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Development of Student Worksheets Based on Discovery Learning for Class X Students of Environmental Pollution Materials

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Abstract: This research is based on Discovery Learning on environmental pollution material and aims to produce Student Worksheets to determine the feasibility test. This feasibility was tested by media experts and material experts, as well as by teachers and students. This type of research is based on the research and development (R&D) improvement of the ADDIE research model. The research sample amounted to 36 students. The instruments used are media and material validation questionnaires, student response questionnaires and teacher response questionnaires, and the feasibility of discover learning-based Student Worksheets based on pretest and posttest. The data analysis technique of this research is quantitative and qualitative. The validation results found that the development of this Student Worksheet was at the stage of the feasibility of the Student Worksheet material with an average of 82.00% of the most appropriate definition criteria and media experts assessed an average of 88.00% of the average percentage of the most probable criteria. Discovery learning based on the teacher's response to environmental pollution, the importance of the Student Worksheet is 82.75% with very interesting conditions. The level of validity assessed by the teacher on this Student Worksheet is obtained by a percentage of 90.00% which is stated to be very practical. And lastly, the results of the pretest and posttest showed that it was 0.74 where this number indicates that the two tests are stated to be very practical. With the average achievement of the pretest getting an average value of 8.92 while the average posttest score getting an increase of 9.72, therefore with the test questions it was found that students experienced an increase in knowledge after using the Participant Worksheet. Discovery Learning-based students on environmental pollution material.

Keywords: Student Worksheet; Discovery learning; ADDIE

Introduction

Weak teaching and learning activities where students get more theory is a very common problem in the world of education. In addition, students' understanding is very focused while the theory that students learn cannot be applied in everyday life. This makes students aware that the content of the lesson is not deep. It is expected that the presence of teachers in teaching and learning activities will increase the potential and creativity of students, which will not only make students have knowledge based on theory, but will also be more interesting and can go through anything that will make students understand easily. The material is given by practicing the times.

Biology is one of the subjects in the science field that offers a variety of science learning processes. The concept of science is continuous with everyday life and clearly highlights the main theme to provide information on the relevance of the concept. Science is an approach that emphasizes the scientific process of studying nature as scientific knowledge and can be applied in everyday life as a learning experience. Therefore, learning activities are expected to be based on student activities and classroom learning, not on results. This is different from when learning science always leads to results and completes lessons without educating

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students to further improve their thinking skills. (Sukmasari and Rosana, 2017).

The curriculum is a series of lessons that contain the content of standard learning objectives that are used by educators as a reference during the lesson. The current curriculum in Indonesia is the 2013 curriculum or abbreviated as K13. In the 21st century there has been a change in the curriculum, in this century everything is technology-based. There are three competencies that students must possess in the curriculum: Attitude, Skills and Knowledge. These competencies are included in K13 because they emphasize a scientific approach which means higher-order thinking skills. The learning process is made so that students actively construct by observing, asking questions, integrating information, connecting, analyzing, and learning through a scientific approach. (Bisri, 2020).

One of the problems in Indonesia is the lack of learning support materials and tools to enrich the student experience, build knowledge of student activities and support problem solving skills. (Kurniawan, 2016).

The limited learning tools certainly affect the quality of learning, especially in biology subjects. One of the teaching materials used is the Student Worksheet which can enable students to develop their thinking skills. (Wati et al., 2018).

Lestari Majid (2013) suggested that the Student Worksheets be prepared by the teacher in accordance with the rules and learning objectives. (Sari et al., 2016). In general, student sheets are learning tools that can be used to complement or support the implementation of lesson plans. The Student Worksheet must also contain instructions or methods that students must carry out to complete a task, and must function to help students express creative ideas and think critically and can create good collaboration between individuals and groups (Mayasari et al., 2015).

Research conducted by El Jannati (2015) reported that students' post-test scores in learning were better than those in the control class. This finding shows that worksheet-based teaching improves student achievement and increases student learning activities. In addition to teaching materials such as Student Worksheets, a good teaching approach helps create interest, interest, motivation and awareness of learning. One way is with a scientific approach. This scientific approach is learning that encourages students to apply scientific skills such as paying attention, asking questions, gathering information, communicating. Education that asks students to be active in practicing scientific skills will certainly get student-teacher correlations and student-student interactions become more effective (Handayani, 2016).

The best way to learn is to have a good relationship between teacher and students when they deliver learning materials. The teacher's role is to help students learn actively and develop their potential (cognitive, emotional, psychomotor), is an important role for teachers as facilitators. (Miftah, 2019). To develop student learning outcomes, if teachers are supported by teaching materials that accelerate learning, the use of teaching materials that encourage them to be active and develop their skills in individual and group learning makes learning more creative.

