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Development of Mathematic Learning Devices using Discovery Learning Models with Riau Cultural Context to Improve Students 'Mathematic Problems Understanding and Solving Ability

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A B S T R A C T

This research was motivated by the low Mathematical Comprehension Ability (KPM) and Mathematical Problem Solving Ability (KPMM) of students and the absence of learning tools that can properly solve the problem of low KPM and KPMM. The products that is produced from this research are syllabus, lesson plans, and LKPD using discovery learning models with the context of Riau culture to improve students' KPM and KPMM. The development model used the Borg and Gall model. The validity instrument was in the form of a validation sheet for the syllabus, lesson plans, and student worksheet. Practicality instrument was used in the form of student response questionnaire. The data collection technique was carried out by validating learning devices and distributing response questionnaires to students. The data analysis technique used the analysis of validity and analysis of practicality. The average validation of the syllabus was 3.7; RPP, namely 3.54; and LKPD namely 3.51 with each category very valid. The average student response questionnaire in the initial field trial was 88.57 with the very practical category. The learning tools developed have been valid and practical to improve students' KPM and KPMM.

1. Introduction

Mathematics learning objectives listed in Permendikbud Number 58 of 2014 include students having the ability to: (1) understand concepts, explain the relationship of one concept to another, and apply concepts appropriately in problem solving; and (2) problem solving which includes the ability to understand a problem, make problem-solving plans, solve problems, and interpret solutions. Based on the objectives of learning mathematics in the 2013 curriculum, the

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important abilities that students must have and hone are KPM and KPMM (Imayanti et al., 2020; Ningsih et al., 2020).

In fact, the KPM and KPMM of Indonesian students are still low. Based on the PISA survey by the Organization for Economic Cooperation and Development (OECD) which is conducted once in three years, Indonesia is in the following rankings: 39 out of 41 countries in 2000, 38 out of 40 countries in 2003, 50th out of 57 countries in in 2006, ranked 61 out of 65 countries in 2009, ranked 64 out of 65 countries in 2012, ranked 69 out of 76 countries in 2015, and ranked 73 out of 79 countries in 2018 (Nuraini et al., 2017; Tohir, 2019).

The results of the PISA study illustrate that the ability of Indonesian students to answer international standard questions is still low, especially for KPM and KPMM. This is because PISA is conducted to test mathematical skills which include the ability of students to: (1) formulate, apply, and interpret mathematics in various contexts; (2) using facts, concepts, and procedures to describe an event; and (3) solving problems (OECD, 2018).

Responding to the above, the researcher observed the learning implementation process, interviewed the teacher, interviewed students and gave KPM and KPMM tests to students in Kampar Regency. Based on the results of observations, interviews, and tests, it was found that the KPM and KPMM of students were still low. The low level of KPM and KPMM is because in the learning process they still rely on teachers as providers of all information and there is still a lack of learning facilities (Guswinda et al., 2019). In addition, students do not understand the concept so that it is difficult to change the problem into a mathematical model (Rahmiati et al., 2017).

Another cause of the low KPM and KPMM of students is that the learning tools owned by the teacher have not been able to properly be used as a solution to the problem of low KPM and KPMM. The learning device is a reference for the achievement of the implementation of learning prepared by the teacher before carrying out the teaching and learning process (Daryanto et al., 2014). The learning tools consist of a syllabus, a lesson plan (RPP), and student activity sheets (LKPD). The learning tools owned by the teacher are not in accordance with the standard process which requires every teacher to be able to compile learning tools completely and systematically. Complete and systematic preparation will produce effective learning and can train KPM and KPMM students.

Several studies have stated that learning tools in other areas are still not in accordance with the standard process, including research by Sulistyani et al. (2015) and Yustianingsih et al. (2017). In Yogyakarta Junior High School, it is found that most teachers only download lesson plans from the internet and use previous lesson plans without any changes in their learning activities (Sulistyani et al., 2015). Yustianingsih et al. (2017) state that the lesson plans designed by junior high school mathematics teachers in Sawahlunto have not yet directed students to be active in the teaching and learning process, while the LKPD only contains a collection of materials in the form of formulas and questions that train numeracy skills only a sign of a problem solving process.

