

**Developing Essay Questions on Prism and Pyramid
for the Ability to Understand Mathematical Concept**

Ingka Jameela^{1*}, Yuriska Destania¹

¹ FKIP, Pendidikan Matematika Universitas Muhammadiyah Bengkulu, Indonesia.

*Corresponding author, e-mail: jameelaingka@gmail.com

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Abstract

The purpose of this study was making valid and practical essay questions on prism and pyramid for students' ability to understand mathematical concepts. The method used was Research and Development with the Tessmer development model consisting of preliminary stages, self-evaluation, expert review and one-to-one stages. The results of this study were in the form valid and practical (legible) essay questions on prism and pyramid for the ability to understand mathematical concepts. the validity of the questions was seen from the validators' comments on the questions and the practicality (legibility) of the questions is seen from the readability of the questions when given to students. There were 10 valid and practical (legible) questions obtained in the end of this research.

Keywords: *developing essay questions, understanding mathematical concepts*



INTRODUCTION

Learning can be defined as a system or process of student learning that is planned, designed, implemented and evaluated so that students can achieve learning goals effectively and efficiently. It is a system consisting of various components interconnected with one another. These components include objectives, materials, methods and evaluation. According to Rusman (2015), learning can be formulated in various senses according to the paradigm used, from the understanding of learning according to behaviourism, cognitivism, and constructivism. Sitepu (2014) concluded that learning is a conscious effort carried out in a planned, systematic manner, and it uses certain methods to change relatively sedentary behaviour through interaction with learning sources.

Mathematics plays an important role in advancing science and technology because all science and technology make use of mathematics. In learning mathematics, students are trained on how to think and process logic so that the teaching and learning process runs optimally, with the aim that students can understand the concepts in mathematics learning. The Ministerial Regulation of the Minister of National Education of 2006 No. 22 on the content standards for primary and secondary education units states that one of the objectives of learning mathematics is that students have the ability to understand concepts, explain the relationship between concepts and apply concepts and algorithms in a flexible, accurate, efficient and precise way in solving problems. By referring to the objectives of learning mathematics, students need to have the ability to understand mathematical concepts in order to understand and understand the concepts of the material being studied.

According to the Great Dictionary of Indonesian language (2008), understanding means knowing precisely, while concepts are defined as ideas or meanings that are abstracted from concrete events. Mawaddah & Maryanti (2016) state that understanding is a process consisting of the ability to explain and interpret something, be able to provide broader and more adequate descriptions, examples and explanations and be able to provide more creative descriptions and explanations.

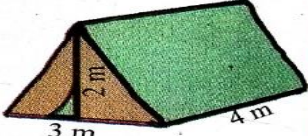
Aledya (2019) states that learning mathematics a deep and meaningful understanding will bring students to feel the benefits of mathematics in everyday life.

Conceptual understanding is a type of learning outcome that is higher than knowledge, with the ability to understand mathematical concepts, students can not only work on math problems by memorizing formulas, but with understanding, students can better understand the concept of the subject matter itself. Masitoh & Prabawanto (2016) state that knowledge learned with understanding will provide a basis for the formation of new knowledge, after the formation of an understanding of a concept, students can give opinions and explain a concept. With this understanding, it will help students to be able to develop their thinking skills in understanding a material more deeply and be able to apply it in problem-solving.

Students' knowledge and understanding of a concept can be measured through indicators of students' ability to understand mathematical concepts, Istikomah & Jana (2018) Explain the indicators of the ability to understand mathematical concepts as follows: (1) Restating a concept, namely students ability to express it again orally or in writing about the material that has been communicated to them, (2) Classifying objects based on certain properties according to the concept, namely students ability to classify an object according to its type based on the properties contained in the material, (3) Giving examples and not examples of a concept, namely the students' ability to distinguish an example and not an example of a material, (4) Presenting the concept in various forms of mathematical representation, namely students ability to explain the concept in a mathematical sequence, (5) Developing the necessary and sufficient conditions for a concept, namely students ability to assess which conditions are necessary and sufficient related to a material concept, (6) Using, utilizing and selecting certain procedures or operations, namely students ability to solve questions appropriately according to the procedure, (7) Applying concepts or algorithms to problem solving, namely students ability to use the concept is in accordance with the procedure in solving problems related to everyday life.