In an interview with a biology teacher at SMAN 1 Pulau Rakyat, the method used by the teacher in teaching is the question-and-answer method, discussion of information and focusing on the teacher. The teacher does not use the Student Worksheet teaching materials. In addition, learning tools that are easy to use are simple, easy, interesting, and easy for students to understand. The characteristics of good and effective teaching materials used in biology education are adjusted to the abilities of students, because their abilities are different.

In addition, according to the results of interviews with class X students, it is said that students do not use Student Worksheets in the learning process and the most difficult thing for students to understand is environmental pollution material. Students are not enthusiastic in reading textbooks. To apply different teaching methods the teacher asks students to be active during the learning process. Students sometimes get bored while attending lessons because they only use learning methods because the teacher is too quick to explain the lesson so that it makes students less motivated to take notes from the teacher. Have students create their own content summaries to help them understand the lesson.

In addition, student problems occur because teachers generally do not prepare Student Worksheets based on discovery learning. Teaching by teachers tends to receive information only by rote, which allows students to develop poor thinking skills. One of the learning models that provide opportunities for students to learn independently, creatively and actively is to use the discovery learning model.

According to Winarti et al., (2020), Discovery learning is a learning method to process concepts, meanings, and correlations through information to reach final conclusions. When individuals are involved, discovery occurs, often using their mental processes to derive certain concepts and principles. Usually done by observing, categorizing, measuring, predicting, determining, and referring. The process by Robert B. Pasir (Hamalik, 2018) is referred to as a cognitive process, discovery itself is a mental process of integrating concepts and principles into the mind.

The principle of learning that seems clear in Discovery Learning is that lessons or learning materials are not presented in a final form, but students are encouraged to identify what they want to know as

learners, then look for information on their own and construct it. They know (the construction) and help them in the final form. By applying the discovery learning method repeatedly, it will advance individual self-awareness (Sahrianti et al., 2021).

The solution that must be implemented in solving problems at school is to develop Discovery Learning-based Student Worksheets to help students be active, creative and easy to understand subjects. This model is a model that focuses on the direct experience of students and emphasizes the process of learning outcomes. Then this model aims to make learning effective and efficient.

The development of discovery learning-based Student Worksheets is expected to facilitate the conceptualization of the material provided by the teacher. and can also ask the teacher to arrange the learning atmosphere to be interesting for students, so that learning can be easily understood. The discovery learning model includes six steps that familiarize students with observing, identifying, analyzing, reasoning, classifying, and drawing conclusions.

Research conducted by (Novayani et al., 2015) states that the discovery learning model is effective in improving students' thinking skills. Then research (Handoko et al., 2016) argues that the discovery learning model not only develops student learning outcomes but also reduces the total involvement in remediation. Sukmasari's research (2017) argues that the use of Discovery Leaning-based Student Worksheets is effective in improving students' metacognitive and conceptual skills.

The scope of the material considered in this study is environmental pollution itself, namely living organisms, energy-giving substances and other substances that are introduced or assimilated into the environment or changes in environmental systems due to human activities or natural processes. The quality of the environment has decreased to the point that it is caused by the environment being damaged or not functioning as in (Environmental Management Law No. 4 of 1982).

Meanwhile, according to data from the Central Statistics Agency (2018), Indonesia's 2018 Environmental Care Behavior Index shows a figure of 0.51 in 2018. This figure shows that the level of public awareness of the environment can cause damage to natural resources and eventually lead to natural disasters. The problem of protecting the environment of the population is influenced by many factors (Yunansah and Herlambang, 2017). A large number of people also affect the environment. The lack of public knowledge about the environment contributes to the level of environmental damage (Wati et al., 2018).

Based on the description above, it is necessary to prepare Student Worksheets that can guide students during learning, so the topic in this research is "Development of Discovery Learning-Based Student Worksheets for Students of Class X Science SMAN 1 Pulau Rakyat Environmental Pollution Materials".

Method

This type of research is research and development. As stated, (Sugiyono, 2017) that Research and development (R&D) is a research method used to develop certain products and test the effectiveness of these products. According to (Sukmadinata, 2021), research and development (R&D) are steps taken to improve new products or improve existing products, which can be considered. Then according to (Putra, 2017), Research and Development (R&D) is a research method that is carried out intentionally, systematically to obtain, improve, develop, produce and test products. The development model used is the ADDIE development model. ADDIE emerged and developed in the 1990s by Rieser and Molanda. There are different types of ADDIE, a development model that includes five stages: analysis, design, development, implementation, and evaluation (Adlini, 2021).