Based on what has been described above, it is necessary to develop mathematics learning tools that can guide students to be active in concept discovery and train KPM and KPMM. The development of learning tools certainly refers to a learning model that can support active students in learning. One of the appropriate learning models to use is discovery learning models. The discovery learning model has stages that help students develop KPM and KPMM. KPM of students who get discovery learning as a whole is in a good category and students' responses tend to agree with this learning (Mawaddah et al., 2016). The results of research by Supraptinah et al. (2015) showed that the KPMM of students was in a good category with the application of the discovery learning model.

In the application of the discovery learning model, the initial stage is to provide a stimulus or stimulation by providing concrete examples of mathematical concepts related to everyday life. Things that are closely related to the lives of students are the culture in their environment. Cultivating cultural values can be done in mathematics learning in schools (Fajriah, 2018). Mathematics learning needs to link mathematics material with culture so that students feel the cultural connection with the mathematics material they are learning. So far, students are not used to being faced with contextual mathematical situations about the culture that exists in society (Nur et al., 2017). The culture that exists in the environment of students is the culture of Riau. The Riau culture in question can be in the form of historical buildings, special foods, and so on. For this reason, in learning it is necessary to apply a model that can challenge students to discover concepts from contextual problems, namely the discovery learning model with the Riau cultural context which contains six stages.

The first stage, stimulation (giving stimulation) in the form of Riau cultural problems that cause students' desire to investigate for themselves about the concepts to be studied. For example, the cube material is given stimulation in the form of problems related to Riau's special food, namely diamonds, which are cut into cubes and will be put into a box. The second stage, problem statements (problem identification) based on things that are relevant to the concepts being studied, this will help students understand and model problems and make temporary hypotheses about the area of plastic needed to wrap diamonds. The third stage, data collection (data collection) related to the problems faced so that students can make problem solving plans and see the relationship between concepts in findings. The fourth stage, data processing (data processing) that has been collected so that students carry out problem solving by applying the formula that has been found. The fifth stage, verification (proof), verifies the truth of the hypothesis and is associated with the results of data processing. The sixth stage, generalization (making conclusions / generalizations) which can be used as general principles and applies to all events.

One of the junior high school mathematics learning materials that must be mastered by students is Building a Flat Side Space. Space building material is one of the materials that students don't like because it has a high level of difficulty and causes students to find it difficult to understand its elements and cannot solve problems related to the material (Widyawati, 2016). Students cannot understand the material concept of building a flat side space well because it only focuses on memorizing formulas without knowing the process of its discovery.

Based on the explanation about the low level of KPM and KPMM, the learning process, and the importance of learning tools, one solution is to develop mathematics learning tools. The developed mathematics learning tools consist of syllabus, lesson plans, and student worksheet using discovery learning models with the Riau cultural context on the material of building flat-sided spaces to improve KPM and KPMM for class VIII SMP / MTs students. The purpose of this study was to produce a mathematics learning device using a discovery learning model with a cultural context of Riau which was valid and practical in improving KPM and KPMM.

2. Methodology

This research was carried out as the Research and Development with the Borg and Gall development model (in Mulyatiningsih, 2014). It has 10 stages, namely: (1) research and data collection; (2) planning; (3) development of the initial product draft; (4) initial field trials; (5) product revision; (6) field testing of the main product; (7) operational product revisions; (8) field trials; (9) final product revision; and (10). In this study, the main product field test stage, operational product revision, field trial, and final product revision were not carried out. This is because all SMP / MTs in Kampar Regency were closed due to the Covid-19 pandemic which did not allow researchers to carry out research on a large scale.

