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# THE DEVELOPMENT OF INTEGRATED SCIENCE TEACHING MATERIALS BASED ON THE SCIENCE LITERACY OF FIFTH GRADERS

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**Abstract.** The pupose of this study to develop integrated science teaching materials based on science literacy with balanced proportion of science literacy, validity, readability, and effectivity of integrated science teaching materials based on science literacy. The study started with product development and then continued by feasibility test and readability test. The data analysis was done with percentage discription and t-test. Based on this result of the research, the characteristics of textbook that developed has a composition scientific literacy category is balanced with the percentage of 2 : 1 : 1 : 1 for science as a body of knowledge, science as the way of investigating, science as a way of thinking, and interaction of science, technology and society. The study results in feasibility test showed that the developed literacy science textbook has average score 90.18. Based on the readability test result, science literacy textbook is easy to learn. The average of score of cloze test was 86%. Test results of the effectivity of the teaching materials show that experimental classes have higher study outcome improvement compared to control classes. Experimental classes have N-gain result of 0.73 compared to 0.47 of control classes. From these research results, it can be concluded that integrated science teaching materials developed are meeting the criteria of validity, comprehensibility, and effectivity to improve cognitive study outcome.

Keywords: Integrated Science, Science Literacy, Teaching Materials

## INTRODUCTION

Teaching materials is one tool to deliver material in learning process. The example of teaching materials are such as the books of teachers and students in the curriculum 2013. They are prepared by the government in order to support the curriculum. Moreover, the components of instructional materials are in the form of concepts that must be mastered students refer to the Core Competence (KI) and Basic Competence (KD).

Teaching materials is one of the important aspects in improving students' literacy skills. In line with this, scientific literacy is also very important to be mastered by students in relation to how they perceive the environment, health, economy, and the problems of modern society which are more dependent on technology and the advancement as well as the development of science (Rusilowati, et al, 2016). The preparation of teaching materials of science must, in essence include the aspects of scientific literacy, namely science as body of knowledge, science as the way of investigating, science as the way of thinking, and the interaction of science, technology and society (Chiappetta, et al., 1991).

Based on an observation conducted at SD 6 Cendono, teacher's teaching materials and student's book used in the school come from the thematic books of the 2013 curriculum recommended by the government. After being analyzed, there found some weaknesses in

student' book. First, it is found that the integrated aspect of science subjects has not been balanced.It is known that the field of physics studies is loaded more than the field of biological studies.Second,the students' book has a proportion of unbalanced scientific literacy loads because the aspect science as the body of knowledge has the same proportion as that of science as the way of thinking with the least portion in the interaction of sciences, society, and technology. Therefore, the books recommended by the government lack of the sufficiency of science materials, texts and information in student's book, andscience materials contained in the student's book with the topic of objects in the environment of class V.

When viewed from scientific literacy contents, the IPA textbook used by the teacher and students has reflected the science literacy, but the proportion of literacy categories presented are not balanced, namely aspects of interaction interaction of science, technology and society in the lowest proportion (Rusilowati, 2013).

Such results are supported by the results of interviews to grade V elementary school 6 Cendono. The results of the interview are: (1) the teacher has not understood the scientific literacy and only use teaching materials. It is proven from the use of teacher and student's books from government only by the teacher, (2) the teacher tends to rarely ask students to dopractical work in conveying the science materials due to inadequate time (3) there found limitations in the time to deliver the materialssince each learning must be completed in one day, each sub theme should be completed in one week, while each theme must be completed one month, (4) less interest of teachers in developing teaching materials due to time and limitations.

The causes of low interest of teachers in developing teaching materials are revealed by Zuriah, et. al, (2016) that the teachers who have low interest in developing teaching materials usually have not had the experience and special competence in developing innovative teaching materials andexperienced teachers enhancement programin creating and developing innovative creative teaching materials. This is due to the lack of understanding and knowledge of teachers in developing creative and innovative teaching materials.

Based on the results of the book analysis of student and teacher's books of the 2013 curriculum, there found the lack of the theme of Objects in the surrounding environment and low interest of teachers in developing teaching materials. As a result, it is necessary to develop appropriate teaching materials whichare expected to increase students' science literacy. The teaching materials developed in this study combines several fields of IPA, namely the field of physics and biology studies with a balanced content of scientific literacy including science as the body of knowledge science as the way of investigating, science as the way of thinking, and the aspect interaction of science, technology and society with the proportion of 2: 1: 1: 1 ratio, respectively (Wilkinson, 1999). Hopefully, the introduction of science literacy-based teaching materials ofintegrated science can lead students to science literacy, that is not merely do they move the concept of materials memorization, but understand the concepts and apply them in everyday life.

