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Discovery Learning Based Ecosystem Student Work Sheet to Improve Problem Solving Ability of Students in Class X MA

Fatayatul Fikri[1*], Miza Nina Adlini[1]

[1] Faculty of Tarbiyah and Teacher Training, Department of Biology Tadris, State Islamic University of North Sumatra, Indonesia.

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Corresponding Author:
Fatayul Fikri
fatayatulfikri@uinsu.ac.id

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Abstract: Problem solving ability is an important aspect to be improved in learning mathematics. One effort to improve problem-solving skills is to apply Discovery Learning -based Student Worksheet assisted learning. The purpose of this study was to analyze the increase in students' problem-solving skills through Discovery Learning-based Student Worksheet assisted learning. This type of research is quantitative with the One Group Pretest Posttest design which is used to compare the level of problem solving ability before and after treatment. The subject of this research involved 25 class X MAN 2 Labuhan Batu Utara students. This subject will receive learning treatment with Discovery Learning-based Student Worksheets. This study uses test instruments and interviews for data collection. Test data collection was carried out 2 times, namely the initial test before treatment (pretest) and the final test after treatment (posttest). Data analysis of pretest and posttest results was carried out by t-test and normalized gain. The results showed that mathematics learning assisted by Discovery Learning-based Student Worksheets could increase students' problem-solving abilities by 0.465 in the moderate category.

Keywords: Discovery learning; Problem solving skill; Student worksheets

Introduction

The digital environment changes various aspects of life, so it is necessary to make efforts to adjust the demands in mastering new skills in the 21st century, especially in the world of education (Lestari et al., 2019). Learning objectives in the 21st century have 4c criteria, namely communication, collaboration, critical thinking and problem solving, creativity and innovation (Arifin, 2017; Brown, 2015). Problem solving skills are needed by students in the learning process, as well as in learning biology (Dung, 2017). Through problem solving, students can increase their understanding of biological concepts through real problems in the context of everyday life (Umar, 2019). Moreover, problem solving can help students to develop analytical, critical and creative thinking skills (Rahma et al., 2022). According to Facione (2015), students' ability to solve problems can be measured through several steps, namely: identifying problems, determining information, making choices, assessing and making decisions, and examining processes.

Based on the results of a preliminary study through observation and interviews with a biology teacher at MAN 2 Labura, information was obtained that students' problem-solving abilities were still low, based on the data obtained that the average acquisition value of students' daily assessment results was 69, which means still below the minimum completeness criteria. This is because teachers rarely associate concept applications with everyday life and rarely invite students to practice solving problems, besides that there are no supporting teaching materials such as Student Worksheets, especially those that can train students' problem-solving skills. Learning activities carried out in class still use the lecture method and are dominated by educators (teacher centered), so that they do not involve the active role of students, even though the paradigm shift in current learning demands places more emphasis on being

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teacher centered to student centered (Kemendikbud, 2016).

This also happened in Vietnam where the ability of students to solve non-routine problems and exam questions measured more reasoning, argumentation and communication skills than questions that measured standard technical abilities related to mere memory and calculation (Mawarti, 2018). The same thing also happened in Sulawesi where this learning was still in the passive learning category because the activities carried out in the form of reading, listening and seeing directly, had not made a major contribution to understanding and memory of the material. This is because cognitive assessment instruments, exam questions, which are used by schools in Indonesia, tend to aim at testing aspects of memory, while questions to train problem-solving skills are still minimal (Kusuma et al., 2017).

Based on these problems, it is necessary to have an innovation in learning that involves students' activeness in it, such as Student Worksheets to improve students' problem-solving skills. Student Worksheets are a collection of sheets containing student activities that allow students to carry out real activities with the objects and issues being studied (Setiawan, 2019). Student Worksheets can be used to improve students' problem-solving abilities because they contain activities that involve the process of investigation and problem solving (Lestari, 2016). The Student Worksheet functions as a study guide which contains a set of basic activities that must be carried out by students to maximize understanding in an effort to form basic abilities according to the achievement indicators taken (Trianto & Sunarni, 2018). In order to create a good and structured LKPD, it is necessary to elaborate the learning process based on discovery learning (Yerimadesi et al., 2015).

