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The Development of Problem-Based Learning Model with Scientific Literacy Approach in Elementary School

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***Abstract*—This study aims to develop a problem-based learning model with scientific literacy approach in elementary schools. The developed learning was expected to be used as a learning innovation to be able to improve the scientific literacy skills of elementary school students. The method used was development research or Research and Development. Research data includes analysis of learning difficulties and curriculum obtained through interviews and observations. Data from the assessment results, input, responses, criticisms, and suggestions for improvement of learning devices were obtained through assessment questionnaires by learning the material and learning media experts. The descriptive analysis was used to analyzed data. Research products that have been successfully developed by researchers were 1) problem-based learning models based on scientific literacy approach; 2) learning tools included the design of learning programs (Learning Plans), worksheets, and teaching materials. The final product of this study produced a teaching guide module for elementary school teachers.**

Keywords—Problem Based Learning Model; Scientific Literacy;

I. INTRODUCTION

One of the goals of science learning is to be able to develop Science Literacy. Science learning is increasingly meaningful for students if students have good scientific literacy skills. Through scientific literacy, students can apply concepts or facts obtained in learning with natural phenomena that occur in everyday life, so students can think analytically in solving problems related to natural events.

Science Literacy is the key to addressing global challenges. Learning about human literacy is essential to survive in the era of industrial revolution today [1]. The fact of the 2015 PISA results that the average value of Indonesian science has only reached a score of 403 from the score of 493 OECD countries (Organization for Economic Cooperation and Development) [2]. In the context of science learning science literacy has not been applied appropriately and comprehensively, so students are not used to looking for various sources.

The low level of scientific literacy abilities of students is influenced by the implementation of learning. Several problems in science learning related to scientific literacy abilities which are divided into three things [3]. First, the lack of linkages between content or material that is taught with things that occur in everyday life, so students consider science learning is challenging to understand. Second, science learning is carried out not in a comprehensive and integrated manner. Third, the low competence of teachers both regarding understanding science material and science learning. In order not to be increasingly left behind with other countries, our nation must immediately improve, especially regarding mastering science literacy. Therefore, one way that can be done is to innovate in learning by integrating the development of scientific literacy through the application of problem-based learning.

Through problem-based learning, students feel the need to look for answers to problems encountered that occur in the environment, and the teacher trains them how the process of finding those answers scientifically and systematically. In the problem-based learning model, students not only work alone but work in groups to give ideas that are correctly and logically owned in the context of real-life problems. The application of a problem-based learning model is in line with the aim of building students' scientific literacy because students learn how to learn from the real problems being studied [3]. Problem-based learning provides a real experience; students are directly involved in solving problems, identifying root causes and conditions needed to produce good solutions, pursue meaning and understanding, and become independent learners. Based on this background, the researcher intends to develop science learning in elementary-based science literacy through a problem-based learning model.

II. METHODOLOGY

This type of research is Research and Development research. The Research and Development method is a research method used to produce specific products and test the effectiveness of products [4]. The development model used in this study is based on the research steps of the development of Borg and Gall [4] with eight steps: 1) Research and initial information gathering; 2) Planning; 3) Development of the initial product format; 4) Initial trial; 5) Product revision; 6) Field trials; 7) Revision of the final product; 8) Dissemination and implementation. But not all steps are carried out according to the development needs in this study. This research has been carried out until the product revision stage (step 5).

The product developed by researchers was science learning in grade V elementary schools with a problem-based learning model based on scientific literacy approach. The study was conducted at Sampali 101774 Public Elementary School. The research products produced are the design of learning programs, student worksheets, and teaching materials. The study was preceded by a needs analysis to obtain information about the description of the implementation of learning in elementary schools. Furthermore, the results of the needs analysis were used as a basis for designing PBL-based science literacy learning devices. The results of the development of learning devices were then validated by material expert and learning experts and were revised based on input from validators.

Data collection techniques used were observation, interviews, document review, expert review, and questionnaire. Observations were used to find out the analysis of needs and conditions in elementary schools. Meanwhile, the interviews were used at the beginning to find out the problems and obstacles in the process of implementing science learning in elementary schools, review documents for curriculum analysis in elementary schools, study experts and questionnaires to assess whether the design of learning models rationally developed will be more effective or not.

