Hipotenusa : Journal of Mathematical Society
Volume 3 Issue 2 Year 2021
ISSN: 2716-3156
Website: https://hipotenusa.iainsalatiga.ac.id/index.php/hipotenusa/index

Mathematics Student Worksheet Based on Guided Discovery for Concept Understanding and Curiosity

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DOI: 10.18326/hipotenusa.v3i2.6316

Article submitted : October 24, 2021
Article reviewed : November 11, 2021
Article published : December 1, 2021

Abstract

This study aims to develop and produce a mathematics student worksheet based on guided discovery to facilitate the understanding concept and the curiosity of eighth grade students on prism and pyramid material. The type of research is research and development using the Richey and Klein development procedure, which consists of the planning, production, and evaluation. Mathematics student worksheet assessment for material and media experts. Material and media experts fill out the mathematics student worksheet assessment. The research data analysis technique is product quality analysis. According to the evaluation of material experts and media experts, the mathematics student worksheet is very good. Based on the results of the study, it found that the quality of the mathematics student worksheet based on guided discovery was classified as very good with the specification of the average score of the material expert validator assessment of 194.5 from the ideal maximum score of 208 and classified in the very good category with the specification of the average score of the media expert validator assessment of 57 from the ideal maximum score of 72. Based on this, the product of the guided discovery-based math worksheets is declared valid and can use in the learning process.

***Keywords**: mathematics student worksheet, guided discovery, concept understanding, curiosity, prism, pyramid*

INTRODUCTION

Mathematics is a branch of science in education that has a fundamental goal for students at school. In learning mathematics, there are learning objectives listed in the Regulation of the Minister of Education of the Republic of Indonesia Number 22 of 2006. One of the goals listed is for students to have the ability to understand mathematical concepts, explain the relationship between concepts and apply concepts or

algorithms flexibly, accurately, efficiently, and precisely in problem-solving (Hadi & Kasum, 2015; Wahidah et al., 2018; Wijaya et al., 2018). In this mathematical objective, it is clear that understanding mathematical concepts has an essential role in learning mathematics and is the most basic ability in learning mathematics.

The concept understanding refers to the ability of students to combine new ideas in mathematics with ideas they know. It is used to describe mathematical situations in different ways, determine differences, and add to the level of knowledge of students who initially do not know and who initially do not understand. Students who can understand concepts can solve problems well because solving problems requires rules based on their concepts (Effendi, 2017). In addition, good concept understanding skills will also provide better knowledge of the facts behind mathematical ideas (Harleni & Ningtias, 2019; Jbeili, 2012; Wijaya et al., 2018). Indicators of the concept understanding used in this study by Research and Development Institution are as follows: ability to restate a concept; ability to classify objects according to specific characteristics (according to the concept); ability to give examples and not examples of concepts; ability to present concepts in various forms of mathematical representation; ability to review necessary conditions or enough conditions from the concept; ability to use, utilize, and select specific procedures or operations; and ability to apply concepts or algorithms to problems-solving (Faulkner et al., 2021; Hendriana et al., 2019; Hill et al., 2015; Ulfa & Puspaningtyas, 2020). Given the many concepts in mathematics that are needed in learning, it will not work if students only memorize concepts. Therefore, a frame of mind that is more than just memorizing is needed, namely linking concepts in a material.

Based on its characteristics, mathematics is an orderly and organized structure. All concepts in mathematics are arranged systematically and hierarchically, starting from the most straightforward concepts to the most complex concepts. In mathematics, the primary object studied is abstract. The basic object includes concepts, principles, and operations (Hasratuddin, 2014). That shows that understanding concepts has an essential role in learning mathematics. Errors in understanding concepts in students will be difficult to correct if they have been used in solving math problems. A good and robust understanding of concepts will make it easier for students to relate mathematical

procedural knowledge. On the other hand, it will not be elementary for students to go to a higher learning process if they do not understand the concept (Hutagalung, 2017).