Ayo Kita Berlatih 8.2

1. Sebuah prisma alasnya berbentuk persegi panjang dengan luas alas 40 cm^2 . Jika lebar persegi panjang 5 cm dan tinggi prisma 12 cm , hitunglah luas permukaan prisma.
2. Alas sebuah prisma berbentuk segitiga siku-siku dengan panjang sisi 12 cm , 9 cm , dan 15 cm . Jika tinggi prisma adalah 30 cm , hitunglah luas permukaan prisma tersebut.
3. Pernahkah kalian berkemah? Berbentuk apakah tenda yang kamu pakai? Bila tenda yang kamu pakai seperti gambar tenda di samping, dapatkah kamu menghitung luas kain terkecil yang diperlukan untuk membuat tenda itu? Coba hitunglah.



Gambar 8.12 Tenda

Figure 1. Questions at SMPN 34 of North Bengkulu

It can be seen that the prism and pyramid questions do not meet the indicators of students' ability to understand mathematical concepts. In fact, the teachers of State Junior High School (SMP N) 34 of North Bengkulu are only fixated on the questions in the book, so students in this school are not familiar with the questions that contain indicators of the ability to understand mathematical concepts and when given questions about the ability to understand concepts the results are still unsatisfactory. Therefore, a reference is needed, which contains indicators of the ability to understand mathematical concepts. Research on the development of prism and pyramid essay questions to accommodate the ability to understand mathematical concepts will be carried out to try to answer the problems previously described.

METHOD

This is a research and development, which according to Sugiyono (2009) is a basic research activity to obtain information on user needs (needs assessment), then is proceed with development activities to produce products and assess the effectiveness of the product. The research was conducted Talang Jarang Village, Air Napal District, North Bengkulu regency, with 6 students of 7 grade at SMP N 34 of North Bengkulu as the subjects.

This research and development follows the research flow of Tessmer model (1993) and modified by Zulkardi (2006). The development model consists of

preliminary stages, self-evaluation, expert review, one-to-one, small group and field tests.

The purpose of this study was to produce a valid and practical (legible) prism and pyramid essay for the ability to understand mathematical concepts of 7th graders of junior high school. The subjective questions are generally in the form of essays (descriptions). The essay form test is a type of learning progress test that requires answers in the form of word discussion or descriptions (Suharsimi Arikunto, 2013)

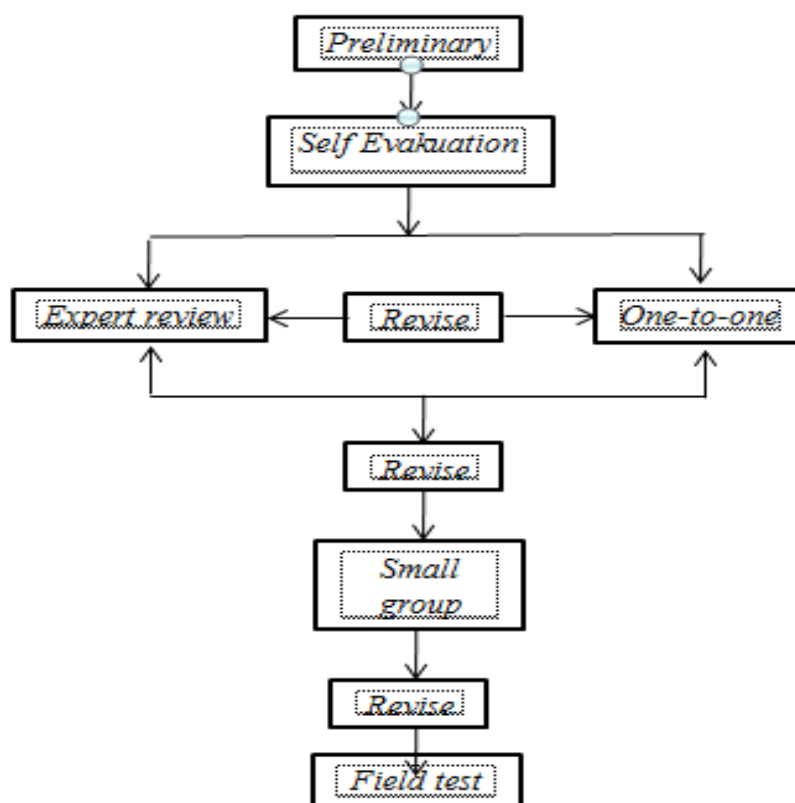


Figure 2. Design flow of Tessmer (1993) modified by Zulkardi (2006)

This research is only carried out until the one-to-one stage by looking at the legibility of the questions because it is not possible to gather many students at the time of the Covid-19 pandemic for the small group stage. This is in line with research conducted by Dwi et al. (2020) whose research is only up to the legibility stage.