III. THE LITERATURE OF RESEARCH

1. Problem Based Learning Model

The Problem Based Learning model is a learning model that is based on the many problems that require authentic inquiry, namely investigations that require real solutions to real problems [5]. Problem Based Learning is a learning process that exposes students to a problem before starting the learning process [6]. Students are faced with a real problem that prompts them to research, describe, and find solutions. Problem-based learning is closely related to the real-life reality of students, so students learn not only in the area of knowledge but also experience and feel.

Based on the opinions above, it can be concluded that Problem Based Learning is a learning model where the learning process is carried out by involving students in a problem to be solved which is optimized through group work using the stages of the scientific method so that interactions between stimulus and response arise.

Problem Based Learning has the following characteristics: (1) learning begins with a problem; (2) ensuring that the problems given relate to the real world of students; (3) organizing lessons around problems, not around scientific disciplines; (4) giving considerable responsibilities to learners in forming and running their learning process directly; (5) use small groups; and (6) requires learners to demonstrate what they have learned in the form of a product or performance [7].

Based on the description it is clear that learning with the Problem Based Learning model starts from the existence of problems related to real life, then students deepen their knowledge by finding new information that needs to be known to be associated with information that students already have in solving problems. After being able to solve the problem students reevaluate whether the solutions obtained by students are appropriate to solve the problem. Problem Based Learning is also related to learning about broader life, skills in interpreting information, collaborative and team learning, and reflective and evaluative thinking skills.

It can be concluded that the purpose of Problem Based Learning is the mastery of learning content by developing independent problem-solving skills or abilities that each student must have both individual learning and group learning.

2. Science Literacy

According to the OECD (2016) [8], science Literacy can be interpreted as knowledge and scientific skills to be able to identify questions, acquire new knowledge, explain scientific phenomena, and draw conclusions based on facts, understand the characteristics of science, awareness of how science and technology shapes the natural, intellectual and cultural environment, as well as the willingness to be involved and care about issues related to science.

Science literacy according to PISA [9] is interpreted as "the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and make decisions about the natural world and the changes it through human activity." The concept of literacy used by PISA is not only related to the ability to read and write but how to apply the ability to understand the principles, fundamental processes and apply them in everyday life. In its measurement aspects, scientific literacy according to PISA consists of three, namely science content, science process, and science application context.

According to Miller, scientific literacy consists of two dimensions, namely vocabulary dimensions and inquiry process dimensions [10]. The vocabulary dimension shows the term science as the necessary foundation in reading and understanding reading material. Meanwhile, the dimensions of the inquiry process indicate security and competence to understand and follow scientific arguments and matters relating to media technology policy. Based on the opinion above it can be concluded that scientific literacy is the ability to use knowledge, identify questions and draw conclusions based on evidence in order to understand and make decisions regarding nature.

IV. RESULT AND DISCUSSION

1. Result research

The results of the preliminary study of the conditions and needs of teachers through interviews and observations in SD Negeri 101774 obtained the following findings: First, all teachers have documents on learning devices. In compiling learning devices, 70% of teachers have no

difficulties, and 30% of teachers experience difficulties. Second, in developing teaching materials and worksheets needed in learning 65% of teachers do not develop themselves. The teacher only uses existing books. Third, the scope of the science subject matter teachers still has significant difficulties in designing learning that emphasizes the science process. Fourth, in the implementation of learning students are not actively involved in the learning process, learning does not provide real experience, and there is no link between content or material that is taught with things that occur in everyday life. So that learning does not integrate scientific literacy in learning.

Based on the results of preliminary studies and the results of theoretical studies and the results of discussions with teachers, a problem-based learning model based on scientific literacy was developed for the scope of material in science subjects in grade V of elementary school. The learning model of problem-based learning based scientific literacy consists of six phases in the learning steps as follows:

a. Provide reading texts containing real problems that occur in everyday life
b. Conduct problem orientation to determine the topic or problem and make questions about the problem to find a solution.
c. Plan and conduct independent and group investigations
d. Discuss the results of the investigation and make a report using reading material
e. Presenting the report results clearly and coherently from the results of the investigation activities and reading activities that have been carried out.
f. Analyze and evaluate the problem-solving process.

Product development data in the form of product drafts, including learning implementation plan components, teaching materials, and worksheets. To produce a learning draft that has feasibility from the aspect of learning design, the draft learning model that has been compiled is then validated before learning experts and material experts before being tested in the field. The results of the validation test for the initial draft show some disadvantages that must be corrected. Therefore, the draft development model underwent several changes from the initial draft. The results of expert validation using an open questionnaire can be seen in the following table.

