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Development of integrated science learning device oriented toward scientific literacy on discovery learning model of environmental pollution theory

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Abstract
This research aims to produce integrated science learning tools in the form of lesson plans and worksheets that are oriented towards science literacy using a discovery learning models of environmental pollution theory and testing the effectiveness of learning devices on student learning outcomes. This research was conducted in SMP Negeri 1 Dimembe with a sample of 20 people, they were grade VII D. This research is a type of research and development (R&D). The development of this learning tools uses the 4D model by Thiagarajan, *et al* (1974) consists of define, design, develop and disseminate. The results of the development of learning tools developed obtained scores for RPP 93,26% and LKS 97,79% with very decent qualification criteria, no need to be revised. The test results of learning tools that have been developed obtained scores for teacher responses questionnaire 98,68%, student questionnaire responses 92,08%, average pre-test score 44,00% and average post-test score 92,50% with very decent qualification criteria, no need revised. So it has produced a learning tool that has been tested and declared valid so it is feasible and effective to be used in learning at school.

Keywords: development of learning devices, scientific literacy, discovery learning, environmental pollution theory

1. Introduction
The rapid development of science and technology requires humans to increasingly work hard in all aspects of life. One of them is the aspect of education that determines the ups and downs of a life whose competition is getting stronger. Every individual in the global era is demanded to be able to develop their ability to compete at the national and even international level. One way for the government to obtain human resources in order to compete in the global era is by making efforts to improve the quality of education (Rusilowati, 2013) [16]. The quality of education in Indonesia is still below the average of other developing countries. The results of the Trends in International Mathematics and Science Study (TIMSS) survey, Indonesia's ability in the field of Natural Sciences in 2007 ranked 38 out of 40 countries and in 2011 dropped to rank 40 out of 45 countries (Martin, Mullis & Foy, 2012) [11].

Science Education (IPA) is a human effort in understanding the symptoms of the universe through proper observation of the target, and using procedures, and explained with reasoning so as to get a conclusion (Ahmad susanto, 2013) [2]. Science Education is expected to produce individuals who are able to compete in the arena of global competition. Natural Sciences is one of the subjects taught in an integrated manner which combines several sciences at once. This was also written by Salirawati in Widi Widayat who stated that Integrated Science learning is a science learning presented as a single entity that is inseparable as a stand-alone subject but all mixed in one unit (Widayat *et al*, 2014) [19].

Science is very well taught in an integrated manner because younger students understand the science process and can easily link relationships between existing science concepts. But learning science that is now not yet taught in an integrated manner, this is what causes the meaning of learning science has not been achieved. In science learning, there is one integrated material whose learning is still abstract, namely Class VII environmental pollution theory in semester II, this theory is said to be abstract because this theory is not explained in an integrated manner and does not link science concepts with daily student experience, this is what causes students to lack motivated to study environmental pollution theory. The learning process always requires learning tools to support the achievement of learning objectives.

However, the reality of the existing learning tools at school is that it does not help students in constructing their own knowledge, the teacher also lacks the ability to develop their own learning devices so that students become passive in learning. This fact is supported based on preliminary studies conducted by researchers when conducting observations at SMP Negeri 1 Dimembe, that there is still a lack of teachers' ability to develop learning tools, teachers are still central in achieving learning outcomes and as if they are the only source of knowledge. This causes students to be passive in the classroom and the low ability of students to solve problems themselves in learning. Therefore, one model that can make students become active in learning and can solve a problem is the Discovery Learning Method. Discovery learning is a teaching method that regulates teaching in such a way that children gain knowledge that they did not know before but not through notification, partially or wholly found by themselves. Science education in Indonesia has been implemented for many years, but unfortunately the results obtained at the international level are still very low, especially in the focus of scientific literacy. PISA (Programme for International Student Assessment) defines scientific literacy as the ability to use science knowledge, identify problems, solve problems (problem solving) and draw conclusions based on evidence in order to understand

and make decisions about nature and changes made towards nature through human activity. (Cosmas Poluakan, 2012) [15]. The latest results from the 2012 PISA study based on the OECD (2014) [14] show the decline in Indonesia's ranking from 60th in 2009 to 64th out of 65 participating countries with the acquisition of a score of 383 to 382. Based on PISA results conducted in 2015 suggest that Indonesia's achievements are below the international level average score (Manurung *et al*, 2017) [10]. Indonesia's average grade which is still relatively low reflects that most students have not been able to analyze and apply concepts to solve a problem. The students are very good at memorizing, but are still less skilled in using the knowledge they have. By having this scientific literacy ability, students can master the science material both cognitive, affective and psychomotor. Science literacy is an important thing to master because of its wide application and almost all fields. The importance of scientific literacy especially for middle school students is to prepare students to face modern life with the rapid development of science and technology (Artati, 2013). The teacher has an important role in improving the ability of student literacy to be able to compete in this modern era, but the fact is scientific literacy is still not well understood by teachers in the application of science learning. Therefore, it is necessary to conduct research with the title: Development of integrated science learning device oriented toward scientific literacy on the discovery learning model of environmental pollution theory.