In Indonesia, character education is packaged in character and competency-based 2013 curriculum, implemented in 2013/2014. The values in character education come from religion, Pancasila, culture, and national education goals. Based on these existing values, in detail in the 2010 Ministry of National Education regarding Development of National Culture and Character Education and Yogyakarta Mayor Regulation Number 60 the Year 2011 concerning Character Education Development in Education Units, 18 character values have been formulated. Based on these 18 characters, one of them is curiosity. Curiosity is a way of thinking, attitude, and behavior that reflects curiosity and curiosity about all things seen, heard and studied in greater depth (Kemendiknas, 2010). Curiosity is a way of thinking, attitude, and behavior that reflects curiosity and curiosity about all things seen heard, and studied in greater depth. Curiosity is the initial capital for students in the learning process at school. Students with a high sense of curiosity will learn more to fulfill the thirst for knowledge they want to have. Through their curiosity, students will learn and discover things (Fauzi et al., 2017; Simamora & Saragih, 2019).

The character of curiosity in students cannot be done instantly but requires an iterative process until it becomes a habit. In achieving this goal, it is necessary to create a learning environment that can teach students, encourage learning, provide opportunities to construct knowledge in learning concepts actively, and raise curiosity (Aningsih & Asih, 2017). Researchers chose indicators on the character of curiosity: asking; answering questions; paying attention; and enthusiasm, the selection of these indicators was adjusted to the learning method used in the study. In increasing curiosity, it can be through learning mathematics, one of which is geometry material.

Geometry is one of the branches of mathematics that has an essential role in life because geometry is often applied in the real life of students. However, students still have difficulty concept understanding geometry (Noto et al., 2016; Septriani, 2017; Sutiarso et al., 2018; Widodo, 2017). Based on the SMP/MTs National Examination results in table 1, the mastery of geometry and measurement materials is the lowest compared to other abilities. Geometry has an average absorption capacity of 44.08%. That shows that geometry is the most challenging material for students. Mastery of

geometry material is needed so that students are ready to learn geometry at the next level. That indicates the need for efforts to improve geometry competence in SMP/MTs.

Table 1. Percentage of Mastery of Mathematics Question Material for SMP/MTs National Exams in 2016/2017, 2017/2018, and 2018/2019 in Indonesia

No	Tested Abilities	Absorption			Average Absorption
		2016/2017	2017/2018	2018/2019	
1	Number	51,05	44,99	39,71	45,25
2	Algebra	48,6	41,88	51,24	47,24
3	Geometry and Measurement	48,57	41,4	42,27	44,08
4	Statistics and Opportunities	56,4	45,71	55,6	52,57

Resource: BSNP Education Assessment Center Kemendikbud

Class VIII students must master is 3D-shapes with flat side, including cubes, cuboids, prisms, and pyramids. Class VIII students must master is 3D-shapes with flat sides, including cubes, cuboids, prisms, and pyramids. 3D shapes with flat sides are a prerequisite for 3D shapes with curved sides, so students need to understand the concepts properly. However, students often have difficulty in studying prism and pyramid (Azizah et al., 2018; Dalle et al., 2017; Herawaty et al., 2018; Mufida et al., 2018). Often students are required to find their own in solving the problems. However, students have difficulty solving the problems because the teacher does not guide students to find concepts or formulas. In overcoming these problems, researchers apply a learning method that provides opportunities for students to gain knowledge by finding the concepts they learn. The method is a guided discovery method. The guided discovery method is a learning method that provides opportunities for students to compile, process, organize data (Sutrisno, 2012). Students will be required to use the understanding they have and an idea to find something new.

There are three difficulties for students in the prism and pyramid: the difficulty in mastering the prism and pyramid concept, the difficulty in finding the formula for the surface area of the prism and pyramid, and the difficulty in using the prism and pyramid surface area formula (Maryanih et al., 2018). Based on the results of interviews with mathematics teachers at MTs Al-Fadliliyah Darussalam Ciamis, the concept

understanding and curiosity of class VIII students still needs to be facilitated because they are still less than the targeted results. The obstacle for teachers in delivering material is that there are differences in the ability of students to receive the material so that the material must be delivered repeatedly. In learning, teachers use textbooks as the primary source and student worksheets as an additional source. However, the student worksheet used has not facilitated the ability to concept understanding and students' curiosity. In this regard, the researcher offers student worksheets based on the guided discovery that can train students to be more active, making it easier to understand the material and facilitating concept understanding and students' curiosity..

The problem in this research is how to develop a mathematics student worksheet based on guided discovery to facilitate concept understanding and curiosity of class VIII students with prism and pyramid material. The product produced in this development is print media in A4-sized. The material presented in the mathematics worksheet is prism and pyramid for class VIII with basic competencies of 3.10 (distinguishing and determining the surface area and volume of 3D shapes) and 4.10 (solving problems related to the surface area and volume of 3D shapes and their combinations).

