	42
3	Desain e-LKPD	25	27	52
4	Ilustrasi	4	5	9
	Avarage Total Score	59	63	61
	Category		Very Good	

In Table 3, it can be seen that the total score of validator 1 is 59 in the "Very Good" category, while the total score for validator 2 is 63 in the "Very Good" category. The average score of the two media experts was 61 in the “Very Good” category. Based on the results of the media expert validation obtained, it can be concluded that the developed e-LKPD is declared valid or feasible to use in terms of media.

The results of the student response questionnaires obtained can be seen in Table 4.

Table 4. Student Response Questionnaire Data

Respondent	Total Score	Category
1	80	Baik
2	86	Sangat Baik
3	78	Baik
4	91	Sangat Baik
5	90	Sangat Baik
6	96	Sangat Baik
7	78	Baik
8	75	Baik
9	86	Sangat Baik
10	77	Baik
11	79	Baik
12	76	Baik
13	73	Baik
14	76	Baik
15	80	Baik
16	64	Cukup
17	80	Baik
Amount	1365	Good
Average Score	80.29	

In table 4, it can be concluded that the developed e-LKPD is declared "practical" because it has met the practicality standard through an average result of 80.29 with the "good" category for student responses.

The fulfillment of the criteria for the validity and practicality of the developed e-LKPD, shows the feasibility of this guided inquiry-based e-LKPD as teaching material for learning the material for a plane solid figure. Thus, the e-LKPD can be used as an alternative to innovative teacher teaching materials to improve the effectiveness of teacher teaching. Effective teaching is important because the effectiveness of a teacher's teaching reflects the

quality of the learning he does, both effectiveness in student success, reliable classroom management and appropriate learning design (Andriyani et al., 2020).

This research still has some limitations. First, the validity of the development product is only reviewed from material experts and media experts, and the response side of students as users and has not been reviewed from the side of the teacher as a party who is also involved and knows how to implement e-LKPD developed in learning. This makes this study need further study of the practicality assessment of e-LKPD from the teacher's point of view.

CONCLUSION

Based on the results and discussion above, it can be concluded that the Guided Inquiry-based e-LKPD for the a plane solid figure material meets the valid and practical criteria for a product development. The validity of the e-LKPD is shown by the results of the assessments of two material experts with an average of 62.5 in the "Good" category and two media experts with an average of 61 in the "Very Good" category of student response questionnaires with an average of 80.29 in the "good" category. Based on these results, it shows that the e-LKPD based on Guided Inquiry for the plane solid figure material developed has been in accordance with good classification and is suitable for use. The school can also integrate a 4C (Critical Thinking, Creative, Communication, and Collaboration) skill into the use of this teaching material to achieve the learning objectives of building a flat side space.

ACKNOWLEDGEMENT

Regarding the effectiveness of the e-LKPD for students, the researcher suggests that further research be carried out in order to determine the effectiveness of the e-LKPD on students' mathematical abilities. also suggest the development of e-LKPD with similar concepts for other mathematics materials, so that abstract concepts can be illustrated and help students understand.

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