2. Conceptual Framework

The success of integrated science learning is influenced by several aspects such as teachers who become facilitators, students as the main target and the learning tools used. In the 2013 curriculum, science education in schools is expected to shape students with high scientific literacy. Science literacy is a key competency in preparing generations who are able to use science and information to interact with life's challenges. In our day, individuals should get the information they need, have the ability to think scientifically by producing new information and making technology that can be used in everyday life (MEB, 2000). They must improve information, understanding, attitudes and values about science, they must improve their ability to search, solve problems, make decisions and to gain some basic skills in this field, individuals must begin their science education in elementary schools (Tatar, 2006) [17]. Research in this field shows that scientific literacy is one of the most important facts of science education (Laughksch, 1999 Nelson 1999, Tsabari & Yarden, 2005 and Knai, 2006) [9, 7]. Instead of transferring existing information, scientific literacy increases students' ability to attain knowledge. Citizens must have the ability to read, write, and have critical thinking about science and technology subjects to increase the economic productivity of the community (Anagün, 2008) [3]. According to research, scientific literacy is one of the most important elements in science education. Scientific literacy brings skills to attain knowledge rather than teaching existing knowledge to students. The skills acquired will be important on several occasions such as problem solving and making important decisions for their lives where students will meet in their future lives.

As an educational institution, schools, especially the learning process in the classroom are expected to provide scientific literacy for students. There are four dimensions of scientific literacy, namely: a) the context of science, b) the content of science, c) science competence, and d) attitude towards science. In the assessment of scientific literacy, PISA determines three sub-categories of scientific competence, namely: a) Identifying scientific problems, b) Explaining phenomena scientifically, and c) Using scientific evidence. Since 2006, the International Science Assessment Program (PISA) has assessed attitudes to science in examinations, which have four sub-categories: a) Interest in science, b) Support for scientific inquiry, c) Confidence in science as students and, d) responsibility for resources and the environment. Science literacy is one of the domains that assesses PISA. Indonesia's ranking in PISA shows that Indonesian students' scientific literacy skills are low. The contributing factors are school infrastructure, curriculum, books, learning methods, learning models, and the influence of human resources on students' scientific literacy. Therefore, educational institutions must prepare students to live in the information age; empower students to be able to use the knowledge and skills they already have to use current technology to discover new things in the future; prepare students to be able to think for themselves, make decisions based on information, develop expertise, and learn throughout life. The preparation of citizens and workers for life in the digital age depends on the excellence of the community, the quality of everyday life, economic life, and the ability to compete; all of which can be developed through good education. But the reality is that currently learning science taught in several secondary schools, especially junior high schools, has not been implemented in an integrated manner, this causes the meaning of science learning has not been achieved. Lack of teacher's ability to develop a learning device that is appropriate to the characteristics of students and the use of conventional learning models causes students to be passive in class and the low ability of students to solve problems themselves in learning. This is supported by a number of research results which show that learning tools are very important, as evidenced by the results of research conducted by Muhammad Rohli (2015) [13] that integrated science literacy-oriented learning tools oriented towards scientific literacy are effective based on students' success in achieving learning goals. The results of other studies from Amelia Hasanah (2015) [4] show that science learning tools are feasible to use theoretically or empirically. Furthermore the results of research conducted by Cosmas Poluakan (2012) [15] show that scientific literasis has an effect on achievement motivation.

This learning devices oriented to science literacy need to be developed by teachers for the integration of science concepts. So the need for the development of learning tools that are appropriate to the characteristics of students oriented to science literacy so that students can play an active role in solving a problem, see everything by the work of a scientist where the results obtained are seen not only limited to results and conclusions but with the process before it becomes a result. The learning tools are in the form of learning implementation Plan (RPP) and student worksheet (LKS). The steps in the lesson plan that are developed are adjusted to the steps of learning with the discovery learning model on environmental pollution theory.