The test subjects in this study were 8 students of class VIII.3 SMP Negeri 1 Kampa who have heterogeneous abilities, 2 high abilities, 4 moderate abilities, and 2 low abilities. The instruments used validity instruments in the form of syllabus validation sheets, lesson plan validation sheets, and student worksheet validation sheets, as well as practical instruments in the form of student response questionnaires.

The data collection technique was carried out by validating learning devices and distributing response questionnaires to students. The data analysis technique used is the validity analysis of the validation sheet to determine the validity of the learning tools and the practicality analysis of the student response questionnaire to determine the practicality of the learning tools. Learning tools are said to be valid if the percentage of validation is more than 70% and can be used if the percentage of readability is more than 70% and the minimum level of practicality achieved is practical (Akbar, 2013).

3. Results and Discussion

The products produced from this study are mathematics learning tools in the form of syllabus, lesson plans, and LKPD which use discovery learning models with the context of Riau culture to improve KPM and KPMM. The development model used is the Borg and Gall model which includes: (1) research and data collection; (2) planning; (3) development of the initial product draft; (4) initial field trials; (5) revision of trial results; and (6) dissemination and implementation.

At the research and data collection stage, the activities carried out were teacher and student interviews, observation and documentation study, material analysis, literature study, and KPM and KPMM tests. At the planning stage, the researcher made a syllabus, RPP, and LKPD design. Furthermore, learning tools are developed based on designs that have been made and validated by experts.

The developed syllabus components refer to Permendikbud Number 22 of 2016. The components of the RPP are modified based on Permendikbud Number 103 of 2014 and Permendikbud Number 22 of 2016. The development of LKPD includes cover and content sections. The cover part consists of the title, student identity, learning objectives, worksheet work instructions, and supporting pictures to make it more interesting. The content section is developed based on the stages of the discovery learning model with the Riau cultural context consisting of stimulation, problem statements, data collection, data processing, verification, generalization, and let's practice. The cover section and one of the parts of the developed LKPD can be seen in Figure 1 and Figure 2.

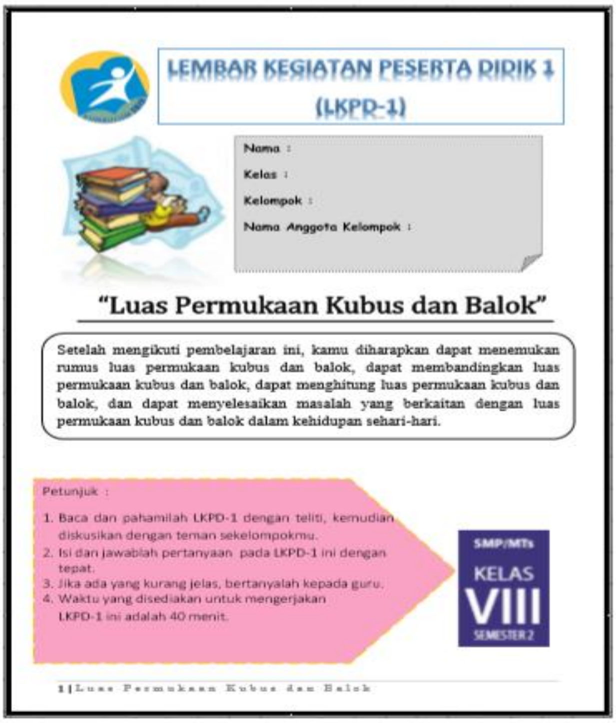

Figure 1. The Cover of LKPD-1

Figure 2. The Stimulation Section of LKPD-1

Learning Tool Validity

The results of the validation of the syllabus, RPP, and LKPD by three validators are presented in diagrammatic form respectively in Figure 2, Figure 3 and Figure 4 below.

