

Research Article

Improving problem-solving skills with worksheets using the discovery learning model-assisted quick response code

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ABSTRACT

Good teaching materials have an impact on the quality of mathematics learning and can help students become more engaged in their learning and develop their problem-solving skills. It is necessary to develop LKPD utilizing a discovery learning paradigm helped by QR codes in order to boost problem-solving abilities. This study uses a reliable and useful discovery learning paradigm with the use of a QR code to identify the characteristics of LKPD. The Plomp model, which has three steps total the preparatory stage, the development stage, and the assessment is used in this particular sort of study, which is called development research. For class VIII of junior high school, LKPD employs a discovery learning methodology with the use of a QR code. The tools employed are validation sheets, observation sheets, questionnaires, interviews, and final exams. The findings demonstrated the validity, applicability, and efficacy of the LKPD for class VIII junior high school students using the discovery learning approach. LKPD practicality was 87%, while LKPD validity was 89%. The average student score on tests measuring their ability to solve mathematical problems was 92%, which indicates the success of the program.

Keywords: discovery learning; math problem solving; student worksheet; quick response code;

1. INTRODUCTION

Mathematics is one of the subjects that is now receiving attention in the educational community. Learning math is one of the subjects that helps students develop their ability to reason rationally, analytically, methodically, critically, and artistically. Math lessons also help students develop their ability to collaborate in order to solve issues and make use of the knowledge they are given. Students should be able to understand concepts, solve problems, communicate effectively, reason, express mathematical relationships, and make connections between concepts, according to (NCTM, 2000). The researcher interviewed one of the mathematics teachers at SMP Negeri 4 Merangin, obtained information that students had difficulty understanding the problem and making plans to find solutions to these problems.

Thinking, learning, memory, transfer, perception, and motivation are all factors that are strongly associated to problem-solving ability. Problem-solving ability is an effort to overcome challenges and attain goals that cannot be met right away (Rohmah & Sutiarso, 2017). Problem-solving is a process that starts from the moment students are faced with a problem until the time the problem is solved (Peng, Cao, & Yu, 2020). Based on the facts found in several public junior high schools in Merangin, students' mathematical problem-solving abilities are still relatively low. This can be seen from the results of the initial test of problem-solving abilities in [Table 1](#).

Table 1. Average Student Problem-Solving Ability

Schools	Problem-solving skill				Average
	1	2	3	4	
SMPN 4 Merangin	64%	60%	50%	40%	53.5%
SMPN 43 Merangin	61%	45%	40%	45%	47.75%

The problem-solving ability test evaluation that was administered in two schools yielded low scores of 53.5% and 47.75%. This may be a result of students' unfamiliarity with problems requiring problem-solving skills during the learning process. Therefore, in order to enhance students' mathematical problem-solving skills, the mathematics learning process must be optimized. In addition to the fact that students are unfamiliar with problem-solving, the low mathematical problem-solving ability is a result of the implementation of learning thus far not directing pupils to be able to build problem-solving skills. Problem-solving steps according to George Polya are: (1) understanding the problem, (2) developing a plan, (3) implementing

the plan, (4) looking back. Therefore, in order to promote learning, educators must employ the appropriate tools or learning tools. According to Kusuma & Harimurti (2017), if the teaching model and learning resources are changed, students will be much more effective and efficient. Because of this, educators must be able to provide effective learning resources in order to fulfill their primary roles as facilitators, teaching resources, and activity monitors for students. The ability of educators to create learning aids that meet students' requirements is one way to improve learning. Worksheets for students could be the instrument. Student worksheets are printed instructional resources in the form of sheets of paper that provide information, summaries, and directions for carrying out learning tasks that must be completed by students, which refers to the fundamental competencies that students must accomplish (Prastowo, 2014).