2. Methods

This research is a research and development (R&D). The orientation of this research and development is a learning device in the form of lesson plans and worksheets. The development in question is to make the device different from the existing one. The development model in this study follows the development model adapted from the 4-D instructional design model developed by Thiagarajan, *et al* (1974). This model consists of development stages namely define, design, develop and disseminate. This model was chosen because it aims to produce products in the form of learning tools.

In this study two learning tools were developed, namely: learning implementation plan (RPP) and student worksheet (LKS). On environmental pollution theory in SMP N 1 Dimembe. Product Validation and Trial is a process of testing and revising the learning tools that have been developed (Abdul Gafur, 1986) [1]. Validation is done by appointing experts, as validators at the development stage. The validator consisted of two expert lecturers, Dr. Anneke T. Rondonuwu, M.Pd and Dr. Meitilistina Sasinggala, M.Si. Furthermore, trials will be carried out to determine the assessment of the products that have been made. The product trials in this study were small-scale group tests.

Data Collection Instruments used to collect data are as follows: 1) Questionnaire is used to obtain data on the assessment of learning tools and activities 2) Interviews are used in taking initial information about the condition of students and schools through science subject teachers and taking initial information about learning Science 3) The test is used to measure student achievement before and after using the product.

Data analysis techniques used to manage data from the results of expert reviews, namely by using descriptive qualitative analysis and descriptive statistical analysis. The formula used in statistical analysis to determine the percentage of validity of learning tools using the Discovery Learning model in this study is as follows.

$$P = \frac{\Sigma\ (\ answer\ X\ weight\ PER\ choice)}{n\ X\ highest\ weight}\ x\ 100\%$$

Information:
P = Percentage of respondents' answers
n = Total number of questionnaire items

4. Results and Discussion

Based on the results of the development of integrated science learning device oriented science literacy on discovery learning models of environmental pollution theory for students of class VII-D of SMP N 1 Dimembe using a 4-D development model consisting of define, design, develop and disseminate. These development procedures include:

1. Define Stage (Define), the defining stage is the initial stage of research development of learning tools. At this stage, the analysis carried out is the initial analysis, student analysis, task analysis, concept analysis and learning objectives analysis. In the initial analysis based on observations made by researchers about the conditions related to science learning in schools, it is obtained information that the existing learning devices in schools are less able to help students construct their own knowledge, teachers lack the ability to develop learning devices, teachers are still central in achievement of learning outcomes and as if to be the only source of knowledge that causes students to be passive in class and the low ability of students to solve problems themselves in learning. This is because students tend to only listen and only imitate what is written and said by the teacher. because of that teachers need to use learning models that make students actively involved in the classroom. Analysis of students obtained is the academic ability of each student is different, the age of students 12-13 years and in the implementation of teaching and learning activities of students using Indonesian even though sometimes using everyday language that is Manado language, parents' educational background of participants students are different. Analysis of the task of observations at the school where the research is, the tasks given to students have not been able to awaken the ability to find the concept of environmental pollution material. These tasks such as summarizing and writing the definition of environmental pollution, water pollution, soil pollution and air pollution. Material Analysis conducted by researchers is based on the content standards set by the government in the 2013 curriculum, namely environmental pollution theory. Analysis of the specifications of the learning objectives obtained namely the learning objectives are adjusted to the Basic Competencies (KD) listed in the 2013 curriculum.
2. Design Stage (Design), the second stage in this study is the design stage. In this study is divided into four, namely the preparation of instruments as a means of data collection, media selection, format selection and initial design. The preparation of the instrument as a data collection tool consisted of the preparation of the lesson sheets and lesson sheet evaluation sheets, questionnaire responses for students and teachers. The selection of media used in this study are laptops, LCD projectors, stationery, whiteboards, whiteboard erasers and practical tools. In the format selection, discovery learning will be used with the following steps: stimulation, problem identification, data collection, data processing, verification / proof, conclusion. And the 2017 revised RPP format is integrated with 4C components (communication, collaborative, critical thinking and creativity), LOTS Level (low level thinking ability), HOTS Level (high level thinking ability). The initial design of the lesson plan consists of cover, preface, table of contents, concept map, including the identity consisting of the name of the school, subject, class / semester, subject matter and time allocation, core competencies and basic competencies, indicators and learning objectives, the number of RPP meetings and subjects, learning models, media / tools / learning resources, learning activities and assessments. The initial design of the worksheet consists of cover, preface, table of contents, instructions for using the worksheet, concept map, basic competency (KD) and indicators, practical objectives, basic theory, steps of practicum activities and evaluation questions.
3. Development Stage (develop), after making the design of learning tools and assessment instruments, the next stage is the development stage. The development phase is divided into two stages, namely the review of

supervisors I & II and expert assessment. In the review phase of the supervisors I and II, the results of the initial draft (Draft I) were given input and suggestions. At the expert evaluation stage, the revised design (Draft II) was validated by 2 validators until valid. The results of the RPP validation of 93,26% and LKS 97,79% with very decent qualification criteria do not need to be revised. To see data on the results of the validation of the lesson plans and worksheets by the two validators can be seen in the following table

