How to develop students' scientific literacy through integration of local wisdom in Yogyakarta on science learning?

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Abstract. Local wisdom in Yogyakarta is very diverse, potential as a learning sources that can be integrated in the science learning process to develop the scientific literacy, which needed in 21st century learning. This research is to produce learning tools based on local wisdom to enhance the students' scientific literacy. This study used the Plomp's Model with several phases namely 1) Analysis, 2) Design, 3) Development, 4) Evaluation and 5) Implementation. The instruments used in this research were validation questionnaire of product and instrument for measure of scientific literacy. The result showed that (1) identification local wisdom in Yogyakarta which used in science learning and accordance with topic environmental pollution was utilizing waste batik as a result of the process of making batik in Yogyakarta, (2) learning toolkit based local wisdom have been produced namely lesson plans and students' worksheet with excellent category of both, and (3) integrating local wisdom in science learning that was develop scientific literacy in very good category. It indicates that learning tools based on local wisdom was effective to use in science learning to develop scientific literacy.
Keywords: *integration, local wisdom, scientific literacy*

1. Introduction

Local culture has shifted which results in neglected local cultural values, therefore education is very instrumental in efforts to improve the shift in local culture [1]. Education is a system to improve the quality of human life in all ways aspects of life and at the same time as an effort to inherit cultural values for human life. Through education it will be easier to instill cultural values that must be preserved. Culture will be better known if it is included in the learning process.

One way to integrate the inculcation of local culture is through the integration of local wisdom in learning [2]. Science education in schools should combine culture in the environment around participants (students). The integration of local wisdom in learning can clearly illustrate the specificity of teaching material, the learning environment, the learning process, and the learning assessment. Learning science in schools lacks meaningfulness especially in daily life. In field, learning is only focused on providing concepts, laws, theories, and memorization [3]. Students do not have knowledge of the relationship between the concepts learned and their application in everyday life, learning is less meaningful. Meaningful learning was developed according to cognitive theory that basically founded on constructivist approach. While, students play an active during learning process and asked construct the knowledge, teacher help their student to construct the knowledge through science learning process based on nature of science [4].

Science learning should be taught according to the nature of science, science is not only as a body knowledge, but also as a way to investigation, a way of thinking and application in technology [5]. In the 21st century science learning places more emphasis on learning science based on scientific literacy. Nature of science (NOS) has been underline as the most important aspect of scientific literacy which help students become recipient of scientific information, answering social-scientific problems, answering in the process of making responsible decisions, and understanding science as part of culture [6].

Scientific literacy can be referred as the ability to use scientific knowledge, make questions, and draw conclusions based on evidence, in an evaluation framework and make decisions regarding nature and changes made to nature through human activities [7]. Development of student scientific literacy includes knowledge about science, processes of science, scientific attitude, and students' understanding of science, therefore students not only know the concepts of science but also can apply scientific abilities to solve various problems and make decisions based on scientific consideration [8]. Someone has scientific literacy and technology is characterized by having the ability to solve problems by using scientific concepts obtained in appropriate education with a level, getting to know the product the technology around it along with the impact, being able to use the product technology and nurturing it, being creative inside make a technological outcome simplified so students able to make decisions based on community values and culture[9].

Based on research conducted by [10], scientific literacy of Indonesians' student is still need to enhancement. This is supported by result of PISA assessment conducted in 2015 show the level of scientific literacy of Indonesian students are ranked 62 out of 70 participating countries [11]. Gormally conducted a study to improve scientific literacy trough inquiry-based learning. Based on his research, it is showed that inquiry-based learning can enhance scientific literacy [12]. Inquiry based learning will help students to develop ways of thinking, scientific skills, and scientific literacy by presenting the local issues [13]. Local issues and learning resources can be found in the daily lives of students, one of which is by generating local potential in an area.

Based on Government Regulation No. 17 of 2010 Article 34, government require that education based on local potential in learning process. Local wisdom and regional culture can be a source of learning because students who already have prior knowledge and bring cultural values that come from the environment and the local community. Local wisdom can be referred to something that has been applied as a tradition in the community that can be scientifically tested thus it can be used as teaching materials [2]. In fact, there are a lot of local potential that can integration in science learning as a theme in learning process. However, utilization the local potential in science learning still minimum on toolkit of science learning, for example lesson plan and students' worksheet in learning process. Therefore, researcher conducted the research to develop learning tools based on local wisdom to enhance scientific literacy.

2. Research method

2.1. Research Design

This research used the research and development (R & D) method by adapting the instructional design Plomps' Model, namely 1) Analysis, 2) Design, 3) Development, 4) Evaluation and 5) Implementation. First phase is carried out to determine the basic problems needed to develop science learning tools that integrate local wisdom to foster science literacy in science learning. Second phase, learning devices are designed that integrate local wisdom aimed at producing prototypes of learning tools. Third, science learning tools by integrating local wisdom to foster science literacy that has been develop, then in the design phase called the prototype 1 and validated by expert. Fourth, prototype tested on science learning in SMP 1 Imogiri Yogyakarta with 24 students of class VII using one group pretest-posttest design and evaluated of the test result. Finally, the last revision of prototype will be implemented in huge area in science learning.