The results obtained from expert validation that the results of the assessment of the design of learning devices, in general, are good, all components are by the characteristics of the instructional model used. However, there is still something that needs to be improved, especially in the development of scientific literacy in learning. Overall, the PBL-based science literacy learning model is valid and can be used in learning in elementary school

TABLE I. RESULTS OF VALIDATION BY LEARNING AND MATERIAL EXPERTS

Components	Components of Assessed Aspects	Results
Learning Plans	Formulation of indicators and learning objectives	Already referring to Primary Competence (PC) and Basic Competence (BC), using the operational word and learning objectives are fulfilled a, b, c, d.
	Elaboration of Learning Materials	Accordance with the characteristics of elementary school students. The material still needs to be arranged systematically.
	Media Determination and Learning Resources	By the indicators, various learning resources are still lacking
	Development of PBL Model Learning Activities Integration of Science Literacy	By the syntax of PBL, scientific literacy already exists but needs to be added.
	Development of Learning Assessment	HOTS included.
Worksheet	Content eligibility	Eligible with PC/BC and students' abilities needed
	Language Feasibility	Language eligible to language rules
	Activity Feasibility / Problem-based Student Literacy Development	Already providing direct experience, directing students to do scientific work and identify findings.
	Feasibility of Presentation	The steps of the activity are easy to understand, the presentation of material on the worksheet needs to be added
	Feasibility of Implementation	Emphasis on PBL learning, scientific literacy still needs to be upheld.
Teaching materials	Components of Teaching Materials	Already included PC and BC, the material is by BC, the list of references still needs to be added.
	Material Substance	The complete material, current, and standard language and can be understood by students or according to student development. Innovation, it still needs to be added.
	Physical appearance	Readable, proportional, good composition, and attractive design

3. Discussion of research

Learning models of science-based problem-based learning can be implemented by teachers in elementary school learning to develop scientific literacy. The selection of problem-based learning models based on scientific literacy pay attention to the material characteristics and characteristics of students. Problem Based Learning is a learning process that confronts students faced with a real problem that spurs students to research, elaborate, and seek solutions [6]. Problem-based learning is closely related to the real-life reality of students, so students learn not only in the area of knowledge but also experience and feel.

The problem-based learning model has several advantages if applied that are realistic to the lives of students, concepts according to the needs of students, foster the inquiry nature of students, retention concepts become foster and robust problem-solving abilities. The problem-based learning model of science-based learning model was

developed based on the principles of learning and curriculum in elementary school [5].

Central Curriculum Recommendations of the Ministry of National Education Research and Development Agency [11] said; the first science learning should foster trust in feeling capable of learning science, so science learning is not feared. Both science learning must be accompanied by the development of scientific attitudes and skills, so that science learning does not only master the concept. The third science learning should be able to develop reasoning abilities, plan and conduct scientific investigations, and be able to use the knowledge they have to understand natural events that occur. The four science learning must be able to revitalize science process skills so that it develops the ability to observe, plan investigations, interpret data, and information and draw conclusions.

The development of a problem-based learning model based on scientific literacy at each step of learning emphasizes and is based on efforts to develop students' literacy skills. In the learning step begins with reading the reading of the contents in the form of real problems that exist in everyday life. From the reading text, students are asked to determine the problem, make questions about the problem, search for information by reading and conducting experiments. Moreover, students explain the phenomenon clear and coherent from the results of the experimental activities that have been carried out and ended by making a report and presenting it in front of the class.

V. CONCLUSION

This research has produced a learning device based on science literacy based problem-based learning models. The research products that have been successfully developed are learning tools including the design of learning programs (RPP), worksheets, and teaching materials. The learning steps of the problem-based learning model based on scientific literacy on water cycle material are: first giving reading texts containing real problems that occur in everyday life. Second, conduct problem orientation to determine the topic or problem and make questions about the problem. Third, plan and conduct independent and group investigations. Fourth, discuss the results of the investigation and make a report using the reading material. Fifth, present the report results clearly and coherently from the results of the investigation activities and reading activities that have been carried out. Sixth, analyze and evaluate the problem-solving process. The final product of this study produced a teaching guide module for elementary school teachers.

The results obtained from expert validation that the results of the assessment of the design of learning devices are generally good, all components are by the characteristics of the learning model used. Overall, the learning model of science-based problem-based learning is valid and can be used in learning in elementary school.

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