Discovery learning is a learning model that develops an active way of learning by self-discovery, self-investigation so that the results obtained will last a long time in students' memories and train students to improve problem-solving skills (Hosnan, 2014). In addition, discovery learning is also one of the learning models recommended in the 2013 curriculum to strengthen the application of a scientific approach, especially in material that has dimensions of factual, conceptual, and procedural knowledge (Kemendikbud, 2016). This is in line with Brookhart (2010) which states that the discovery learning model can develop high-level ways of thinking and ways of learning that are active learners by discovering, investigating both concepts and principles themselves which results in long-lasting results obtained.

The use of teaching materials such as Student Worksheets based on discovery learning is an alternative solution to support the learning process to improve problem-solving skills (Fitriani et al., 2017). According to Redhana (2013), discovery learning-oriented student worksheets will provide direct experience and meaningful learning because it uses structured questions that direct students to be able to find the concept of discovery learning-based student worksheets that are able to train students' problem-solving skills on cell material, excretory material (Nastiti, 2016), and on digestive system material, but there are still few who research it on Ecosystem Material. This study aims to produce Student Worksheets based on discovery learning on Ecosystem material that are valid, practical, and effective for improving students' problem-solving skills. This research is expected to help students improve their problem-solving abilities and familiarize students with practicing developing problem-solving skills and abilities, then assist teachers in evaluating students' problem-solving skills after the learning process.

Method

The development model used in this study is a 4-D (Four D) development model (Thiagarajan et al., 1974), which consists of 4 main stages, namely: Define, Design, Develop, and Disseminate, this is in accordance with the process or method used to validate and develop products.

Define

The implementation of the research begins with the define stage aims to establish and define the requirements needed in the development of Student Worksheets. This stage is carried out by analyzing the objectives within the limits of the subject matter being developed. There are three steps taken in the definition stage, namely: Needs analysis to see the extent to which teachers and students need the Student Worksheets through interviews. Furthermore, in terms of curriculum by analyzing KI, KD, and indicators of achieving material competencies contained in the syllabus issued by BSNP in 2017. Then, formulating learning objectives to be achieved by students. Several things that need to be considered in this curriculum analysis are the material analysis in class X MIPA. Analysis was also carried out by analyzing teacher's books and student's books. Analysis of the teacher's book was carried out to examine the relationship between indicators, learning objectives to be achieved in class X semester II in the theme of Ecosystem Material. In this analysis, we see problems related to the development of Student Worksheets. Analysis of student books is carried out by examining the material and pictures contained in

student books. The results of this analysis are used as an illustration to develop Student Worksheets.

Design

The design stage aims to design Student Worksheets. Student worksheets are designed in such a way that students can learn according to their individual learning abilities. The design of Student Worksheets is carried out by selecting a format that is in accordance with the research format of Student Worksheets that is good and correct by taking into account the suitability of the material and curriculum. The development of teaching materials is prepared according to the demands of KI, KD, indicators and learning objectives that refer to the components contained in the teaching materials. This LKPD also pays attention to the way of presenting discovery learning-based ecosystem learning material.

Develop

The develop stage aims to produce teaching materials that are valid, practical, and effective. The developed Student Worksheets are validated by two validators, namely the content validator which checks the suitability of the Student Worksheets according to the biology learning material and the construct validator which checks the suitability of the components of the Student Worksheets. In this case the instrument is used in the form of a validation sheet. The practicality test of teaching materials was carried out using a teacher and student response questionnaire. The results of this questionnaire are used as a basis for making improvements to the student worksheets that are being developed. The effectiveness test was carried out to evaluate whether the teaching materials were effective or not by using instruments in the form of a pre-test and post-test in the form of an essay test with a total of 5 questions. Data analysis techniques for the results of content and construct validation were carried out by calculating the average rating for each material and media aspect indicator. After that, the average is converted into content and construct feasibility categories.

Data analysis was continued by analyzing the results of the worksheet legibility questionnaire during a small-scale trial. The analysis was carried out by calculating the total score from each student's assessment and then converting it into the category of worksheet readability level. Response questionnaire data analysis was carried out by calculating the total score of each student's assessment and then converting it into student response categories. Data analysis of pretest and posttest results was carried out by assessing students' pretest and posttest answers and then calculating the increase that occurred using the n-gain test. This is done by looking at the activity of learning. Through the dissemination phase, the use of Student Worksheets is also seen for the effectiveness of other subjects, for example in other classes, or other schools. The aim is to test the effectiveness of using the Student Worksheet on different subjects. Student Worksheets are said to be effective if they can provide good results on students' problem-solving abilities, after which discovery learning-based Student Worksheets will be distributed on a limited scale, namely in class X MIA MAN 2 Labura.

