JKPM | Jurnal Kajian Pembelajaran Matematika
Vol. 6, No. 2, October 2022, pp. 67-75
ISSN: 2549 – 8584 (online). http://journal2.um.ac.id/index.php/jkpm

Contextual-based student worksheets designed to facilitate mathematics representation ability

Haya Okta Fikriya[1], Dian Permatasari[1*]
[1]Universitas Islam Negeri Sunan Kalijaga Yogyakarta, Sleman, Daerah Istimewa Yogyakarta, Indonesia

*Corresponding author.
Email: dian.permatasari@uin-suka.ac.id

Abstract
Representation is one of the objectives of learning mathematics, but the representation ability is still low. Thus, the purpose of this study was to develop a contextual-based Student Worksheet on similarity and congruence material to facilitate students' mathematical representation skills. This research was Research and Development. The research used the PPE development model developed by Richey and Klein with three stages of development: planning, production, and evaluation. The results showed that the contextual-based student worksheet on similarity and congruence material to facilitate students' mathematical representation skills was declared valid based on the expert validator's assessment with an average validity value of 0.81 and included in the high criteria.

Keywords: *research and development, students' worksheet, contextual approach, mathematics representation ability*

Submitted February 2022, Revised July 2022, Published September 2022
How to cite: Fikriya, H. O., & Permatasari, D. (2022). Contextual-based student worksheets designed to facilitate mathematics representation ability. *Jurnal Kajian Pembelajaran Matematika*, *6*(2), 67-75.

INTRODUCTION

Representation ability is one of the goals of learning mathematics (Yusriyah & Noordyana, 2021; Agustina & Sumartini, 2021). It is the ability to represent students can support students in understanding the mathematical concepts studied and their relationships; communicate students' mathematical ideas; more familiar with the connections between mathematical concepts; or apply mathematics to realistic mathematical problems through modeling (Annajmi & Afri, 2019; Aryanti & Nursangaji, 2013; Ramziah, 2018; Yenni & Sukmawati, 2020). Muhamad (2016) revealed that mathematical representation skills could help students build concepts, express mathematical ideas, and make it easier to develop their abilities. In addition, learning mathematics that involves mathematical representations can spur educators to improve teaching skills, and educators can see and examine how students think about mathematics (Herdiman et al., 2018).

Facts on the ground show that most teachers do not view mathematical representation skills as an important foundation in learning mathematics (Huda et al., 2019). Mathematical representation skills need to be carried out by students because it is related to the ability of mathematical relationships and problem solving (Kusumaningrum & Nuriadin, 2022). Pictures, graphs, diagrams, or other forms of representation are used to express a mathematical problem (Lette & Manoy, 2019). PISA data shows that Indonesia scored 379 in mathematics. PISA questions are used to measure students' mathematical representation abilities. From that score, Indonesia was ranked 6th from the bottom. In the other hand, according to research conducted by (Handayani, 2014; Putri, 2017; Lestari, Andinasari, & Retta, 2020) shows that the mathematical representation ability of high school students is still categorized as low. In addition, several research results (Fikri et al., 2019; Herdiman et al., 2018; Suryowati, 2015) state that students' mathematical representation abilities on congruence and similarity materials are still relatively low. Herdiman et al. (2018) stated that the representation ability of junior high school students on similarity and congruence material on qualifications was lacking for indicators of representation of words and indicators of representation of equations or mathematical expressions and on capabilities sufficient for indicators of visual representation. On the other hand, according to Fikri et al. (2019), students have difficulty working on similarity and congruence questions, especially in representing in the form of words, pictures, and similarities. It can be seen from the unsystematic response of students, errors in placing units or quantities in the images that have been made, and mistakes in making comparisons. The low mathematical representation ability causes students to have difficulty solving mathematical problems faced and results in the low mathematical achievement of students. One of the reasons for the low representation ability of students is that the teaching materials used have not facilitated the representational abilities of students (Kusumaningrum & Nuriadin, 2022).

Teaching materials are a set of learning tools or tools containing learning materials and methods and evaluations designed systematically to achieve the expected learning objectives (Lestari, 2012). One of the

teaching materials that can support learning is student worksheets. Student worksheets are one of the learning resources developed by educators who act as facilitators in the learning process. Kartika (2018) explains that the purpose of preparing students' worksheets is to strengthen and support classroom learning in achieving indicators and competencies by the curriculum and assisting educators in achieving learning goals in class and making students more active, creative, and independent. The representation ability of students in Indonesia is still relatively low even though many efforts have been made to improve students' mathematical representation abilities (Annajmi & Afri, 2019; Yusriyah & Noordyana, 2021; Suningsih & Istiani, 2021). In an effort to improve students' mathematical representation skills, teacher need to stimulate students' thinking power to form their own knowledge in solving mathematical problems they face (Agustina & Sumartini, 2021; Kusuma et al., 2020).