METHOD

This research uses Richey and Klein's development method. There are three stages of development, namely planning, production, and evaluation (Sugiyono, 2019). Data sources are from the assessment of two media experts and two material experts, and literature. The types of data are qualitative data and quantitative data. The qualitative data is an assessment of product quality based on categories and suggestions, comments, and criticisms from media experts and material experts. The quantitative data is numerical results processed from qualitative data based on categories using a Likert scale to state conclusions regarding the feasibility of mathematics worksheets. The research instrument is a product rating scale. The data collection technique is the assessment scale. The data analysis are; (1) The validators of material experts and media experts, which are qualitative data, are converted into quantitative data; (2) calculate the average score of each aspect with the formula $\bar{X} = \frac{\sum x}{N}$, where $\bar{X}$ is the average score, $\sum x$ is the number of scores and N is the number of raters (Sudjana, 2014); (3) Change

the average score of each aspect of the evaluator into a qualitative value by the ideal assessment with the following conditions (Sudjana, 2014).

Table 2. Idea Assessment Category Criteria

Score Range (i) Quantitative	Qualitative Category
$M_i + 1{,}5\ SB_i < \bar{X} \leq M_i + 3\ SB_i$	Very Good
$M_i + 0{,}5\ SB_i < \bar{X} \leq M_i + 1{,}5 SB_i$	Good
$M_i - 0{,}5\ SB_i < \bar{X} \leq M_i + 0{,}5 SB_i$	Poor
$M_i - 1{,}5\ SB_i \leq \bar{X} \leq M_i - 0{,}5\ SB_i$	Very poor

RESULT AND DISCUSSION

The research product is a mathematics worksheets based on guided discovery on prism and pyramid material for Class VIII obtained by a development process using PPE procedures which include planning, production, and evaluation. The explanation of the three stages are:

Planning

Product planning is based on functionality requirements analysis. The analysis conducted through interviews and literature studies showed that the learning media developed was the mathematics student worksheet and was able to facilitate the concept understanding ability and students' curiosity. The material presented in this mathematics student worksheet is by the 2013 curriculum. The planning stage has the following steps. *First* is the curriculum analysis stage, which is a analysis of the junior high school curriculum. Curriculum analysis includes analysis of core competencies, basic competencies, and indicators of competency achievement. This stage is carried out to make the mathematics worksheets according to the needs of students at MTs Al-Fadliliyah Darussalam Ciamis. The results of the curriculum analysis are presented in Table 3.

Second, choosing the type of teaching materials to be developed. Selection of the type of printed worksheets with A4 size. *Third*, researchers collect references from various sources based on the 2013 Curriculum with prism and pyramid material by collecting reference materials. That is for content in the worksheet. The reference used is a mathematics book with prism and pyramid material and a literature review of books and scientific articles of guided discovery. In this case, the researcher also uses visual

assets from the internet. *Fourth,* compiling a map of the needs for mathematics student worksheet, compiled based on the results of the curriculum analysis. The map of mathematics student worksheet needs can be seen in Figure 1.

Table 3. Results of The Curriculum Analysis

Core Competencies	Basic competencies	Indicators of Competence Achievement
1) Appreciate and practice the teachings of their religion 2) Appreciate and practice honest, disciplined, responsible, caring behavior (cooperation, teamwork, tolerance, peace), polite, responsive, and pro-active and show attitudes as part of the solution to various problems in interacting effectively with the social environment and nature and in placing oneself as a reflection of the nation in the association of the world 3) Understanding knowledge (factual, conceptual, procedural, et cetera) based on their curiosity about science, technology, art, culture related to visible phenomena and events 4) Trying, processing, and presenting in the concrete realm (using, parsing, assembling, modifying, and making), and the abstract realm (writing, reading, counting, drawing, and directing) according to what is learned in school and other similar sources from the point of view/theory.	3.10. Differentiate and determine the surface area and volume of 3D shapes with flat sides (prisms and pyramids) 4.10. Solve problems related to surface area and volume of 3D shapes with flat sides (prisms and pyramids)	1) Find and Identifying and understand the elements of prisms and pyramids 2) State the characteristics of prisms and pyramids 3) Draw various shapes of prism and pyramid nets 4) Find the general formula for the surface area of prisms and pyramids 5) Solve problems related to the surface area of prisms and pyramids 6) Find the general formula for the volume of prisms and pyramids 7) Solve problems related to the volume of prisms and pyramids