## METHOD

This study belongs to Research and Development (R & D). The development procedures used in thisstudy was based on theresearch model used by Thiagarajan, et.al (1974) covering 4 stages of development research, namely Define, Design, Development, and Desseminate.

The initial product trial was focused on product readability test was conducted at SD 3 Kandangmas, while the final product trialused the design of Pretest-Posttest Control Group Design by involving SD 6 Cendono as the experimental class and SD 1 Rejosari as the control class.

The data collection technique in this study was done by test and non-test. Further, the non-test method was realized by the use of structured interview method, observation, documentation, and questionnaire. Therefore, theinstrumentsused were in the form of observation sheet, interview guide, validation sheet of instructional materials, fill-in-the-blank test, and test of the results of scientific literacy learning. The collected data were then analyzed by employing pre-requisite tests (validity test, reliability test, differentiation, difficulty level, normality test, and homogeneity test), N-gain test, and independent sample t test.

## RESULT AND DISSCUSSION

The results of this study are the characteristics, validity, readability, and

effectiveness of science literacy-based teaching materials integrated science.

**Characteristics of Teaching Materials**

The developed teaching material covers the development of the thematic book of the 2013 with the theme of Objects in the surrounding environment. This teaching materials contains an integrated science study with the same proportion of linking physical and biological materials.

It's characteristics are based on scientific literacy which contains four balanced aspects proportion (1) science as the body of knowledge, (2) science as the way of investigating, (3) science as the way of thinking, and (4) interaction of science, technology and society (Chiappetta, et al, 1991). These four aspects are reflected in the subtopic of the books entitled"Ayo Belajar" (Let's Learn), "Mencoba Yuk" (Let's Try), "Ayo BerpikirI lmiah"(Let's Think Scientifically) and "Sains dalam Kehidupan"(Science in Life). The division of the previously mentioned scientific literacy aspects has a balanced percentage, namely 40% of the aspect of science as the body of knowledge of all learning indicators, while other aspects obtain 20%for each.. The percentage of scientific literacy aspectswas calculated based on learning indicators. This is in accordance with Wilkinson's (1999) study that the proportion of the scientific literacy aspects in teaching materials should meet 2: 1: 1: 1 ratio and it can be argued that the proportion of the scientific literacy aspects in the teaching materialsare balanced between the aspects of science as the body of knowledge, science as the way of investigating, science as a way of thinking, and interaction of science, technology and society. Therefore, the results of this study support the results of previous research by Rusilowati, et.al, (2015) that teaching materials should have a balanced proportion of scientific literacy aspects, with the division, 40% of the first aspect of all indicators and 20% for every other aspect.

**The Validity of Teaching Materials**

The developed teaching materials tested in large-scale trials were further tested by validators. The results are presented in Table 1.

**Table1.** Validation Results of Science Literacy-based Teaching Materials of Integrated Science

| No | Aspects | Validation Results | | | |
|---|---|---|---|---|---|
| | | V1 | V2 | V3 | V4 |
| 1 | Contents | 87,50 | 87,50 | 92,00 | 96,00 |
| 2 | Presentation | 87,50 | 92,00 | 92,00 | 96,00 |
| 3 | Language | 80,00 | 85,00 | 90,00 | 90,00 |
| 4 | Graphics | 93,75 | 94,00 | 94,00 | 94,00 |
| 5 | Scientific Literacy Aspects | 83,33 | 83,00 | 93,00 | 93,00 |
| Average | | 86,42 | 88,30 | 92,20 | 93,80 |
| Final Average | | 90,18 | | | |
| Criterion | | Very Valid | | | |

Table 1 shows that the results of validation by experts obtained an average value of 90.18 with very valid criteria. This means the science literacy-based teaching materials of integrated scienceare feasible to use.