The typical age of junior high school students, who are considered to be in their early teens, is 12 to 14 years old. According to Piaget's theory, students over the age of 11 have been able to develop formal thinking, they also begin to be able to reach logic and reason. Involving them in an activity will have a positive impact on their cognitive development (Ali & Asrori, 2016). So, when viewed from the characteristics of these students, it is suitable to apply to learn using the discovery learning model. This is consistent with the mentorship role that educators play by giving students the chance to engage in active learning, as educators' opinions must lead and influence students' learning activities in accordance with the objectives (Daryanto & Karim, 2017). This is also consistent with the idea of discovery learning, which is a type of instruction that gives students opportunities or permits them to participate actively in teaching and learning activities (Kurniawati, Siwi, Friyatmi, & et al, 2020). Students will learn, employ, and discover things that are helpful to them through these educational exercises (Hosnan, 2014). As a results, researchers offer solutions to these issues by incorporating discovery learning models into worksheets and lesson plans to enhance problem-solving skills. As previously said, the discovery learning model requires educators to take a more active role in setting up scenarios that require students to actively seek out concepts using a collection of data or knowledge gleaned from observation and experimentation (Riduwan, 2015). The most recent technology should be used in conjunction with the educational paradigm to support learning. The QR code is one of them. Users can link immediately to a web site without entering a web address by scanning a QR code, a sort of two-dimensional barcode, with a mobile device (Park, Lee, & Yun, 2019). According to the Ministry of Kemendikbud (2013), the phases for discovery learning are stimulation, problem statements, data collecting, data processing, data verification, and generalizations. This study intends to assess whether the use of learning resources, such as lesson plans and LKPD based on discovery learning helped by QR codes, has improved the eighth-grade junior high school students' capacity for solving mathematical problems.

2. RESEARCH METHOD

To enhance problem-solving abilities, research development employs discovery learning-based lesson plans and LKPD learning resources with the use of QR codes. The study's participants were eighth-grade SMP Negeri 4 Merangin students. The Plomp development model contains three stages: initial research, prototyping, and evaluation. The LKPD development stage refers to these steps (Akker, Bannan, Kelly, Nieveen, & Plomp, 2010). The purpose of the research phase is a preliminary analysis, where there is a needs analysis, curriculum analysis, concept analysis, and analysis of student characteristics. The instruments used at this stage are interview guidelines, student questionnaires, and checklist sheets.

The prototyping phase of product development puts practicality first, emphasizes validity of the product, and leads to effectiveness. This step comprises of various stages, including expert assessment and self-evaluation to determine the viability of the created learning tools. Three students were then given the opportunity to participate in the one-on-one evaluation stage. After that, move on to the small group evaluation stage, which is given to 6 students. Self-evaluation questionnaires and learning device validation questionnaires were the tools employed. Activities during the small group evaluation stage are concentrated on assessing the outcomes of the one-on-one evaluation stage. The assessment was done to see if the learning aids that were produced were reliable, usable, and efficient at helping students get better at solving mathematical problems. Using the results of six students' final exam on solving mathematical problems, the usefulness of teaching resources is evaluated.

3. RESULTS AND DISCUSSION

Based on the research that has been done with three stages of development, discovery learning-based worksheets with the help of QR codes obtained the following results:

3.1 Initial Investigation Stage (Initial Research)

Activities carried out at this stage begin with needs analysis, curriculum analysis, concept analysis, and student analysis. In the needs analysis, information about the mathematics learning process at SMP Negeri 4 Merangin was obtained through checklist sheets and interviews with mathematics educators who stated that students' mathematical problem-solving were still low. Especially on indicators of problem understanding, solution planning, and concluding. Curriculum analysis is carried out to examine the curriculum used. Based on the the study, it is known that learning is based on the 2013 curriculum: KD 3.3 about relations and functions. Next is the concept analysis. Based on the concept analysis, the function relation material was chosen because in the learning process the discovery learning model can be used to improve mathematical problem-solving abilities. Fourth is analysis of students, based on the results of student analysis after the initial test of mathematical problem-solving ability is still in the low category. Students want teaching materials or learning resources that are interesting and easy to understand to improve their mathematical problem-solving abilities.

3.2 Prototype Development Stage

After getting the results from the preliminary stage, the next step is product design, namely the development of discovery learning worksheets assisted QR code to improve student's problem-solving abilities. LKPD is prepared with clear sentences so that it can direct students to carry out activities and answer questions well. LKPD uses A4 paper size. The display of discovery learning-based worksheets assisted QR codes to improve mathematical problem-solving skills can be seen in Figure 1.