In this study, the data collection instruments used are documents, validation sheets, student comments/suggestions, and prototypes. The documents are in the form of data about student knowledge and the curriculum implemented in schools. They are

collected as references in designing questions of students' ability to understand mathematical concepts. The validation sheet is used to obtain question validation data which will be shown to the validators consisting of 2 lecturers. The results of the validators' comments and suggestions are used as material to revise the question. This instrument is used at the Experts Review and one-to-one stage to obtain validation data based on content, constructs and language. Student comment/suggestion sheets for questions are used to obtain data about student opinions on the questions being developed.

The prototype in this study are essay questions tried out on students and evaluated by experts and teachers. Prototypes are reviewed by experts at the expert reviews and one-to-one stages.

The data analysis technique used in this study is based on the following stages: preliminary and self-evaluation, experts review and one-to-one. Documents obtained during preliminary and self-evaluation were analyzed qualitatively. At this stage, there will be data analysis related to students, especially students of class VIII SMP and students' knowledge of prisms and pyramids. In addition, the curriculum used in the data collection was the 2013 curl.

Experts Review and One-to-one are used to validate the essay questions developed. The results of validation at the expert's review stage are based on content, constructs, and language, which are then analyzed qualitatively as materials for revising the prototype. In the One to one stage, the results of student work are analyzed qualitatively as a consideration for the legibility of the questions that have been made.

The good indicators for questions in this study are those which are declared valid and practical. Validity will be seen from the extent to which the accuracy of a measuring instrument performs its measuring function. According to Kusaeri and Suprananto (2012), validation is appropriateness, meaningfulness and usefulness of a conclusion obtained from the interpretation of test scores. Essay questions developed will be seen the validity of the content, the validity of the language and the validity of the construct. Validation will be carried out by experts who meet the criteria of a mathematics learning expert.

Content validity is the degree to which the evaluation test measures the scope of the substance to be measured. (Sukardi, 2008). Meanwhile, a test can be declared valid in terms of the construct validity of the items that construct the test measure every aspect of thinking (Arikunto, 2012). Meanwhile, the validity of the language will see that the language used in the essay questions developed is in accordance with standard language rules (EYD) or not. Practicability test is needed to see the level of ease of use of the product being developed. Practicability is seen from the students' legibility of the questions.

RESULTS AND DISCUSSION

This research consists of four stages, namely: preliminary, self-evaluation, experts review and one-to-one; the activities carried out are as follows:

Preliminary

In the preparation stage, the researcher looks at the existing problems. The problem found is that there are still a few questions for the students' ability to understand mathematical concepts for the subject of prisms and pyramids. In contrast, these questions are needed to train and find out the students' concept understanding skills. After identifying the existing problems, a research location is determined, the village of Talang Jarang Village, Air Napal District, North Bengkulu regency, with 6 students of 7 grade at SMP N 34 of North Bengkulu as the subjects. The next agenda is setting the research schedule and research procedures.

In addition, curriculum analysis is also carried out. At this stage, an analysis of the curriculum used at SMP N 34 of North Bengkulu is carried out. This activity was carried out on May 28, 2020. The analysis process was carried out through interviews with mathematics teachers of clas 7 at SMP N 34 of North Bengkulu. The results of the curriculum analysis are as follows: (a) Each week of mathematics lessons 2 times with an allocation of time 2 x 40 minutes and 3 x 40 minutes, (b) The curriculum used at SMP N 34 North Bengkulu is the 2013 curriculum. And essential competencies in accordance with the prism and pyramid material can be seen in Table 1.

