Improving students scientific literacy: a development of thematic ethnoscience-based teaching material

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Abstract. This research aims to develop ethnoscience-based thematic teaching materials to improve students' scientific literacy. The procedure was divided into two phases; developmental phase and experimental phase. This developmental research used Four-D Model. However, within this research, the process of development would not involve disseminated as the last step. The teaching materials which were developed consist of a lesson plan, student handbook, student worksheet, achievement test and scientific literacy test. The experimental phase used one group pretest-posttest design. Results show that the validity of teaching materials which were developed was very good and revealed the enhancement of students activities with a positive response to the teaching-learning process. Furthermore, the learning materials increase the students' scientific literacy level.

1. Introduction

Entering the 21st century, the mastery of science and technology becomes an important key [1] which not only spends lesson material but also gives freedom to life skills, learning and thinking skills (literacy and learning skills), literacy in information and communication technology (ICT literacy) [2]. Literacy of science is very important to be mastered in order to understand the environment, health, economics and other issues related to modern society related to the progress of science, technology and the environment in which to live [3]. The development of scientific literacy is constantly evolving. The phase of the development of the times, the literacy of science is the ability to use the knowledge, information and facts necessary to make decisions about nature as well as on activities [4]. Literacy learning cannot be done freely by students and students with a difficult and understandable background, including education including teachers who do not understand what is needed and what is lower than the teacher in terms of both material and science understanding [5]. Not surprisingly, the differential of this chain is the low literacy of science in Indonesia [1] this does not apply to the result of PISA obtaining Indonesian learners from year to year which is always bellow an international average of 500 [6].

One way that can be done to improve process quality is to use the local cultural aspects of learning [7]. The use of the environment will result in a nail process and learning outcomes. Because, students are faced with experiences and situations that are natural, more real, factual, and truth that is more accountable [8]. The experience is a mindset (cognitive domain), attitude patterns (affective sphere), and behavioural patterns of the psychomotor domain [9]. Instead, the analysis is needed in the process as the process of transfer and improvement of teachers to students. On the mandate and development principles of the Curriculum 2013, this is an example of local culture to learn and internationalize local cultures such as Etnosains [9]. Ethnosists are knowledge created by institutions or more appropriate for
nation-states or social groups as different systems of knowledge and cognition of cultures or systems that can be different knowledge of society as distinct from other societies [7].

Primary school students need a holistic and meaningful understanding [8] by linking some aspects both in the subject and in the eyes of the Lesson, the student will produce profound knowledge. Knowledge aims for students [9] "meaningful" because in thematic learning students will understand the concepts they learn through direct experience and connect with other concepts that have been understood [10]. The existence of the relationship between the content of science, technology and mathematics as well as by using real-world activities, students can perform the functions and processes necessary to actually have scientific literacy [11].

The use of ethno-chemical approaches to learning has been done, for example the use of subak as a way of describing ecosystem concepts [12], linking living habits undertaken by communities such as their use of traditional plants or managing land in the students' process of biodiversity [13] or linking traditional and typical Indonesian food in additive material lessons [14]. In this study, the students of the typical Gresik food are "pudak" involved in the daily learning process. Natural resources, food lovers adapted to elementary school. Providing things that are different from previous studies that only explain the concepts in this study can also increase scientific literacy.

To realize a significant learning pattern, teachers are required to really want to learn about how to do knowledge, accumulate practice wisdom, and actively reflect on their experiences [1]. Teachers as learning management in education units are expected to prepare and develop quality learning media, including lesson plans, information sheets, and student teaching materials to achieve learning objectives. Therefore, development research is needed to evolve environmentally oriented learning to improve students' scientific literacy.

2. Method
This research is a developmental research, as, within it, the science teaching-learning material base to ethnoscience is developed. The program is designed to improve student scientific literacy. The teaching and learning material comprise lesson plans, student worksheet, and assessment sheet were tested in the classroom. The developed learning materials implemented in a class with 10 pupils of the five grade. The research procedure is divided into three phases, i.e. developmental phase, experimental phase and analysis phase.

2.1. Developmental phase
Developmental phase aims to produce better learning through revision and validation from experts. This developmental research refers to 4D (Four-D Model) by Thiagarajan [15]. The procedure of the development consists of four stage namely, define, design, develop, and disseminate. However, within this research, the process would not involve the last stage, i.e. disseminate. The researcher chooses a model because it is detailed in stages, systematical, and suitable for the development of learning base ethnoscience to improve scientific literacy.

2.2. Experimental Phase
This phase employs a research design called “One group pretest-posttest design” [16]. The observed variable consists of five elements. They are validation learning media, implementation of the lesson plans, students activities, students responses, literacy science test. Therefore, to determine the quality of the developed teaching materials, it is required to obtain three kinds of data, i.e. validity, practically and effectiveness.