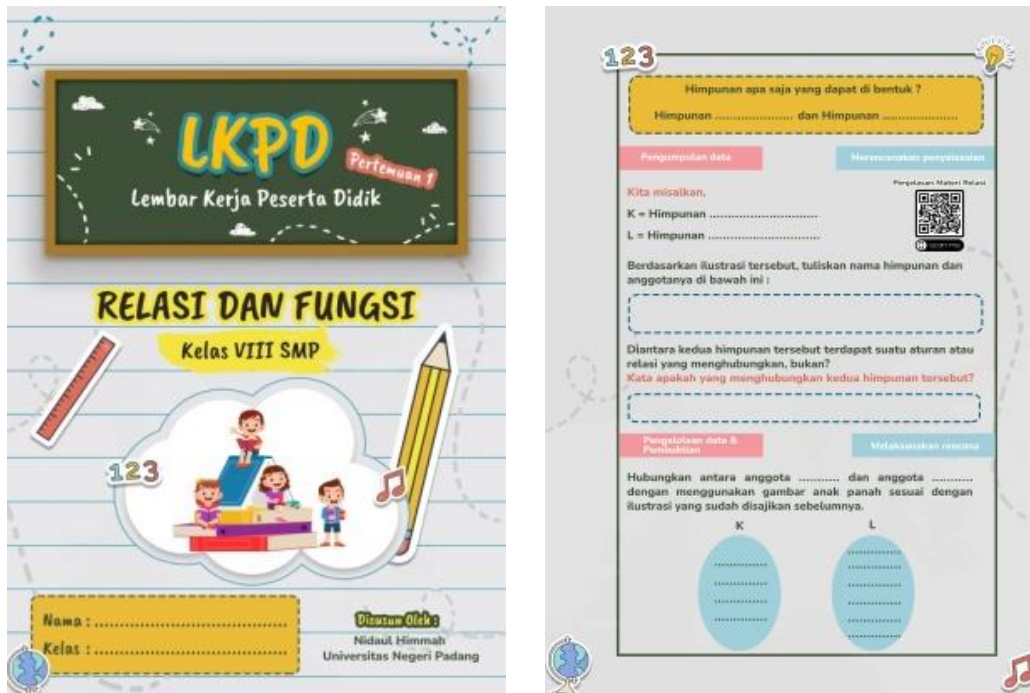


Figure 1. Cover and Display of QR Code on LKPD

The cover and all sections of the LKPD are designed using the Adobe Photoshop 2019 program. The design of this LKPD product consists of instructions for use, basic competencies (KD), indicators, learning objectives, material content, and practice questions. All steps in the LKPD are made based on the steps of the discovery learning model and the steps of students' mathematical problem-solving abilities.

Next is a self-assessment is carried out on the resulting product. At this stage, the researcher checked for typing errors, punctuation marks, the suitability of the material, and the suitability of the problems listed in the RPP with the LKPD. Furthermore, the product was prepared to be validated by an expert (expert review) consisting of 3 mathematics education lecturers, one educational technology lecturer, and one language lecturer. The results obtained at the expert review stage to test the validity of the LKPD can see in Table 2.

Table 2. Validity Results of LKPD Based on QR Code Assisted Discovery learning by Mathematics Education Experts

No.	Value Aspects	Validity Index	Category
1	Presentation	3.7	Very Valid
2	Content Eligibility	3.61	Very Valid
	Average	3.65	Very Valid

Based on Table 1, the LKPD assessment by 5 lecturers was declared valid with a validity index value of 3.65. Therefore, it can be said that the LKPD is good and can be used to the next step. This is the opinion of Abdi, Murni & Saragih (2021) when viewed based on the total validation results of the developed LKPD reaching 93% in the "very valid" category, this means that the developed LKPD definitely a good LKPD. After carried out the validation process, the next stage is a one-to-one evaluation which aims to observe the problems contained in discovery learning-based worksheets assisted by QR codes. This activity was on three students with different ability levels. Students are to read, comment on and study with the LKPD. After the LKPD based on discovery learning assisted by QR code is improved based on the results of the one-on-one evaluation, it can proceed to the small group evaluation stage. The trial was conducted at the small group evaluation stage on six students on different ability levels. In carrying out the small group evaluation stage, the researcher acts as an educator who teaches by using the steps of the discovery learning model following the discovery learning-based lesson plans assisted by QR codes. At the evaluation stage, a small group of observers assessed the implementation of discovery learning-based lesson plans assisted by QR codes, the observer's assessment can be seen in Table 3.

Table 3. Results of Observation of RPP Implementation

No	Value Aspects	Validity Index	Category
1	introduction	3.36	Practical
2	Core activities	3.55	Very practical
3	Closing	3	Practical
	Average	3.42	Very practical

Based on **Table 2**, the practicality of lesson plans for each aspect is practical and very practical. Overall the value of the practicality of the implementation of the RPP is 3.42 with a very practical category. At this stage, the LKPD practicality questionnaire was also given to educators and class VIII students of SMP Negeri 4 Merangin. The results obtained from the questionnaire response of educators to the practicality of the LKPD at the small group evaluation stage were 88% in the very practical category and from the student response questionnaire 87% in the very practical category. Based on the LKPD practicality questionnaire filled out by educators and students, discovery learning-based worksheets with the help of QR codes are stated to be very practical. This is of Rumiyaatun's research (2021) based on the results of the research and the results of the student response questionnaires obtained an average score of 3.6 with good criteria so that LKPD can be said to be practically used in learning activities.