Table 1. Core and Basic Competencies of Prism and Pyramid Materials

Core Competencies	Appreciating and living honest behaviour, discipline, responsibility, care (tolerance, mutual cooperation), courteous, self-confidence, in interacting effectively with the social and natural environment within the range of association and existence.
	Understanding and applying knowledge (factual, conceptual, and procedural) based on his curiosity about science, technology, art, culture related to visible phenomena and events
	Processing, presenting, and reasoning in the concrete realm (using, unravelling, arranging, modifying, and making) and the abstract realm (writing, reading, counting, drawing, and composing) in accordance with what is learned in school and other sources that are the same in perspective /theory
Basic Competencies	Demonstrating curious behaviour in carrying out activities at home, school, and society as a form of implementation of investigating the properties of cubes, blocks, prisms and pyramids and their parts through props
	Determining the surface area and volume of a cube, block, prism, and pyramid
	Estimating and calculating the surface area and volume of irregular shapes by applying their basic geometry

Material analysis

In the material analysis, the material used in this study is the prism and pyramid material. Before studying the prism and pyramid material, students have studied cubes and blocks. So that when studying prisms and pyramids, students can find it easier to understand the material. Prisms and pyramids are one of the materials in the 2013 curriculum. The use of this subject has also been adjusted to the time of the study so that while researching students have studied the material first.

Student analysis

Student analysis is a study of student characteristics to suit the design and development of questions. These characteristics include the students' background knowledge and cognitive development.

Analysis of students' background knowledge

The prism and pyramid sub-topic studied in 7 grade is new material studied by students, but the elements of prisms and pyramids such as triangles, squares, pentagons, etc., have been studied by students so that students can understand the prism and pyramid material.

Analysis of student cognitive development

The 7th graders at SMP N 34 of North Bengkulu are the subjects in this study, with an average age of 12-13 years. At this age, the thinking ability has entered the formal operational stage. When solving a problem, children at this stage will think about it theoretically. The theoretical analysis can be done verbally; they analyze the problem by solving various hypotheses that may exist. On the basis of this analysis, then an approach is made in solving the existing problems at an early age.

Design

The results of the student analysis, curriculum and material are used as a reference for designing the ability to understand mathematical concepts.

Self-evaluation

At this stage, the prototype that has been designed based on indicators, question grids and answers totalling 20 questions is self-assessed in terms of content, construction and language. This is done before being validated by the experts (validators).

Experts review

At this stage, the items that have been designed for the ability to understand mathematical concepts are reviewed by two validators, who are lecturers in mathematics education at the Muhammadiyah University of Bengkulu. The study of these items is viewed from the material, construction and language. This question study is a qualitative analysis of the items for validity, especially the content validity of the items. The results of the experts' review are written on the validators' comments and suggestions. These comments and suggestions are to revise prototype 1. In the first validation, validator I argued that many questions in the prototype I do not match the indicators; here is one of the results from experts review:


	 <p>Ella mempunyai sebatang coklat, dengan bentuk memanjang, jika di tegakkan, sisi tegaknya berbentuk 3 buah persegi panjang yang kongruen, dengan sisi alas dan tutup berbentuk segitiga sama kaki yang kongruen, jika kaki - kaki nya memiliki panjang 6 cm dengan alas 4 cm, serta coklat tersebut memiliki tinggi 20 cm, tentukanlah volume dari coklat tersebut!</p> <p>8. Sebuah limas dengan alas belah ketupat mempunyai panjang diagonal 24 cm dan 15 cm, jika tinggi limas tersebut adalah 28 cm, tentukanlah volume limas tersebut!</p>	<p>Sesuaiakan dengan indikator</p>
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Figure 3. One of the experts review results

After two revisions with the validator I, the prototype is declared valid, and the validation continued with validator II, the validation process with validator II for 4 times and the prototype is declared valid, then proceed to the one-to-one stage.

One-to-one stage

After the expert reviews the questions, 14 valid questions are produced, then the questions are given to 6 junior high school students in grade 7 having different abilities by asking students to read, understand the aims and objectives, then the students are asked to record their comments and suggestions on the sheet provided. The comments and suggestions from students regarding question number 1 tested are as the followings:

Table 2. Student comments about the ability to understand the concepts given

Students name	Comments
Putri ramadhani	The story is interesting, current and quite clear.
Cinta violita	The story is very good and interesting.
Repi aprilia	The story is good and interesting
Jona ade putra	The story tells about corona
Rehan hidayatullah	Tells about covid-19
Irfan saputra	The story is very good

From the students' comments above, it can be concluded that most of the questions given to them were easy to understand and interesting. They were very happy when given story questions, even though there were still students who did not understand what the questions meant.