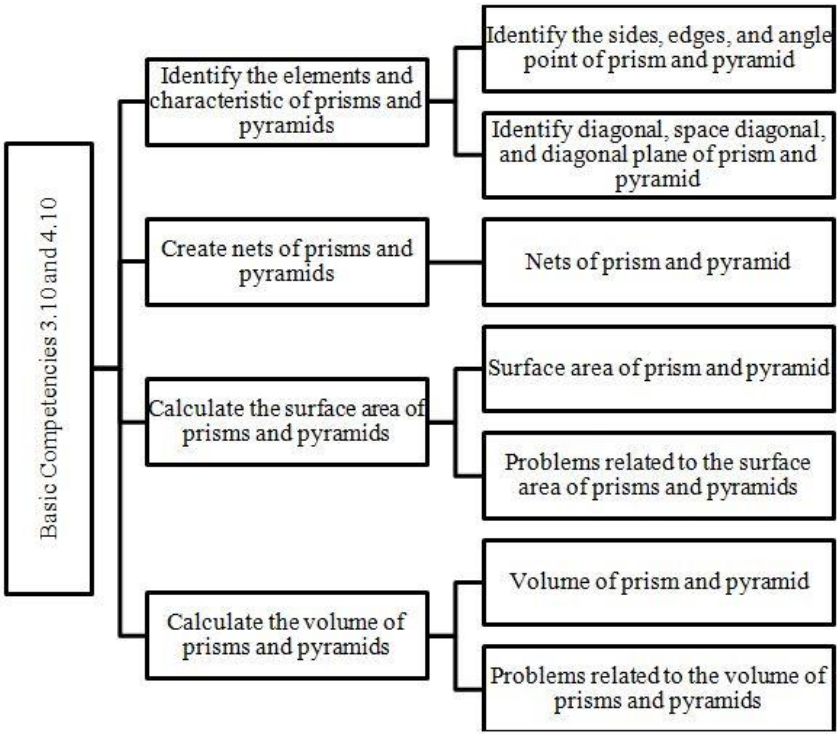

Figure 1 The map of mathematics student worksheet needs

Fifth, compile the assessment instrument arranged to assess the quality of mathematics worksheets. The assessment instrument is presented in an assessment sheet consisting of four assessment categories: very good, good, poor, very poor. In addition, at the end of the assessment sheet, a column is provided for the expert validator to write criticisms and suggestions for improving the worksheet. The assessment instruments are divided into two types, namely material expert assessments and media expert assessments.

The mathematics worksheets can facilitate concepts understanding and curiosity of class VIII students, especially prism and pyramid material. Materials, practice questions, or task implementation instructions adjusted to their contents with indicators of concept understanding can facilitate concept understanding ability. At the same time, curiosity can be facilitated by questions, directions, or interactions between students and teachers when using the worksheet.

Production

The production stage contains activities to realize the design of making mathematics worksheets into a tangible form. The production has the following steps. *First*, to test the validity of the research instrument. *Second*, compile the structure of the

mathematics worksheet that contains an overview and order of the material's overall content and the presentation. The structure of the mathematics worksheets can been seen in figure 2.