Students' worksheets that can facilitate representation abilities must be designed with appropriate learning designs that allow students to develop their ideas construct their knowledge. Students are also facilitated with discussion activities with students who another, because with the discussion, students can exchange opinions and thoughts (Handayani, 2015). Learning using a contextual approach is the learning design that facilitates mathematical representation skills. Several studies (Handriani, 2017; Hutagaol, 2013; Widiati, 2015) show that contextual learning can improve students' mathematical representation abilities. On the other hand, research (Astin et al., 2017; Handriani, 2017) has also been developing students' worksheets with a contextual approach to facilitate representation ability. The foundation used in the contextual process is constructivism which is characterized by actively building understanding creatively and productively independently (Maryati, 2018). In its implementation, contextual learning involves seven components: constructivism, questioning, inquiry, learning community, modeling, reflection, and authentic assessment. The learning process that uses a contextual approach can help students find and construct their knowledge in understanding the material provided. Handayani (2015) states that the factor that causes the increase in students' mathematical representation abilities in learning mathematics with a contextual approach is that students actively construct their knowledge and issue ideas or ideas so that learning is more meaningful. By building their knowledge and expressing their ideas, students will better understand the concepts being studied, and representing a concept will also develop. Thus, it is necessary to have students' worksheets by the environmental conditions of students so that students will find it easier to reason and understand the mathematical concepts being taught. Therefore, this study aims to develop a contextual-based student worksheet on congruence and similarity materials to facilitate students' valid mathematical representation ability.

METHOD

This research is research and development. This study uses the PPE development model developed by Richey and Klein with three stages of development, namely planning, production, and evaluation. At the planning stage, the researcher conducts an initial analysis curriculum analysis, arranges the structure of the students' worksheet, analyzes material, and develops research instruments. Furthermore, the researcher collects relevant references at the production stage and develops the students' worksheet design. The researcher validates by an expert validator on the students' worksheet developed at the evaluation stage. In this study, the test subjects were two expert validators, the lecturer of the mathematics education study program at UIN Sunan Kalijaga Yogyakarta using the product validity instrument. The qualitative data obtained was then converted into quantitative data using a Likert scale with Table 1.

Table 1. Product rating sheet scoring guideline

Category	Score
Very Good	4
Good	3
Not Enough	2
Very Less	1

Then, it is calculated using Aiken's Formula (Retnawati, 2016b) to determine the validity of the developed product.

$$V = \frac{\sum s}{n(c-1)}$$

where
V = validity

lo = lowest validity rating score
c = highest validity rating score
r = number given by rater
$s = r - lo$
n = number of validators

The results of the product validity assessment obtained in the previous step are then converted into qualitative values according to the product validity criteria (Retnawati, 2016a) in Table 2. The product developed is valid if the average validity score interval is at a high criterion.

Table 2. Product validity criteria

Validity Score	Criteria
$0.80 < V \leq 1.00$	High
$0.40 < V \leq 0.80$	Medium
$V \leq 0.40$	Low

RESULTS AND DISCUSSION

The students' worksheet development results are based on three stages of the PPE model, namely planning, production, and evaluation. Preliminary analysis, curriculum analysis, students' worksheet structure, material analysis, and research instruments are carried out at the planning stage. The initial analysis results show that students' mathematical representation abilities on similarity and congruence materials are still relatively low (Fikri et al., 2019; Herdiman et al., 2018). Students need to use students' worksheets that can facilitate. The solution is using students' worksheets with a contextual approach because using a contextual system was quite effective in facilitating students' mathematical representation abilities (Astin et al., 2017; Widiati, 2015). Next is curriculum analysis. Curriculum analysis is done by analyzing Core Competencies, Basic Competencies. Then, the Core Competencies and Basic Competencies were formulated into six Competency Achievement Indicators and Basic Competencies 3 and four Competency Achievement Indicators from Basic Competencies 4. Then compile the students' worksheet structure. The developed students' worksheet consists of three components: the initial, core, and end. The initial section contains a cover, students' worksheet identity, preface, table of contents, concept map, and in the teacher's handbook students' worksheet there are additional descriptions of contextual approaches, mathematical representation abilities, Core Competencies, Basic Competencies, Competency Achievement Indicators, and lesson plan. The core section contains material and practice questions, and the final section includes a bibliography. The next step is material analysis. Based on the material analysis results, the developed students' worksheet is divided into four sub students' worksheets: congruence of flat figures, congruence of triangles, congruence of planes, and triangles. In the planning stage, it needs to develop a research instrument. The instrument used was a product validity assessment sheet. This assessment sheet is in the form of a questionnaire using a Likert scale with four possible answers. The aspects contained are content feasibility, linguistic feasibility, and presentation feasibility.