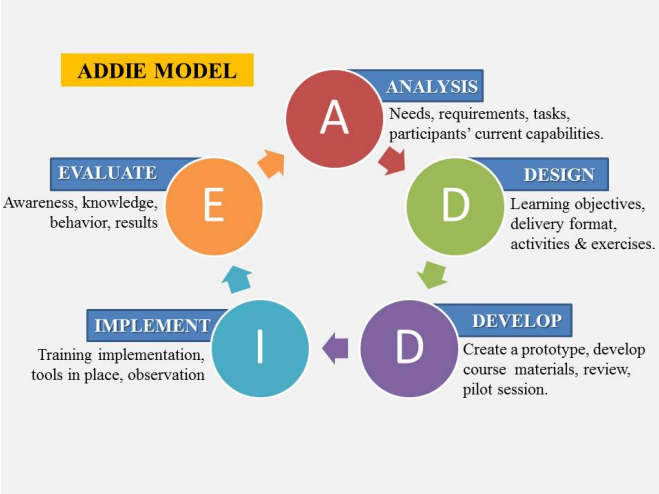

Figure 1. Five Stage of ADDIE Model

The tools used in this study are visual aids such as models, objects, and other visual aids that provide real experiences, encourage learning, and increase learning absorption or retention.

The subjects of this study were students of class X IPA SMA N 1 Pulau Rakyat, from July 11 to July 13, 2022 the research sample used in this study amounted to 36 students through interviews, tests in the form of research tools, and observations.

Result and Discussion

Analysis

This stage is the initial stage carried out in the development of this Student Worksheet. The purpose of this step is to identify and describe learning needs,

starting with an objective analysis of material constraints based on discovery learning. According to experts, this level includes many aspects of analysis, which include student characteristics, where students have different cognitive abilities, the activity level is low because learning is still teacher-centered, so Student Worksheets are needed to help students be active. (Qurniati et al., 2015).

In addition, based on previous preliminary observations, it was found that the Student Worksheets were still in simple form, namely in the form of sheets containing questions without following the writing structure. Therefore, based on student analysis and initial observations, discovery learning-based Student Worksheets were made on environmental pollution material, which hopes to stimulate students' enthusiasm to participate more actively in the learning process. Visual perception results in higher academic performance and lower cognitive load (Yung and Paas, 2015), so it is not more student-centered. The level of discovery education mentioned by Muhibin Syah quoted by (Priansa, 2018), discovery learning, learning procedures include:

a. Giving encouragement, early at this stage students will face something that causes question marks, followed by not giving general statements, so that the desire for self-introspection arises. In addition, teachers can initiate teaching and learning activities by asking questions, reading books, and doing other problem-solving learning activities.
b. Identifying problems, then the teacher directs students to identify problems according to the topic that has been given. The selected problem must be presented in the form of a hypothesis statement that provides temporary answers to the questions given. Providing opportunities for students to identify and analyze the problems they face is a valuable tool in building students' problem-solving skills.
c. Collecting data. Students collect as much information as possible. The information collected must be relevant, read articles, view objects, interview sources, conduct own experiments, and so on. The result of this stage is that students actively learn to get something related to the problem, so that students unconsciously connect the problem with previous knowledge.
d. Processing data. All data from reading interviews, observations, and other data were processed, randomly, randomly, tabulated, even needed, calculated by certain methods, and interpreted with a certain level of confidence. Data processing is called coding, whose function is to form concepts and generalizations. From these generalizations, students gain new knowledge about alternative solutions that need to be verified logically.
e. Validate. At this stage, students carefully examine the results of data processing to determine whether the hypothesis is true or not. According to Bruner, the learning process is better and more creative if the teacher provides opportunities for students to search for concepts, theories, laws or knowledge through real life examples.
f. Generalize. This step is a process of drawing conclusions that can occur if the general principle is applied to all similar incidents or problems, taking into account the results of the verification. Based on the verification results, the principles under a general summary are prepared

Design

At this design stage, before the research is carried out, from the beginning by studying in depth about environmental pollution based on textbooks, and also based on the main discussion topics related to environmental pollution, including, water pollution, soil pollution and air pollution (Ryder and Leach et al., 1999). This research paper aims to produce Student Worksheets that are in accordance with the applicable curriculum, and students will be more interested in actively studying environmental pollution because it will be easy to understand and interesting.