Disseminate

The fourth stage is the disseminate stage. At this stage it was carried out in class X MIA MAN 2 Labura by providing Student Worksheets related to the products developed to MAN 2 Labura schools.

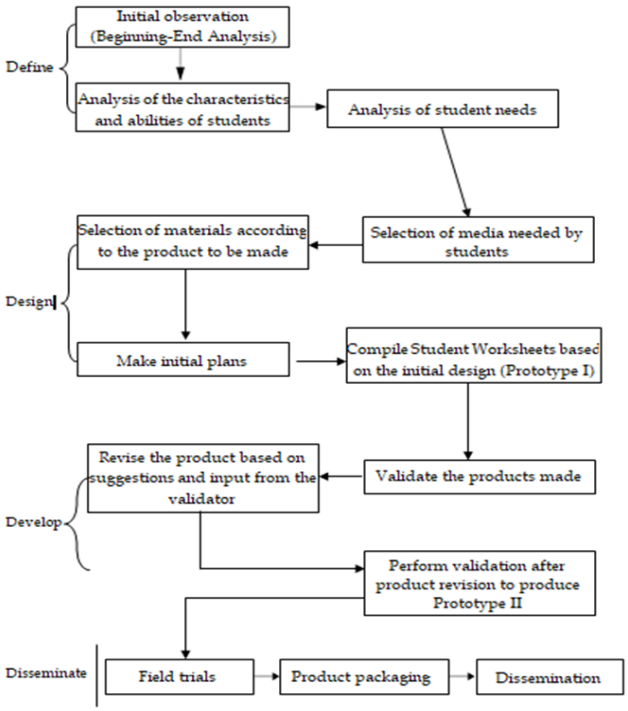

Figure 1. Diagram research flow

Results and Discussion

Problem solving skill is Wrong One objective main learning mathematics, so that need for improved. Wrong One attempt to improve it with using discovery -based Student Worksheets learning. The following are the results of the research about application Student Worksheets based discovery learning in learning.

Validity and Reliability Test Results

Before measuring the ability to solve problems, test the validity and reliability of the instrument. This is done to increase the effectiveness of the data collection process (Sugiyono, 2015). Problem solving ability was

tested on 26 class XI TBSM students. The results of the validity test and reliability served on Table 1.

Table 1 show that fifth question which piloted valid with a value of r_{count} every question is over from r_{table} = 0.388. Meanwhile, count-only reliability grain question in a manner whole that is 0.687. Based on matter the show thattest instrument the stated reliable with mark $r_{\text{count}} > r_{table}$.

Table 1. Validity and Reliability Test Results

Question	Results of validity test	Results of reliability test
1	0.459	
2	0.796	
3	0.762	0.687
4	0.741	
5	0.582	

Description of t-Test Results of Students Problem Solving Ability

Inferential statistics is used for analyze something sample andinteresting conclusions for the population of a sample used (Sutopo & Slamet, 2017). The sample used in this study was class X Mipa TKJ (25 students). This sample will be given treatment in the form of LKPD based on discovery learning. Before starting the analysis of problem solving abilities, first test the normality of the data. The normality test was carried out using SPSS with a significance level of α = 5%. The result is presented in Table 2.

Table 2. Test Results Normality Data

	Kolmogotov-Smirnov			Shapiro-Wilk		
	Statistics	Df	Sig.	Statistics	df	Sig.
Pretest	0.173	25	0.053	0.933	25	0.104
Posttest	0.161	25	0.093	0.938	25	0.135

From the data in Table 2 obtained the significance value (p) of the pretest is 0.104 with thereby $p > 0.05$. Whereas, mark significance (p) fromposttest is 0.135 with thus $p > 0.05$. Based on results the state that data pretest and posttest distributed normal. Afterthe data is normally distributed then followed by t test using Paired Sample t Test to find out the difference in students' ability to solve problem before and after treatment (Table 3).

Table 3. Results of t-Test

	Means	t	df	Sig.
Pretest	39.68	−12.285	24	0.000
Posttest	66.56			

Table 3 obtained mark t_{count} = −12.285. With α = 5%/2 and $d\ f$ = 24 obtained (0.025; 24) = −2.064. Because $t_{\text{count}} <$ (0.025; 24), so H_0 is rejected. With say other, can concluded that there is an average difference flat between mark pretest and posttest. This difference can be shown by mark average ability solving phase problem posttets ($\bar{x}$ = 66.56) higher than average flat mark pretest ($\bar{x}$ = 41.12). Matter this show that there is influence use Student Worksheets based discovery learning in enhancing the students' ability of solving problem.