To find out the practicality (legibility) of the developed mathematical concept understanding, a trial was conducted by asking students to work on 14 questions on the ability to understand mathematical concepts, the researcher conducted this trial for 2 days, on the first day the students were asked to work on questions 1-7, and on the second day students were asked to do questions 8-14. One of the answers from students is:

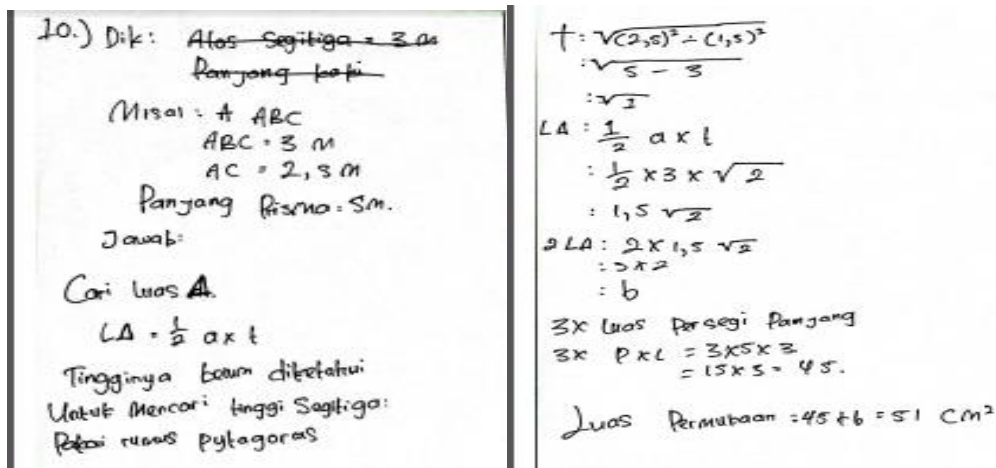


Figure 4. The answer from an advanced student named PutriRamadhani

In question no.10 Putri was wrong with the shape of 3 rectangles that make up the tent, she thought that the three rectangles that made up the tent were congruent, while from the triangles we can see that the congruent rectangle is only the vertical side of the tent, while the sleeping base used by Andri had different sizes.

10. Dik : Alas berbentuk persegi panjang
 Atap 2 buah persegi panjang
 yg kongruen dengan alas
 dg : panjang = 5 m
 lebar = 2,5 m

2. buah segitiga yang belum diketahui tingginya :
 dengan alas = 3 m
 panjang kaki = 2,5 m

Jawab : L persegi panjang = $5 \times 2,5 = 12,5$
 $L \square$ keseluruhan = $3 \times 12,5 = 37,5 \text{ cm}^2$
 $L A = \frac{1}{2} a \times t$
 $T = \frac{\sqrt{(2,5)^2 - (1,5)^2}}{1}$
 $= \frac{\sqrt{5 - 3}}{1}$
 $= \sqrt{2}$
 $L A = \frac{1}{2} a \times t$
 $= \frac{1}{2} a \times \sqrt{2}$
 $= \frac{1}{2} 3 \times \sqrt{2} = 1,5 \sqrt{2}$
 $L 2 A = 2 (1,5 \sqrt{2})$
 $= 3 \times 2$
 $= 6$
 Luas permukaan tenda
 $37,5 + 6 = 43,5 \text{ cm}^2$

Figure 5. The answer from an advanced student named Cinta Violita

Vio was also not very careful in question no.10 when determining the size of the rectangle in the tent. She thought the rectangle in the tent was congruent, the daughter used the width = 3, while Vio used the width = 2.5.

From the one-to-one stage, 10 practical (legible) questions were obtained as prototype II. The screenshot of Prototype II in the form of essay questions that have been declared valid and practical can be seen in Figure 6.

Soal essay

1. Tahun 2020 menjadi tahun yang sangat bersejarah bagi umat manusia, di tahun ini seluruh dunia digemparkan dengan virus corona atau covid-19. Virus ini memiliki tingkat penularan yang sangat tinggi, sehingga pemerintah Indonesia menyarankan agar semua kegiatan yang melibatkan masyarakat banyak diliburkan, termasuk kegiatan belajar mengajar di sekolah, sehingga siswa harus menjalani sistem belajar online. Dzaky diminta gurunya untuk mengamati bentuk limas dalam kehidupan sehari-hari, jika yang Dzaky amati adalah atap rumah, dengan bentuk seperti gambar di bawah ini.



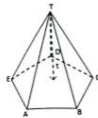
Bantulah dzaky menyatakan mengapa atap rumah seperti gambar di atas bisa disebut limas!