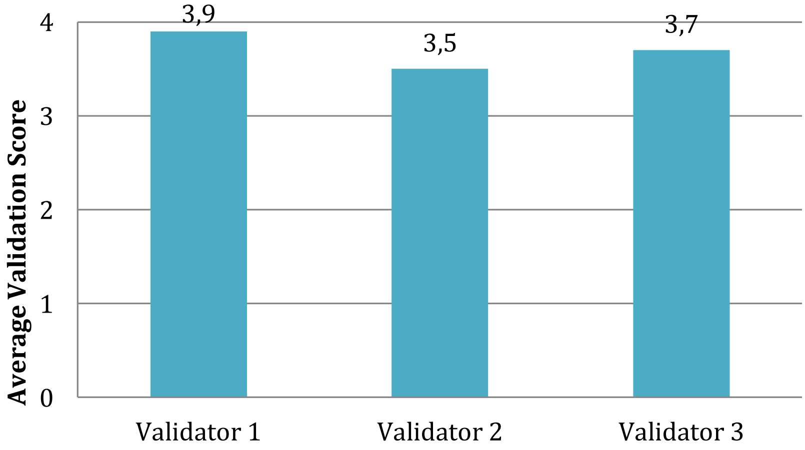

Figure 2. Results of Syllabus Validation

The results of the validation of the syllabus in Figure 2 show that the syllabus has very valid criteria with an average of 3.7. Improvements were made to the use of Operational Verbs (KKO) in formulating Competency Achievement Indicators (GPA) that are not in accordance with Basic Competencies.

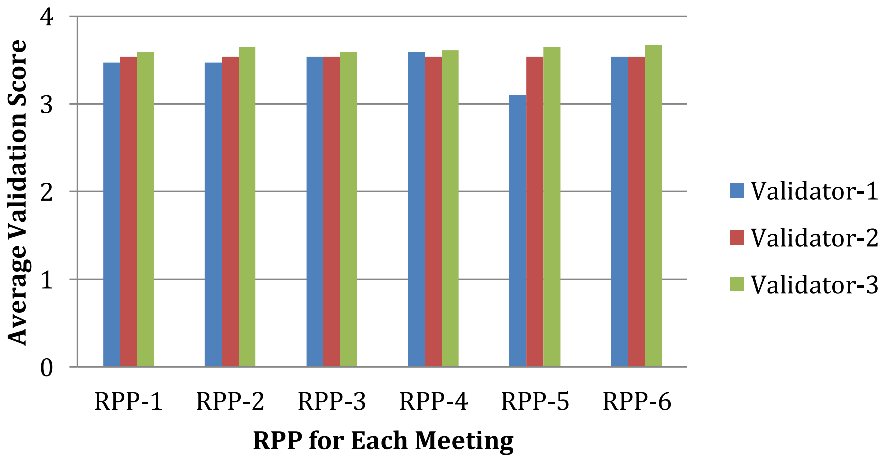

Figure 3. RPP Validation Results

The results of the RPP validation in Figure 3 show that the overall lesson plan is declared very valid with an average of 3.54. Based on the validator's suggestion, improvements were made to the GPA with KKO that did not match Basic Competence (KD), eliminating the formulation of learning objectives that were not compatible with KD, adding facts to the description of learning materials, adding pictures to learning activities, and replacing the KPM indicator in the assessment of learning outcomes.