2.2. Data Analysis

The results of local wisdom tools validation were analyzed by quantitative descriptive used analysis method:

$$P = \frac{f}{N} x\ 100\%$$

The description of "P" is the percentage of eligibility of learning tools N is the maximum number of score and f is the number of scores obtained [14]. The product of learning tools is considered to be deserved as a good category if the validation rating achieves ≥ 69% [15].

Score of test science literacy analyze by total score of answers divided by maximum score multiple by 100%. Meanwhile, the improvement of science literacy by instrument test analyzed by N-Gain of Hake <g> [16], <g> was consulted with three categories.

Table 1. N gain categories.

Range score	Category
<g> ≥ 0.7	High
0.3 ≤ <g> <0.7	Medium
<g><0.3	Low

3. Results and Discussion

In fact, science learning process in field not only focus on product knowledge but also on process, attitude, and application of knowledge. In other words, science learning process based on nature of science, thus it will be enhanced scientific literacy and learning process to be meaningful[17]. Therefore, teachers need a learning approach that creates meaningful learning by involving contextual sources presented in learning, one of which is local wisdom-based learning. To complete the learning process, a local wisdom-based learning tools were developed. The steps that have been used to develop this learning tool namely 1) Analysis, 2) Design, 3) Development, 4) Evaluation and 5) Implementation.

3.1. Data Analysis

At this phase an analysis of supporting theories of product development is carried out as a basis for lesson plan and student worksheet development in accordance with applicable regulations. In addition, analysis of the curriculum in accordance with the level of competence and Basic Competence of Junior High School Natural Sciences subjects. Next, identification student analysis is to look at student characteristics related to academic abilities, scientific skills and literacy skills. The last is the analysis of teaching material by analyzing the Basic Competence of subject matter which has local wisdom characteristics. Result of analyzed showed at table 2.

Table 2. The result of analysis phase.

Analysis Curriculum	Local Wisdom	Aspect of science literacy
Analyzing the occurrence of environmental pollution and its impact on the ecosystem Make writings about the idea of solving pollution problems in their environment based on observations	The process of Making "Batik" In the process of making batik is examined in terms of the impact of pollution from batik waste both liquid, solid and gases.	Context Competence Content Attitude

Table 2 represented that process of making Batik able to become theme in science learning especially in subject matter environmental pollution. We can see that in process making Batik consist of several step that produced water pollution from batik washing waste, dye and washing waste of batik as a soil pollution, and smoke produced from the slamming process. While, if science process

learning put forward nature of science, it will enhance scientific literacy namely context, competence, content and attitude[18]. There are 3 things about scientific literacy, namely knowledge of science concepts / ideas, understanding of how to obtain the nature of science knowledge (nature of science) by way of inquiry and self-awareness in reasoning and making decisions both socially or in everyday life, while aspect of PISA assessment about science literacy consist of four aspect, namely content, context, competence and attitude (figure 1) [19]

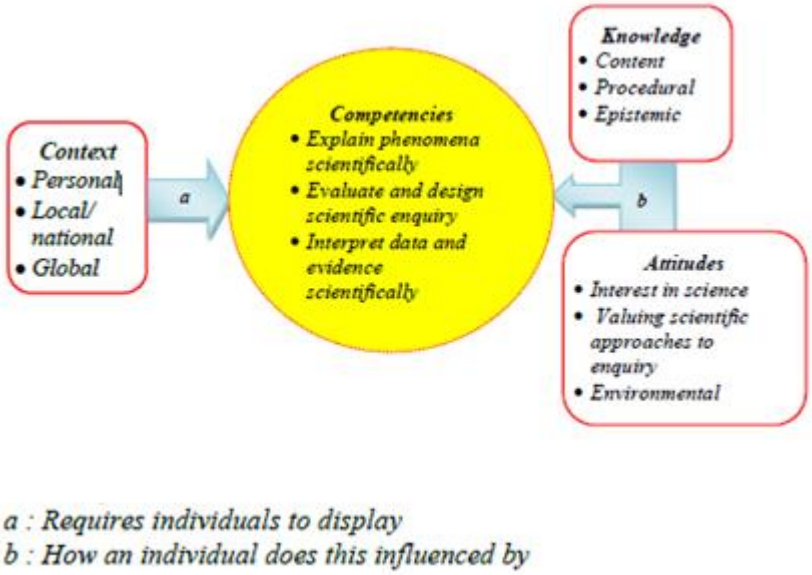

Figure 1. Framework assessment of science literacy PISA 2015.

3.2. Design Phase

In this phase, learning devices are designed that integrate local wisdom to produce prototypes of learning tools, namely lesson plan and students' worksheet. In addition, also designed instruments needed in the study include instruments of product validity, instrument of science literacy test and non-test. In this step also obtained device design products that integrate local wisdom to foster science literacy in science learning. Lesson plan consist of several components' accordance with the Indonesian Ministry of Education and Culture Regulation number 22 concerning the lesson plan format. While the students' worksheet has several components that related with science literacy and theme of local wisdom namely process of making Batik. Students' worksheet was design three activity. First, identification characteristics of water that consist of washing waste of Batik. Second, teacher asked student to identification the soil which impact of dye of Batik and washing waste. Finally, analyze gases that produced by process to slamming of Batik. In addition, has been produced task analysis of environment pollution. By involving local wisdom in science learning, will spur student to develop science literacy by explain the phenomena, conduct the investigation and searching the scientific evidence [20]. Students will be trained to investigate natural phenomena related to local wisdom, which will develop science literacy.