By using the Student Worksheet in product design, students are expected to discuss and work together with their teammates. Students will be directly exposed to various observations related to environmental pollution so that they can better understand the material of environmental pollution. The designed Student Worksheet will be based on the predetermined preparation criteria, so we hope that the discovery learning-oriented Student Worksheet product design will be the most practical and innovative teaching material. At this stage the development of tools that support the development process. The arrangement takes into account the most important elements in the development process, such as titles, learning guidelines, basic competencies or subjects, supporting information, work standards and evaluations. (Meutia et al., 2021).

Development

At the development stage based on the initial design to produce the first product, this development includes several aspects, namely cover design, student worksheet cover display design, environmental pollution images, use of content descriptions in the student worksheet cover student worksheet only consists of one part. The cover color is designed in full color (HD) with a green base color and the cover support features include several components, for example the title of the Student Worksheet material, the cover construction display is shown in Figure 1.

Figure 1. Student Worksheet Cover

In terms of content, there are several pictures of environmental pollution in the Student Worksheet based on discovery learning, material pollution, water pollution, soil and air pollution. The third aspect is testing by media expert verifier experts and the purpose of the material is to determine the accuracy of the production of student notebooks and research tools made. This is based on the opinion given. Research. (Rahman, 2017). The validation results are used as a reference for suggestions to improve the Student Worksheet based on discovery learning. Input and validation input are used as a reference for product improvement to produce a good product. The results of the media and material expert verification can be reviewed in Table 1.

Table 1. Validation by Media Expert Lecturers and Material Experts on Student Worksheets

Type of Validation	Percentage (%)	Criteria
Material Validation	82.00	Valid
Media Validation	88.00	Valid

From the table above, it can be seen that 82.00% of the results of the fact checker evaluation of Discovery Learning-based Student Worksheets are in the correct category. While the results of the evaluation of the Student Worksheet based on discovery learning by the media validator were 88.00% and included in the most accurate category. The results of the study concluded that the contents of the Student Worksheet based on discovery learning could be used. Then enter the query validation stage, where the query validation results are verified before being used. The questionnaire used is a student and teacher response questionnaire. After the questionnaire was made, it was verified by the verifier who was in the most accurate category, so that the student response questionnaire could be used with some modifications. If the results of the assessment are confirmatory, the teacher's response questionnaire, the Development of the Student Worksheet is also prepared based on the design that has been carried out at a stage that is adjusted to the Learning Program Plan. The draft Student Worksheet that has been designed is then given to the supervisor for review and then given to the expert to be assessed for input and advice (Andani et al., 2020).

Next is the pre-test and post-test testing stages for students, and the effectiveness of Discovery Learning-based Student Worksheets is the result of student achievement tests after the Student Worksheets are tested in class. The test given is in the form of multiple-choice questions with a total of 20 questions. This test is carried out first before learning (mock) and finally after completing the explanation of the material using the Student Worksheet (post test). Learning Outcomes Test is given to students. Student Worksheets based on discovery learning. The following table shows the results of the learning outcomes of students in class X IPA SMAN 1 Pulau Rakyat.

Table 2. Gain Pretest and Posttest of Students

Number of Pretest and Posttest Questions	N-Gain Results
20 Questions	0.74 (High)

While the results of the calculation of the average value of the Pretest and Posttest are as follows.

Table 3. The average results of the students' pretest and posttest

Average	Total Score
Pretest	8.92
Posttets	9.72

From the number of percentages above, discovery learning-based Student Worksheets can have a positive effect and improve student learning outcomes. Based on the percentage of master learning outcomes, it can be concluded that the Student Worksheet is considered effective with the acquisition of learning masters more than 80.00%. This theory supports that student are said to be successful (complete) if they get a greater value with the Minimum Completeness Criteria value. One of the assessment principles in the Education Unit Level Curriculum is the use of benchmarking. (Sarnoto and Wahyudin, 2018) Using certain criteria to determine student graduation. The minimum standard to declare students complete is called the Minimum Completeness

Standard. Minimum Mastery Criteria must be determined before the start of the school year. No matter how much you exceed the minimum requirements, do not change the teacher's decision to declare selection and not pass the course.

These benchmarks do not immediately change as a result of the results of an objective assessment. Classical learning is considered successful if at least 80.00% of students achieve perfect scores. If the results of using the product provide the expected results, then the effectiveness aspect is met. Effectiveness is measured based on classical student completeness, where the number of students who complete is greater than or equal to 80.00% of the number of students in the class.