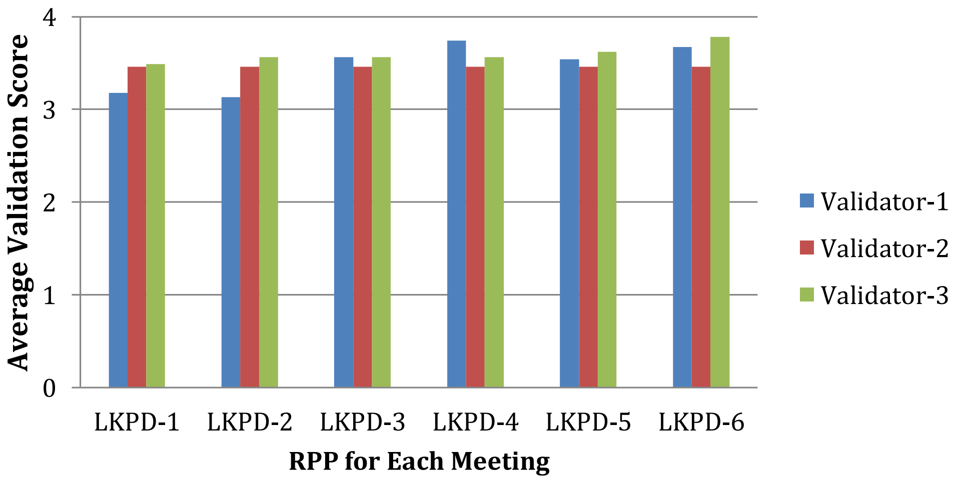

Figure 4. LKPD Validation Results

The results of the LKPD validation in Figure 4 show that overall LKPD is declared very valid with an average of 3.51. Based on the validator's suggestion, improvements were made at the discovery learning stage that cannot be repeated in one meeting, clarity of instructions at the data collection stage, and made problem solving columns at the data processing stage.

Based on the results of the validation, the learning device used the discovery learning model in the context of Riau culture to improve the KPM and KPMM of class VIII SMP / MTs students had met the valid criteria. If the learning device meets the valid criteria, then the learning device can be used in the learning process (Sari et al., 2018).

Practical Learning Devices

Learning devices that have met the valid criteria were tested on 8 students of class VIII.3 SMP Negeri 1 Kampa which were divided into two groups with heterogeneous abilities. The use of discovery learning models with the Riau cultural context in LKPD makes students interested in following the learning process. After seeing the pictures of typical Riau food that were presented at each LKPD, students began discussing with their group of friends about the form of food and whether they had ever eaten the food.

In LKPD-1 that is regarding the surface area of cubes and blocks, stimulation related to Riau culture is presented, namely diamond-shaped cubes and blocks that will be inserted into cubes and blocks with the sizes listed. Students discuss the shape of the diamond cut, there are students who have encountered pieces that are similar to the pictures given and there are also those who have encountered different cut shapes. This makes students curious about the relationship between these diamond pieces with cube and block material. Students stated that the shape of the pieces in the form of cubes and blocks would facilitate the arrangement of diamonds if they were put into boxes that were also cubes and blocks.

The LKPD-2 that is about the volume of cubes and blocks, stimulation of Riau's typical food is presented, which is a bad stick cake whose dough will be put into a cuboid and block-shaped container. Students discuss with a group of friends about the bad cake sticks they often eat when Eid. There are some students who have made the cake with their families and some have not. One of the students asked the researcher about the cookie dough container whether it had to be cubes and blocks because he used a round bowl when making it at home. The researcher provides an explanation of the containers currently used in connection with the volume of cubes and blocks, while in making it at home it is possible to use other containers.

The LKPD-3 that is regarding the surface area of the prism, stimulation of Riau's typical food is presented, namely rasidah cake and kemojo cake which will be put into a prism-shaped box. All students have eaten chemojo cake, but students have never eaten or seen rasidah cake. This is the material for the discussion, they asked the researcher whether this rasidah cake is the same as pizza because the pieces are almost the same. Researchers provide an explanation that rasidah cake is one of Riau's specialties and not pizza. Next, students discuss the unique shape of the box to package the cake. The shape is almost like a slice of cake which they think will make it easier to arrange the cake in the box.

The LKPD-4 taht is about the volume of prisms, stimulation of Riau's special food is presented, namely Rasidah cake, which the dough will be put into a unique container shaped like a hexagon prism. The unique form of the container becomes a discussion material for students. Students say that the form of the container relates to the subject matter, the same as the previous meeting.