2.3. Analysis Phase
Analysis phase in this study was 5, first, validation of teaching materials, i.e lesson plans, student handbook, student worksheet, and literacy science test calculating the average validator score [17] and match between observers [18]. Second, the implementation of lesson plans by two observers and calculating the average score [17]. Third, student activity [19]. Fourth, the literacy scientific test uses a score [20], determines the increase of scientific literacy base on subject and base on aspect adaption PISA with N-Gain [21]. Fifth, student response [22].
3. Result and Discussion

The results of developing the science teaching and learning material base ethnoscience to improve scientific literacy are described as follows:

3.1 Validation of Learning Media
The result of the validation of learning media showed in Table 1.

<table>
<thead>
<tr>
<th>No</th>
<th>Learning Media</th>
<th>Average Score</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lesson plans</td>
<td>4.00</td>
<td>Very Good/Valid</td>
</tr>
<tr>
<td>2</td>
<td>Student Handbook</td>
<td>3.89</td>
<td>Very Good/Valid</td>
</tr>
<tr>
<td>3</td>
<td>Student worksheet</td>
<td>3.96</td>
<td>Very Good/Valid</td>
</tr>
<tr>
<td>4</td>
<td>Literacy science test</td>
<td>4.00</td>
<td>Very Good/Valid</td>
</tr>
</tbody>
</table>

3.2 Lesson Plan Implementation
All learning activities in Lesson Plan were implemented for three meeting, with the average score obtained by each aspect in the amount of 3.6 was a good category. The average score first meeting amount of 3.91, second meeting amount of 3.93 and third meeting amount of 3.91. This indicates that lesson plan using the overall thematic base ethnoscience has been implemented in the classroom learning process.

3.3 Students Activity
During the learning, the researcher conducted an observation of the student activities. The percentage of students activity Percentage of students’ activities of 99% in three meetings is described as follow: listening to teacher explanation and guidance of 13%, answering teacher questions of 12%, working on student worksheet of 12%, working with friends in one group of 13%, discussing problems encountered in the project undertaken of 13% and exchanging opinions between friends in one group and 1% of irrelevant action aspects. Thus, in general, students activity was a very good category and student centre.

3.4 Students Response
To elicit the students’ response towards the learning, a questionnaire is given to the subjects. The analysis in the percentage of subjects’ response is described as follows: for the material/content, teaching materials, student worksheet, learning atmosphere and the way teacher teach is 98 % of students were very interested and 2% were interested enough. For the content components, teaching materials, student worksheet, how teacher teach and learning environment, student worksheet, the learning environment is 97,5% of the students stated that is was very new and 2,5 % of others stated that those aspects were clear enough. Thus, in general, the students give a very positive response to learning science with thematic with ethnoscience.

3.5 Literacy Science Test
The test consisted of 10 item of multiple choice and 5 item test of the essay have been adapted to the indicators of PISA and adjusted to the ability of elementary school students were given twice, i.e pretest and posttest. The average score of the student’s literacy science test at the pretest time was in the amount of 29.9 (level 2) and 70.9 (level 5) for the posttest. Average sensitivity was about 0.43 with category “sensitive”. Based on the result of the research that, the improvement of students’ scientific literacy was shown by calculating the subject N-gain, and then it was averaged and interpreted into the N-Gain category. The result of the gain score of scientific literacy test showed in table 2.

| Table 2. N-Gain Result Base on Subject |
Table 2 shows that scientific literacy score was improving. The average improvement score (gain) of student’ at 0.60 was categorized middle. To strengthen the analysis, then the calculation of (gain) on each aspect of both groups was performed. The result was showed in table 3.

### Table 3. N-Gain result base on the aspect

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Average</th>
<th>Pretest</th>
<th>Posttest</th>
<th>N-Gain</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explain phenomena scientifically</td>
<td></td>
<td>30</td>
<td>76</td>
<td>0.66</td>
<td>Middle</td>
</tr>
<tr>
<td>Evaluate and design scientific enquiry</td>
<td></td>
<td>30</td>
<td>76</td>
<td>0.66</td>
<td>Middle</td>
</tr>
<tr>
<td>Interpret data and evidence scientifically</td>
<td></td>
<td>32</td>
<td>78</td>
<td>0.69</td>
<td>Middle</td>
</tr>
</tbody>
</table>

As it is shown in the results of N-Gain result base on aspect in Table 3, the average score of each aspect middle category and the highest aspect is interpreted data and evidence scientifically at 0.69, which mean the students can give analyse and evaluate data, clams and arguments in a variety of representations and draw appropriate scientific conclusions [6], this aspect represents a very important ability that is used as evidence to have the scientific literacy ability [1].

Based on the results of the study, there is an increase in students' science literacy through ethno-chemical based learning that links the typical culture in learning, so that students are able to take decisions on the existing problems. It appears that student activity is excellent because teachers facilitate and provide learning by making the information meaningful and relevant for students [23].

**Conclusion**

Based on the result of media experiment, analysis, discussions, and findings in the learning process, it can generally be concluded that the teaching materials thematic base ethnoscience on developed problems have been valid, practical, and effective to improve the scientific literacy of students.

**References**


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