Implementation

This step is to implement the Student Worksheet teaching media in the education process. Learning media for Student Worksheets is based on discovery learning by involving students in experiments to determine student responses and teacher responses. This stage is the next stage of development. At this stage all media designs are implemented after revision (Hamriana, 2021). By using the developed Student Worksheet, the learning media is implemented in real situations, namely in the classroom. This is done by the developer so that students are more curious when studying content on learning media. The questionnaire was given by the developer on the last day of the experiment after the teacher and students finished paying attention to the learning media. (Usman et al., 2019). This questionnaire was distributed to 36 students and 1 biology teacher. The results of the performance level of the Student Worksheet can be seen in the following diagram.

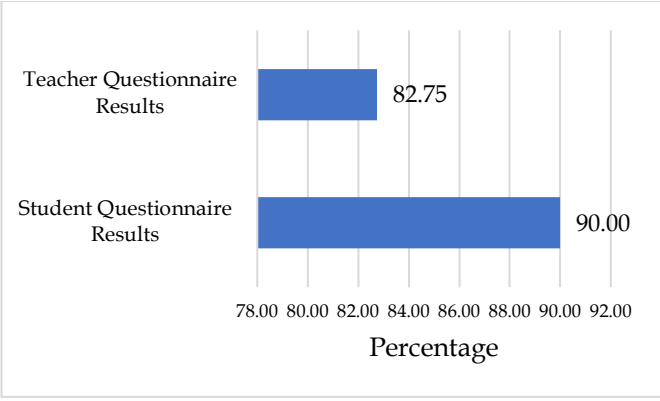

Figure 2. Results of the Practicality of Student Worksheets

In this way, the level of student worksheet action is obtained based on Discovery Learning from the student and teacher response questionnaire to the Student Worksheet developed by the researcher. The assessment category is 82.75% (very practical) and the teacher assessment questionnaire reaches 90.00% (very practical) which is a positive response to the development of Student Worksheets and students are interested in participating in learning. The activities fostered by the Student Worksheets are based on discovery learning. Therefore, it can be said that the practical standard of this Student Worksheet is found and used in practice during the learning process (Andayani, 2020).

Evaluation

At this stage, the results of the evaluation and management of conclusions are carried out. Based on the results of questionnaires from media experts, material experts and students, it can be concluded that the Discovery Learning-based Student Worksheet can be used for environmental pollution based on the benefits of the Student Worksheet. The successful product is a student worksheet based on discovery learning (Kurniawan, 2016). Kesumaningrum's opinion in his research is that this media is used to explain material about environmental pollution and its changes. (Kusumaningrum et al.). It was stated that this product would be the final product without the need to review the tests carried out on this media by many teachers who had passed the verification stage. The researchers really wanted to. This product has several advantages, namely:

a. Discovery learning-based Student Worksheets equip students with new knowledge about this environmental pollution material.
b. Student Worksheets based on discovery learning on environmental pollution material have a motivational content that motivates students to be more enthusiastic about learning.
c. Discovery learning-based Student Worksheets stimulate students to learn independently because they contain practicum activities that ask students to be more active in teaching and learning activities.
d. Discovery learning-based Student Worksheets provide discovery learning content with conceptual assistance, problem solving, and motivation. It is appropriate. Avoid discussing extensive citations and published articles.

Conclusion

Based on the description above, it can be concluded that from this development study based on the assessment of material experts, the feasibility of the Student Worksheet based on teaching research is an average of 82.00% percent of the best interpretation criteria and media experts on average 88.00% of the best interpretation criteria. most likely criteria. Based on the teacher's response, the level of interest in the Student Worksheet based on environmental pollution education has a very attractive requirement of 82.75%. The level of attractiveness based on student responses of SMAN 1

Pulau Rakyat based on field tests found a very interesting interpretation. This shows that the Student Worksheet can be developed as one of the media supporting learning because it is very attractive to teachers and students. The acceptance rate of Student Worksheets based on discovery learning of environmental pollutant materials is 90.00% which is considered very practical, so this Student Worksheet is very feasible and satisfactory to be used for field experiments. The results of the students' pretest and posttest showed that it was 0.74 where this number indicated that the two tests were stated to be very practical. With the average achievement, namely the pretest, the average score was 8.92, while the average posttest score was 9.72. Therefore, with the test, the results showed that students showed an increase in knowledge after using the Participant Worksheet. Discovery learning based on environmental pollution material.

Acknowledgements

The researcher found that the results of the study in the form of Discovery Learning-based Student Worksheets on environmental pollution materials could be used in the learning process in schools, so that the quality of the Student Worksheets as a whole would be more useful. It is hoped that this research can be developed in the future not only on environmental pollution but also on other materials.

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