The LKPD-5 that is about the surface area of the pyramid, stimulation of the typical Riau food is presented, namely lepat bugi wrapped in banana leaves. Students are very interested in fast bugi because they often encounter it everyday. Lepat bugi in the shape of a pyramid amazes students because they only realized it at this meeting, whereas previously they had often eaten fast bugi.

The LKPD-6 that is about the volume of pyramid, a stimulation of Riau's special food is presented, namely the manufacture of lepat bugi, which the dough will be put into the banana leaves that have been provided. Students discuss with a group of friends about how to make lepat bugi, after being put into banana leaves, the lepat bugi will be steamed. As with the previous meeting, students were interested in the cultural issues presented by Riau.

Students' interest in Riau culture which is presented at the stimulation stage enables students to understand the problem well and be able to make careful settlement plans at the problem statement stage. This is in line with the results of Hutagalung's (2017) research, which is that when students are faced with contextual problems that exist in the surrounding environment, students will find it easier to understand and compile their knowledge based on their personal experiences. Thus, giving problems related to Riau culture can develop KPMM students. In addition, Irawan et al. (2017) in their research stated that the integration of culture in the learning process fosters awareness and motivates students to recognize the surrounding culture related to mathematics.

Overall, students can find the right formula at the data collection stage based on the experiments they do. In the process of finding the formula, students can develop their KPM on indicators linking one concept to another. This is in line with the results of research by Hutagalung (2017) which states that the discovery learning model guides students in concept discovery and students can construct their own ideas.

At the data processing stage, overall students can solve problems appropriately. Students can apply the formula they have obtained to solve problems related to the given Riau culture. This stage can develop students' KPM with indicators to remember and apply formulas in simple calculations when solving problems. In addition, students can also develop their KPMM with indicators of carrying out problem solving. At the verification stage, students have checked the answers they have obtained using a formula with an estimated answer at the problem statement stage. With the existence of verification, it can develop students' KPMM on indicators of checking again.

At the generalization stage, students have made conclusions about the surface area and volume of a flat side space using their own language. With this stage, students can develop KPM on indicators restating the concept. In the trial process, there are several things that make students confused. Among them are the location of the cardboard area in the stimulation in LKPD-1 which is not suitable and the form of an abstract image that is not understood by students in the LKPD-2 questions. This is used as material for revisions to improve LKPD.

Furthermore, students are given a response questionnaire to see the practicality of using LKPD. The results of the analysis of the student response questionnaire obtained an average of 88.57. Based on these results, it can be concluded that the learning tools developed have a very practical level of practicality. If the learning device meets the minimum practical criteria, then the learning device can be used in learning (Syahrir, 2019).

Based on the interviews the researchers conducted after the trial, students stated that the learning steps in the LKPD helped them find concepts. The concepts and principles that are usually given immediately without the discovery process make students forget easily and cannot do the exercises if the problem is slightly different from the example questions. After getting used to the discovery process, when given questions about the surface area of an incomplete shape, students can solve it because they already understand the concept. Thus, the learning tools used can develop students' KPM and KPMM. This is in line with the results of Ramadhani's (2017) research, namely the collaboration of teachers, students, and appropriate discovery learning model stages can create conducive learning and can improve students' KPM and KPMM.

The next stage, namely field testing of the main product, product revision, field testing, and revision of the final product, could not be carried out by researchers because of the Covid ¬ 19 pandemic. All schools in Kampar District were closed until the end of the even semester which resulted in researchers unable to conduct large-scale trials. For the dissemination and implementation stages, the learning tools that have been developed will be presented in a limited-scale seminar on research findings in the Mathematics Education Postgraduate program attended by supervisors, respondent lecturers, and seminar participants.

4. Conclusion

Based on the results of the validation of learning tools (syllabus, lesson plans, and LKPD) it can be concluded that the learning tools developed have met the validity criteria. Based on the results of the student response questionnaire analysis, it can be concluded that the learning tools developed have met the criteria for practicality. Overall, it can be concluded that the learning tools developed have met the valid and practical criteria.

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