3.3. Develop Phase

This phase aims to produce the prototype of product based on local wisdom and science literacy which are carried out two steps, namely (1) expert appraisal followed by revision, (2) developmental testing.

3.3.1. Expert appraisal. Product assessment involves two expert lecturers and two science teachers using an expert validation assessment sheet for each type of product. Table of product validation results from experts and science teachers can be presented in table 3 and table 4**.**

Table. 3 The feasibility of lesson plan.

Aspect	Lecture (%)	Teacher (%)	Average (%)	Category
Component of lesson plan	85.5	85.5	85.5	Very Good
Indicator	86.5	85	85.75	Very Good
Learning objective	87	86.5	86.75	Very Good
Scenario of learning based local wisdom and science literacy	86.5	86.75	86.63	Very Good

Table 4. The feasibility of student worksheet.

Aspect	Lecturer (%)	Teacher (%)	Average (%)	Category
Title of activities	86	86	86	Very Good
The objective of activities	87.5	86.5	87	Very Good
Activities improve science literacy (competence, attitude, context, content)	87	87.5	87.25	Very Good
Subject matter based on local wisdom	88.5	87	87.75	Very Good
Lay out	90.5	89	89.75	Very Good

The development of lesson plan based on local wisdom consist four aspects, namely component of lesson plan, indicator, learning objective, Scenario based on science literacy and local wisdom. While, aspect of feasibility of student worksheet have four aspects, there are explain scientific phenomena, evaluate investigation, prove data and evidence, explain relationship of concept and it is application in daily life. Overall based on validation lecture and teacher, it is known that development of lesson plan and student worksheet in the very good category for all aspect. The suggestion from experts are on the student worksheet, the literacy aspect is emphasized more in each activity. It is mean that, product lesson plan and student worksheet are feasibility to enhance science literacy in environmental pollution topic.

After revision was carried out accordance with suggestion from validator, product was conducted in SMP 1 Imogiri, Yogyakarta grade VII. Scientific literacy measured includes the dimensions of content, context, attitude and competence. Aspect of competence, attitude and context measured by observation sheet, while aspect content measured by test. The result main testing can be represented in table 4 and table 5.

Table 5. Score of science literacy aspect competence, attitude and context.

Aspect	Score (%)			Average (%)	Category
	1	2	3		
Explain scientific phenomena	77	85	100	87	Very Good
Evaluate the investigation	81	81	88	83	Very Good
Prove data and scientific evidence	93	93	95	94	Very Good
Explain relationship between concept and application	84	86	88	93	Very Good

Based on table 5, aspect of scientific literacy, namely competence, attitude and context at very good category that measured by observation sheet. Science learning in accordance with the nature of science is to enable students to learn to gain knowledge through the inquiry process will realize scientific literacy[21]. Learning process was carried out by presenting local wisdom as learning, namely the local potential which consists of the process of making batik involving students can learn how to learn it with environmental pollution materials. Science learning emphasizes the process and hands-on experience to develop the ability of students to be able to help and enhance local potential or

indigenous knowledge in a scientific manner[22]. The introduction of local potential can increase student respect for local potential, recognize the values of local wisdom and improve the internalization of values that can lead students to become personal characters[23].

Scientific literacy as a requirement for using scientific knowledge and abilities, asks questions and draws conclusions about available evidence and data so that they can be questioned and helps researchers make decisions about the natural world and human interaction with nature[24]. There are 3 things about scientific literacy in students, namely knowledge about scientific concepts, understanding of how to obtain the nature of scientific knowledge (the nature of science) by means of inquiry and self-awareness in reasoning and decision making both socially and in everyday life[5]

Table 6. Data science literacy aspect content.

Data	average	*N-gain*	Category
Pretest	56,24	0.77	high
Posttest	89,65		

By designing learning based on local wisdom, students not only develop character but are also able to find knowledge related to competency aspects, application of knowledge in solving problems around them [25]. Learning to integrate local wisdom will create meaningful learning, thus knowledge will be embedded as long-term memory, which will have an impact on increasing product of knowledge. This is reflected in the results of tests for product trials presented in the table 6 that by integrating local wisdom, has increased science literacy in all aspect, no exception in product knowledge. It indicates that learning tools based on local wisdom was effective to use in science learning to develop scientific literacy for disseminate phase.

4. Conclusion

The integration of local wisdom in science learning can create meaningful learning. Hence, they can do and implement their knowledge and their skills to work out many cases of science phenomenon. This learning is designed by bringing up local wisdom in Yogyakarta in the process of making batik that utilizes batik waste as a theme in learning for environmental pollution subject.

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