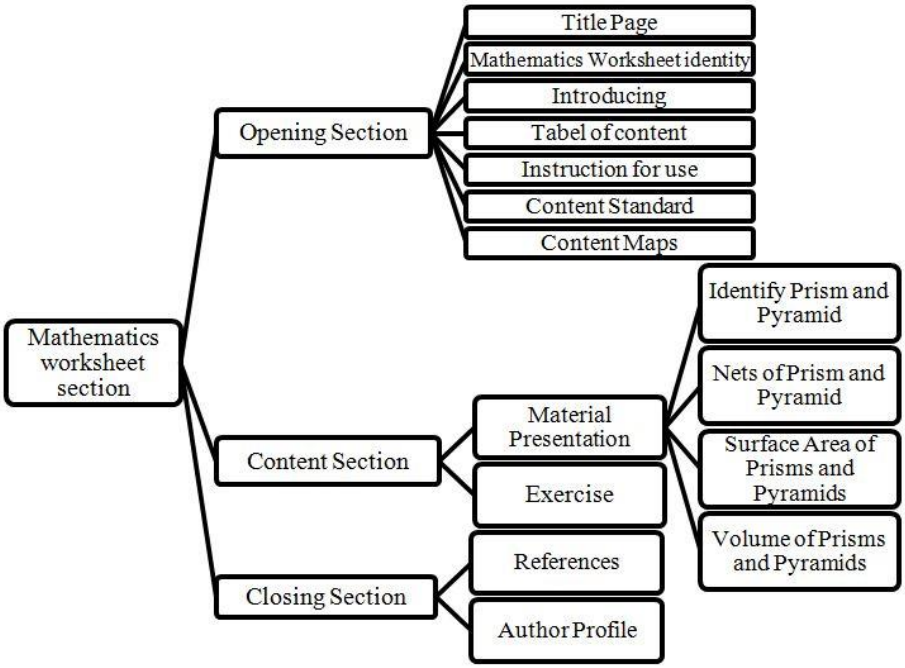

Figure 2 The structure of the mathematics worksheets

Third, designing mathematics worksheets is referring to the structure worksheets. The design of the mathematics worksheets was made using Corel Draw X8 software and Microsoft Word 2019. This worksheet was designed with a blue and purple theme. A blue color combination is expected to give an attractive impression so that students' curiosity about the material and exercises in the worksheets is increasing. The color combination Purple is also expected to affect the imaginative aspects of students so that students can understand the concept properly and carefully. *Fourth*, create mathematics worksheets, compiled based on the structure, references/library sources, illustrations or pictures, initial mathematics worksheets design, and other purposes that support the process mathematics worksheets creation. The results of this stage are consulted with the lecturer to improve according to suggestions.

Evaluation

Evaluation is a process to see if the product developed is suitable for use or not. The evaluation is carried out by validating the experts and testing the product. The results of this stage are mathematics worksheets products suitable for use as teaching

materials for prisms and pyramids. The results of the material assessment are presented in Table 4, the results of the media assessment are presented in Table 5.

Based on Table 4, the content feasibility component is in the very good category with an average score of 104. The linguistic component is in the very good category, with an average score of 41.5. The presentation component is in the very good category, with an average score of 49. Overall, the assessment result is in the very good, with an average of 194.5. In general, assessing the quality of the mathematics worksheets by material experts is in the very good category.

Based on Tabel 5, the design component is in the good category with an average score of 57. In general, assessing the quality of the mathematics worksheets by media experts is in the good category.

Table 4. The Results of The Material Assessment

No.	**Validator**	**Component Assessment Results**			**Total (Max 208)**
		Content Feasibility (Max 112)	**Linguistic (Max 44)**	**Presentation (Max 52)**	
1	I	96	39	46	181
2	II	112	44	52	208
Total		208	83	98	389
Average		104	41,5	49	194,5
Category		Very Good	Very Good	Very Good	Very Good

Table 5. The Results of The Media Assessment

No.	**Validator**	**Design Component Assessment Results (Max 72)**	**Total (Max 72)**
1	I	54	54
2	II	60	60
Total		114	114
Average		57	57
Category		Good	Good

In the conclusion, mathematics worksheet meets the validity criteria to be used as a reference in carrying out learning activities. However, mathematics worksheet certainly have deficiencies, (1) Mathematics worksheets are limited to prism and pyramid material, (2) The display design of mathematics worksheets is developed according to the ability of researches so that the design is still simple, (3) Research development is only carried out until validity stage. The mathematics worksheet has not been tested, so it is unknown whether the mathematics worksheet meets the criteria of practicality and effectiveness when used in learning activities.

CONCLUSION

Based on the research results, product quality is based on assessment from material and media experts using the assessment sheet. This assessment sheet includes an assessment sheet for material experts consisting of three assessment components with 52 statements and an assessment sheet for media experts consisting of one assessment component with 18 statements. The quality of mathematics worksheets based on guided discovery is in very good based on the assessment of the material expert and media expert and it is in good category based on the assessment of the media expert. The mathematics student worksheet based on guided discovery is declared valid. Suggestions for further Research are: every aspect of the mathematics student worksheets can be improved; the presentation of learning in the mathematics worksheet can be made more communicative and interactive; and mathematics worksheets can be further developed to the field trial stage and developed further by conducting experiments using comparison classes so that the quality of the LKPD is tested in its use.

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