2. Untuk mengisi kekosongan saat libur karena dampak covid-19, bu Selly mengajak anaknya untuk berkreasi, dengan membuat kotak berbentuk prisma segi enam seperti gambar di bawah ini :



Kotak tersebut akan dijadikan oleh bu Selly sebagai tempat penyimpanan benda-benda kecil yang ada di rumah agar tidak berantakan.

Mengapa kotak di atas dapat disebut sebagai prisma segi enam? Jelaskan!



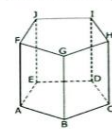
Kotak hantaran tersebut dapat dibuka dengan cara menggantung rusuk-rusuk tegaknya, bagaimana bentuk kotak hantaran tersebut setelah dipotong rusuk-rusuk tegaknya? Gambarkanlah!

7. Pak Rudi akan membuat akuarium dengan sketsa sebagai berikut:



Aquarium itu akan diisi dengan air, dengan bentuk aquarium seperti gambar di atas, bantulah pak Rudi menghitung berapa liter air yang pak Rudi perlukan agar aquarium itu bisa terisi penuh!

8. Pak Riza seorang tukang kayu mendapat pesanan membuat pot bunga dengan bentuk prisma segi lima, seperti gambar di bawah ini!



Pelanggan meminta agar pot bunga tersebut memiliki volume 3.744 cm^3 , tinggi potnya 13 cm dan panjang apotema alas pada pot tersebut adalah 9 cm karena saat pelanggan memesan pot tersebut pak Riza sibuk, sehingga ia tidak terlalu mendengar saat pelanggan menyebutkan panjang sisi alas segilima dari pot tersebut, dengan nilai-nilai yang telah diketahui, bantulah pak Riza untuk menentukan panjang sisi dari alas prisma yang berbentuk segi lima tersebut!

3. Perhatikan gambar berikut



Suhu di kota Bengkulu sudah mencapai 32° Celsius, membuat Indah ingin membeli es krim cornetto, benda di samping adalah es krim cornetto yang berbentuk kerucut. Apakah es krim cornetto juga berbentuk limas? Jelaskan dan berikan contoh dan bukan contoh limas yang terdapat di sekitarmu!

- 4.



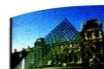
Pak Narto adalah seorang mandor, ia akan mengerjakan proyek pembangunan perumahan di suatu kompleks perumahan di kota Bengkulu, pak Narto membutuhkan semen, batu bata, dan pasir. Coba perhatikan bentuk batu bata di samping, apakah batu bata termasuk ke dalam bangun ruang sisi datar jenis prisma? Jelaskan dan berikan contoh dan bukan contoh prisma dalam kehidupan sehari-hari!

- 5.



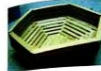
Bu Mega pemilik toko coklat, ia ingin mendesain kotak coklat agar menarik pembeli, dia kepikiran untuk membuat kotak coklat berbentuk limas, jadi bu Mega harus menggambar sketsa kotak coklat tersebut. Bantulah bu mega dengan langkah-langkah berikut :

- Gambarlah sketsa dari kotak coklat tersebut!
- Gambarlah jaring-jaring dari kotak coklat tersebut!



Indahnya Piramida Louvre di Kota Paris, dengan bentuk limas segitiga, dengan sisi-sisi tegak terbuat dari kaca, dan berdiri tegak diatas lantai di tengah kota Paris, jika lantai yang dibutuhkan berbentuk segitiga sama sisi dengan panjang sisi 6 m, tentukan luas kaca yang akan digunakan jika panjang rusuk piramida tersebut adalah 6 m!

10. Farel membeli buah yang akan diletakan di sebuah wadah dengan bentuk seperti gambar di bawah ini:



Tinggi dari wadah tersebut adalah 20 cm, jika panjang sisi dari alas wadah diatas adalah 40 cm, tentukan luas permukaan dari wadah tersebut!

Figure 6. Prototype II

CONCLUSION

Based on the results and discussion of the development stage, it can be concluded that the essay questions on the prism and pyramid material for the ability of mathematical concepts understanding developed for the 7th graders are declared valid by the expert. At the expert review stage, the questions developed were reviewed by two lecturers, and the data were valid in terms of material, construct and language.

The essay questions developed were also stated to be practical (legible). It was assessed at a one-to-one stage, based on students' comments and answers about the questions

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