The second stage is the production stage. According to a previously made design, this stage develops student worksheets for students and teachers. The steps that have been taken at the production stage are collecting relevant references and developing the students' worksheet design. Researchers contain pertinent references to the product to be developed Contextual-based Student Worksheets on similarity and congruence materials to facilitate students' mathematical representation abilities. Next in the production stage is to develop the students' worksheet design. Students' worksheet design was made using Microsoft Office 2007, Corel Draw X5, and images from several references. The components designed include students' worksheet cover, preface, table of contents, concept map, Core Competencies, Basic Competencies, Competency Achievement Indicators, materials, practice questions, and a bibliography. The students' worksheet design is shown in Figure 1.

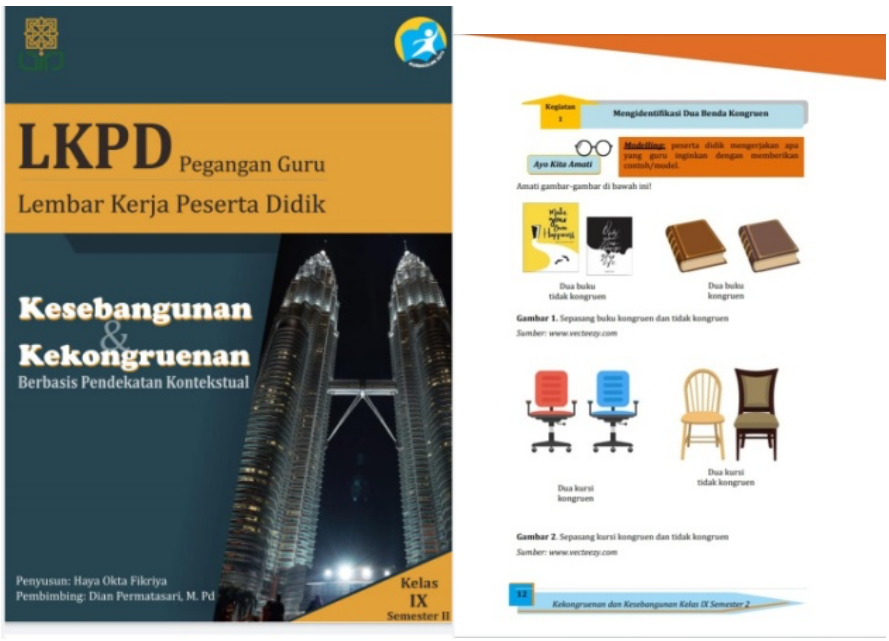

Figure 1. Students' worksheet component design

The students' worksheet developed is a contextual-based students' worksheet. In presenting the activities in this students' worksheet, it is necessary to pay attention to the components of the contextual approach, namely constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment. The implementation of the elements of the contextual approach in the students' worksheet developed is as follows.

1. Constructivism
   Constructivism is a philosophy that assumes that knowledge is the result of human formation or construction. Rangkuti (2014) states that knowledge cannot be transferred from one person to another but must be interpreted by the students. The active involvement of students in learning provides opportunities for students to construct their knowledge so that learning is more meaningful. The worksheets developed in this study are presented in activities that students must do, such as the activities "Let's Observe," "Let's Reason," and "Let's Find," which can encourage students to understand and construct their material similarity and congruence.
2. *Inquiry*
   Discovering is the process of moving from observation to understanding. This activity begins with observing phenomena or objects in everyday life, followed by meaningful activities to produce students' findings (Hidayat, 2012). The finding component in the students' worksheet lies in the activities "Let's Observe," "Let's Reason," and "Let's Find Out." The activities are presented using contextual examples and problems and are shown in Figure 2.

Figure 2. Example of inquiry

3. Questioning
   In contextual learning, asking questions is considered an effort by educators to encourage and provoke students to know and find the material and show the development of students' abilities. This student's worksheet's question component is located in all activities except "Let's Practice." Activity questions in students' worksheets can encourage and assist students in understanding similarity and congruence material. The example of the application of the ask-in-question component is shown in figure 3.

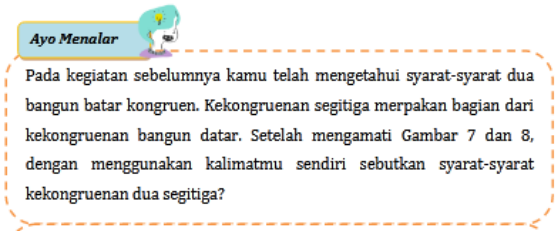

Figure 3. The example of questioning

4. Learning community
   The concept of a learning community in contextual learning results from learning obtained through cooperating with other people. In this students' worksheet, students can discuss and work together in activities. The component of the learning community in the students' worksheet lies in the Let's Discuss and Come On Discover activities.