Description Enhancement Kemam-Madam Solving Problem

Based on difference average mark pretest and post test, researcher use normalized gains for count enhancement ability solving problem participant educate. The result show thatability solving problem experiencing enhancement as big 0.465with category currently. Enhancement ability solving problem give influence positive toresults Study participant educate in learning mathematics. These results are obtained based on test N-gain which confirmed based on category Meltzer (2002), so that increasing ability solving problem participant educate as a result of integrating the application of Student Worksheetsbased discovery learning in learning mathematics. In line with research by Nasution et al. (2019) state that Student Worksheets based discovery learning in a manner can significantly increase the madam student problem solving. More analysis carry on use test normalized gains to know ability solving problem oneach indicator (Table 4).

Table 4. Results of normalized gain Indicators of Problem Solving Ability

Indicator	N-Gains	Category
Understand Problem	0.872	Tall
Compile Plan	0.281	Low
Carry out Plan	0.401	Currently
See Return	0.177	Low

Based on Table 4 shows that study thisusing four indicators. First indicator, understand problem obtain normalized gain as big 0.872 with criteria tall. On stage this participant educate already capable identify and analyze what which is known and asked in question with appropriate. In line with Wedelin et al. (2015) say that understand the problem is aspect which important in problem solving. Solution to problem this participant educate write what which is known and asked with strategy formulate return problem use understanding Alone. This helps students for identify information important and what which become objective from problems.

Second indicator, compile plan obtain *normalized gain* as big 0.281. Results analysis this state that enhancement ability compile plan still relatively low. Indicator improvement draw up a plan indicated by participant educate capable plan steps settlement problembiology well. Learners compile plan settlement

problem with write strategy form formula nor sentence which will used in finish problem. Matter this done for guide participant educate in finish problem so thatwalk with good. In line with Syaiful et al. (2020) stated that in stage plan solution participant educate need identify-authentication strategy which will used as guide in solve problem.

Third indicator, carry out plan obtain normalized gain as big 0.401 with criteria currently.Enhancement indicator carry out plan shown by students already capable do calculation that connects several concepts material in solving problem correctly. The material contained in in Student Worksheets connect between concept of biotic and abiotic components with food webs. Where is the initial ability of students before use Student Worksheets connect between concept of biotic and abiotic components with their food webs still feel difficulty in do. However, after use Student Worksheets This participant educate experience enhancement in do connect between concept of biotic and abiotic components with food webs with appropriate. Besides That, students are also able to make andimplement plan infinish problem newwith appropriate. In line with Sujarwanto et al. (2014) state that problem solving requires ability cognitive participant educate in do concept of biology during implementation plan settlement problem.

The fourth indicator, checking again obtained a normalized gain of 0.177 with low criteria. The re-checking indicator is an activity of reviewing whether the solution used has obtained the right end result or not. In this process students review solutions by working on problems using other ways to re-check the answers they have obtained. This is done to minimize errors and ensure the final answer is correct (Xin et al., 2008). The drawback of this research is that students need more time to understand the material. Meanwhile, the advantages of this research make students active and independent in obtaining a concept. This activity of independently investigating concepts has a positive impact on students where the knowledge gained will last a long time in memory (Afandi et al., 2013). In addition, the use of Student Worksheets Based on Discovery Learning can familiarize students to develop skills in problem solving. Therefore Student Worksheets based on Discovery Learning can used in learning mathematics as Wrong One material teach For increase ability solving problem. Study this hope to provide insight and benefit for practitioner education mathematics in repair quality of learning. In addition, can help learning biology walk effective and efficient.

Conclusion

The findings of this study prove that Discovery Learning-based LKPD-assisted learning can increase students' solving abilities by 0.465. This research still requires further elaboration due to the limitations of the research subjects and the subjects involved. Therefore, further research needs to involve subjects from various levels of education for the subject matter in Discovery Learning-based worksheets. So that the increase in students' problem-solving abilities can be evenly distributed at all levels of education.

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Author Contributions

Fatayatul Fikri conceptualized the research idea, designed of methodology, management and coordination responsibility; Miza Nina Adlini analyzed data, conducted a research and investigation process, conducted literature review and provided critical feedback on the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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