Table 1: Results of RPP validation

Validator	Score achieved	Expected maximum score	Validation Criteria
Validator 1	97	104	93,26 %
Validator 2	97	104	93,26 %
Average			93,26 %

Table 2: Results of LKS validation

Validator	Score achieved	Expected maximum score	Validation Criteria
Validator 1	130	136	95,58%
Validator 2	136	136	100%
Average			97,79%

Try Product

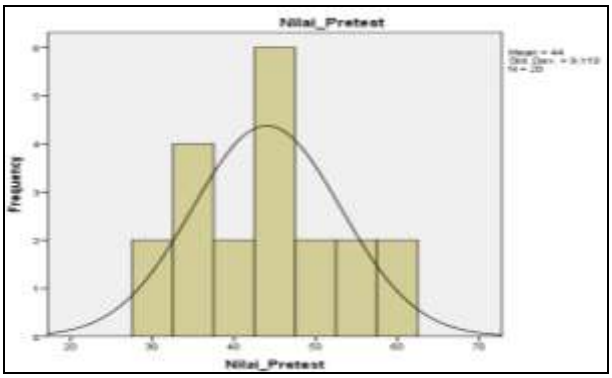
The validated learning kit was tested in class VII-D of SMP N 1 Dimembe with a total of 20 students. The learning tools tested include RPP and LKS. This trial activity was held in June 2019. The trial was conducted during 1 meeting. At the trial stage the data obtained were 92,08% student response questionnaire results, teacher response questionnaire results 98,68% student learning outcomes test results consisting of pretest with an average of 44,00% and posttest with an average of 92,50%. To see the results of trial data can be seen in the following table and figure:

Table 3: Results of Teacher Response Questionnaire

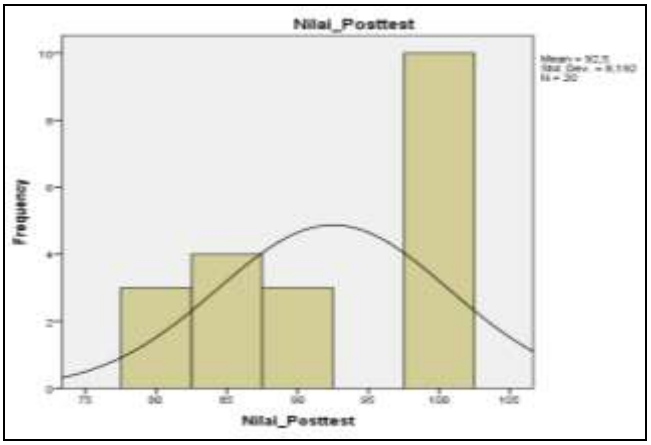
Validator	Score achieved	Expected maximum score	Validation Criteria
Validator 1	75	76	98,68 %

Table 4: Results of Student Response Questionnaire

Validator	Score achieved	Expected maximum score	Validation Criteria
Validator 20	1105	1200	92,08 %



Picture 1: Pre-test Value



Picture 2: Post-test Value

4. Dissemination stage, at this stage the learning tools in the form of lesson plans and worksheets that have been developed are distributed to science teachers of grade VII of SMP Negeri 1 Dimembe.

5. Conclusion

Based on the results of research and discussion, it can be concluded that integrated science literacy oriented learning device have been produced in the discovery learning model of environmental pollution theory as one of the proven learning media that is declared valid and effective so that it is suitable for use in learning. This can be seen from the results of the development of learning tools that were developed with a score for RPP 93,26% and LKS 97,79% with qualification criteria very feasible, do not need to be revised while the test results of learning devices that have been developed obtained scores for the teacher questionnaire responses 98,68%, response questionnaires students 92,08%, average pretest score 44,00%, posttest average score 92,50% with an average increase in value of 48,50%. Mastery learning 100% with the highest value of 100 and the lowest value of 80 with a range of values of 20.

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