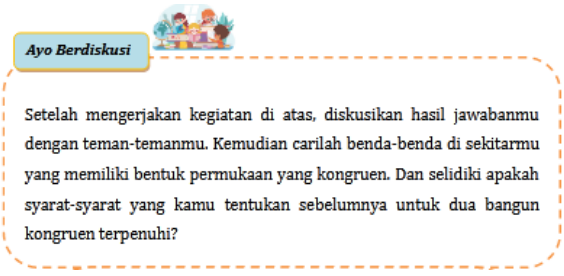

Figure 4. Example of learning community

5. Modeling
   The concept of modeling in contextual learning is to provide a model that students can imitate. Educators can provide examples or models that students can observe and work on related to material concepts. The modeling component in the students' worksheet is contained in the Let's Observe and Let's Find activities. Let's Observe in Students' worksheet 1. One of the activities presents a congruent and incongruent model of pairs of objects in everyday life. Students are expected to state why the pairs of objects are congruent incongruent.

Figure 5. Examples of modelling

6. Reflection
   The concept of reflection in contextual learning conveys or rewrites what has been learned. At the end of the lesson, the teacher provides opportunities for students to write and share the material they have learned. The implementation of components in the students' worksheet lies at the end of the activity.

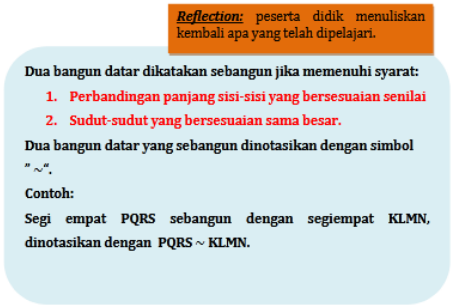

Figure 6. Example of reflection

7. Authentic assessment
   Authentic assessment is the process of collecting shared data that can provide an overview or information about students' learning development. During the learning process, the teacher assesses skills and activities, and at the end of the lesson, the teacher can give a written test such as practice questions. The " Let's Practice " activity contains authentic assessment components in the students' worksheet in the "Let's Practice" activity. In the "let's practice" activity, there are contextual questions related to similarity and congruence material.

Figure 7. Example of authentic assessment

The last stage in developing this students' worksheet is the evaluation stage. At this stage, the researcher has assessed the students' worksheet developed. Product assessment is done by providing a product validity assessment sheet to the expert validator. The assessment results in suggestions, criticisms, and comments from expert validators will be used as a reference in product improvement so that the product developed can be valid. The validator gives several suggestions, criticisms, and comments, namely writing errors, writing questions that cause multiple interpretations, not explaining the right sides and angles in the students' worksheet, and input in several activities. After the calculations are done, the results of the expert validator assessment are obtained, which are presented in Table 3.

Table 3. Product Validity Assessment Results

Assessment Aspect	Category Validity	Average
Content Feasibility Aspect	0,81	High
Aspects of Language Eligibility	0,81	High
Aspects of Feasibility of Presentation	0,80	Medium
Average All Aspects	0,81	High

The assessment of the validity of the students' worksheet is contextually based on similarity and congruence material to facilitate students' mathematical representation abilities. The average value of product validity for all aspects is 0.81 and is included in the high criteria. Thus, it can be concluded that the product developed in the form of contextual-based worksheets on similarity and congruence materials to facilitate students' mathematical representation abilities is valid.

Research conducted by researchers is in line with several studies (Hutagaol, 2013; Widiati, 2015; Rohmah, Rohaeti, & Afrilianto, 2018; Septianingsih, Parwati, & Ariawan, 2020) that state that contextual learning can improve students' mathematical representation abilities. In the other research, Neli (2018) shows that students whose learning uses a contextual approach have better mathematical representation abilities than students whose learning does not use a contextual approach. Astin et al. (2017) also show that using a contextual approach effectively facilitates students' mathematical representation abilities. Then, it is also confirmed by Handriani (2017), which explains an increase in students' mathematical representation abilities after using LKS teaching materials with a contextual learning approach.

CONCLUSION

The PPE development procedure developed contextual-based student worksheets on similarity and congruence materials to facilitate mathematical representation. Planning, production, and evaluation stages of developing a contextual-based Student Worksheet on similarity and congruence materials to facilitate students' mathematical representation abilities. The three steps have been carried out properly without any missed procedures. The development of contextual-based Student Worksheets on similarity and congruence materials to facilitate students' mathematical representation skills has met the product validity criteria based on the expert validator's assessment with an average product validity value of 0.81 in the high category.

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