3.3 Assessment Stage

The assessment stage is carried out in small groups (small group evaluation). After being revised on a one-to-one stage, the LKPD was tested on a limited basis in class VIII A of SMP Negeri 4 Merangin. At this stage, the practicality and effectiveness of the developed LKPD can be seen. The practicality of the LKPD is seen from the results of the questionnaire analysis of the responses of educators and students. While the effectiveness is seen in the final exam of students' mathematical problem-solving abilities.

The following are the results of the analysis of each instrument.

1) The results of the educators and students questionnaire

Based on results of questionnaire response of educators to the practicality of the LKPD at the small group evaluation stage were 88% in the very practical category and from the student response questionnaire 87% in the very practical category. Based on the LKPD practicality questionnaire filled out by educators and students, discovery learning-based worksheets with the help of QR codes are stated to be very practical.

2) The final exam of mathematical problem-solving skills

At the small group evaluation stage, an effectiveness test was also carried out which aims to determine students' mathematical problem-solving abilities after learning with discovery learning-based worksheets with the help of QR codes, the test consists of 2 description questions. The final test results can be seen in **Table 4**.

Table 4. Results of Small Group Mathematics Problem Solving Ability Test

Name	Step 1		Step 2		Step 3		Step 4		Score	Category
	1	2	1	2	1	2	1	2		
AFH	3	3	2	2	3	3	2	3	88	Very high
ICE	3	3	2	2	3	3	3	2	88	Very high
IMP	3	3	3	3	3	3	3	3	100	Very high
RY	3	3	3	3	3	3	2	3	96	Very high
DAP	2	3	3	3	3	3	3	2	92	Very high
RKD	3	2	3	2	3	3	2	3	88	Very high
Average	2.83		2.58		3		2.58		92	Very high

Small group students completed with an average score of 92%, so at this stage, it can be concluded that discovery learning-based worksheets can improve students' mathematical problem-solving abilities effectively. The learning outcomes obtained in this study were in the form of a 2-question description test. This test was conducted to assess students' mathematical problem-solving abilities after using discovery learning-based worksheets with the help of QR codes. The following is one of the students' answers in completing the final test of mathematical problem-solving abilities.

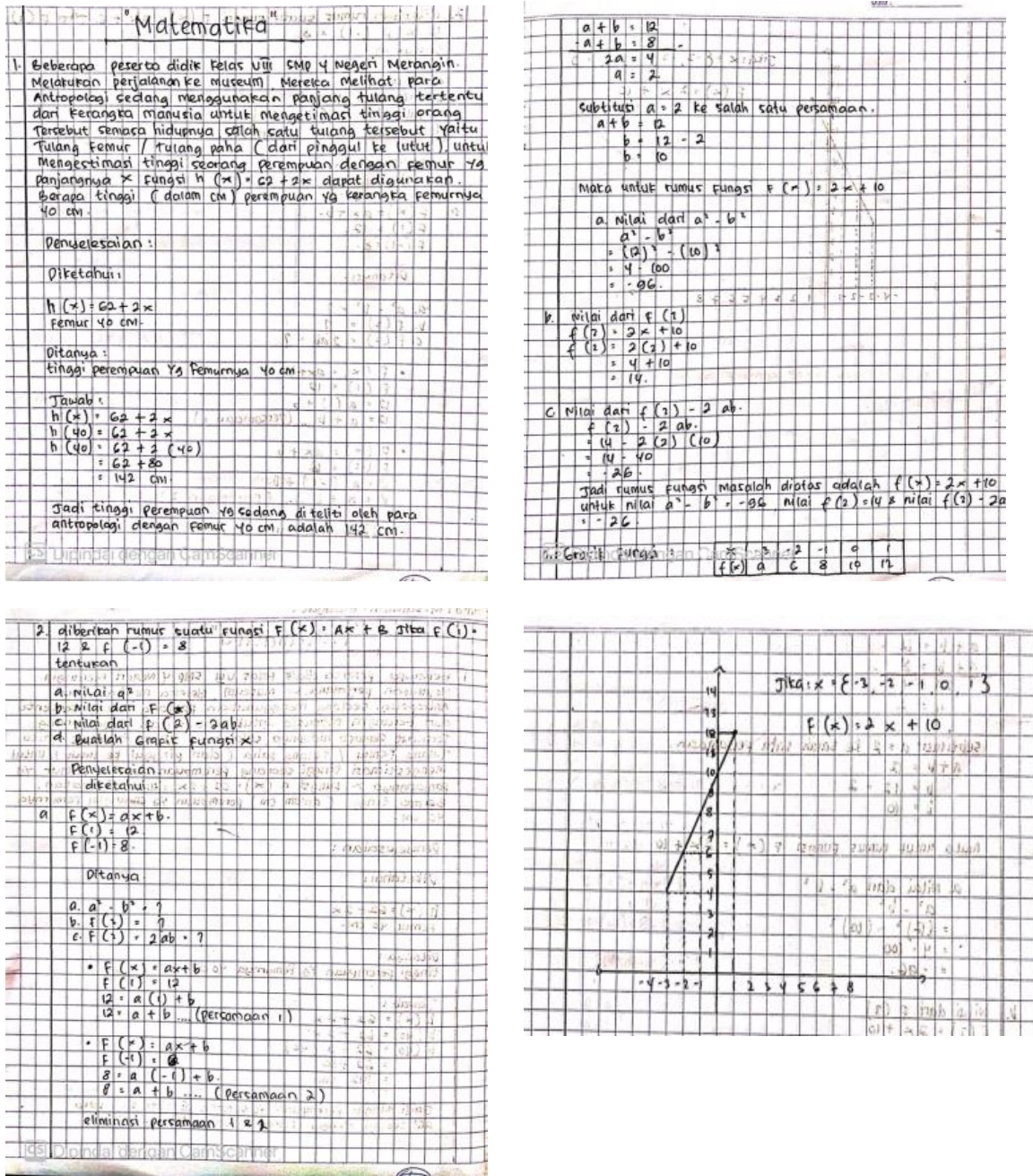


Figure 2. One Example of Student Answers

When compared with the initial student problem-solving ability test which had an average score of 53.5 compared to the last problem-solving ability test given to students, it was found that the percentage of the average score was 92. It can be seen that there are differences in the level of problem-solving ability and mathematical problems of students to use LKPD based on discovery learning assisted by QR codes. This is opinion of the research by Hendri & Kenedi (2018) where based on the results of the data analysis that has been carried out, it can be concluded that discovery learning-based learning tools are effective in improving students' problem-solving abilities. ability by showing that as many as 71.87% of students completed the final test. math problem-solving skills.

Based on the results of the analysis, it is known that discovery learning-based worksheets assisted by QR codes can improve students' mathematical problem-solving abilities. Some of the things that cause discovery learning to help improve students' mathematical problem-solving skills are students are more active in learning, discuss with each other, exchange information, focus on learning, and are asking both educators and others student. Based on the analysis of the research results and the theory that is used as a reference, it can be concluded that there are differences in students' mathematical problem-solving abilities after the discovery learning model is applied and when the discovery learning model has not been applied. Therefore, the application of the QR code-assisted discovery learning model can improve students' mathematical problem-solving abilities. This result is in line with the research results of Nur., et al., (2020) the selection of discovery

learning in learning is that with this model students can participate actively during the learning process, grow and instill an attitude of seeking support. students' ability to solve problems. In addition to the use of appropriate learning models, the use of the latest technology also plays a role in helping to improve students' mathematical problem-solving abilities.

This is the opinion Doorman., et al. (2007) schools must take advantage of the opportunities provided for problem-solving activities, one of which is exploring the benefits of technology for problem-solving purposes. Learning must always follow technological advances to attract students' interest. The use of a quick response code (QR code) in education is the latest implementation that expands the delivery of knowledge on the classroom wall. Learning must always follow technological advances to attract students' interest. The use of a quick response code (QR code) in education is the latest implementation that expands the delivery of knowledge on the classroom wall. Learning must always follow technological advances to attract students' interest. (Fantis, Kalagiakos, Kouloumperi, & Karampelas, 2012). This is in line with the results of research at SMA Lab school UNTAD in 2013 in class X, the results showed that the learning outcomes of students who received learning with QR codes were better than the learning outcomes of students who received conventional learning. (Mustakim, Walanda, & Gonggo, 2013).

4. CONCLUSION

Student Worksheets (LKPD) for class VIII students at SMP Negeri 4 Merangin that used discovery learning and QR codes to explain how KD functions relate to one another were deemed legitimate, useful, and efficient. 3.65 was rated as having a very valid category based on the findings of the validation by five experts. The results showed that the discovery of learning-based worksheets with the aid of a QR code of material relational functions were effective as seen from the average value and the percentage of completion of students who participated after going through a one-on-one evaluation process and small group evaluation with a final test of students' mathematical problem-solving abilities. arithmetic test of problem-solving skills.

AUTHOR'S CONTRIBUTIONS

The authors discussed the results and contributed to from the start to final manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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