The teaching materials developed referred to the feasibility aspect of teaching materials from the BSNP (2007) which consists of content feasibility aspect, presentation feasibility aspect, language feasibility aspect, and graphic feasibility aspect as well as the aspects of scientific literacy in the teaching materials. First, in content feasibility aspect, the materialsare presented in accordance with the Core Competencies, Basic Competencies and Indicators that have been established. Meanwhile, the level of difficulty is adjusted and arranged based on the development of students, namely from the easy one to thehard one. Also, the presented materials are startedby digging students' knowledge, then conducting an investigation until students are able to think scientifically. This is in accordance with the principles of teaching materials from Depdiknas (2008) which revealed that the development of teaching materials should start from the easy to understand the difficult, from the concrete to understand the abstract. Second, in presentation feasibility aspect, the materialsare presented in order and systematically in accordance with learning activities ranging from apperception, core material and closing material. Third, the language feasibility aspect of teaching materials are in accordance with the level of knowledge and understanding of

students. The language used is effective, interesting and easy to understand. Also, messages in the materialsare presented in an engaging and communicative language.Thus, it is hoped to give motivation to the students. Fourth, in graphic aspect, the teaching materials are presented in fullcolor, have drawings and illustrations with attractive colors. As a result, the presentation of the material is in accordance with the character of students. Therefore, the science literacy-based teaching materials of integrated sciencecan be valid teaching materials used in terms of the integration of science and from the aspects of science literacy.

**Readability of Teaching Materials**

The readability testwas done in SD 3 Kandangmas by involving 30 students. Based on the test, the percentage of average literacy obtained was 86,02%, so the teaching materials can be considered as easy to understand criterion.

The readability of reading text is one of the conditions as the main consideration during the process of selecting and presenting the materials. By reading the text, it can enrich the student's knowledge and it will make them easier to obtain new information during the reading process (Alfassi, 2005). The easy to understand criterion of the teaching materials readability test is in accordance with (Glynn &Muth, 1994) who state that students with good science process and reading skills are good at achieving science literacy. Meanwhile, the background of students'knowledge has a great influence on students' ability to understand what they read (Fisher & Frey, 2009).

**The Effectiveness of Teaching Materials**

The effectiveness of teaching materials is seen based on the analysis of scientific literacy capability by using scientific literacy skill test. The results of final data analysis showed that the experimental class and control class were normal and homogeneous, so the hypothesis was tested by using independent sample t test.

**Table 2.** The Result of t Test Average Difference

| | *Lavene's test* | | *t-test* | | | |
|---|---|---|---|---|---|---|
| | F | *Sig* | T | Df | *Sig. (2-tailed)* | Average Difference |
| Same Variant Assumptions | 0,597 | 0,442 | 7.640 | 67 | 0,000 | 10.025 |
| Different Variant Assumptions | | | 7.598 | 64.110 | 0,000 | 10.025 |

Based on Table 2, it is known that $t_{count}$ = 7,640 and its significance is 0.000. Therefore, it is known that 7.640> 2.032 or $t_{count}>t_{table}$ and 0.000 <0.005 or significance value <0.05, then H0 is rejected. So, the conclusion of this study is that the average of scientific literacy learning result of experimental class students is better than control class students. To know the difference of students' learning results, the researcher presents the following Table 3.

**Table 3.**Learning Results Difference

| Class | N | Average |
|---|---|---|
| Experiment | 36 | 89.72 |
| Control | 33 | 79.70 |

Based on Table 3, the experimental class average is 89,72, while the control class is 79,70. From these results, the average of the experimental class is greater than the control class. This suggests that experimental class learning outcomes are better than control class.

The improvement of students' scientific literacy learning results is obtained from *pre-test post-test*scores with *N gain* test.

**Table 4.** The Results of N-Gain Test

| Class | Average | | N-Gain |
|---|---|---|---|
| | *Pretest* | *Posttest* | |
| Experimental | 61,97 | 89,72 | 0,73 |
| Control | 61,88 | 79,70 | 0,47 |

Based on Table 4, the results of the N-gain test in the experimental class showed 0.73 with the high category, while in the control class showed 0.47 in the medium category.

Meanwhile, the analysis of t-test data from the result of the average difference of improvement (N-gain) obtained tcount = 7,600 and its significance was 0.000. Therefore, it is known that 7,600> 2032 tcount>ttable and 0.000 <0.005 or significance value <0.05, then $H_0$ is rejected. Therefore, it

is concluded that the improvement of the average of scientific literacy learning results of experiment class students is better than control class students.

The gain of the cognitive learning outcomes of every aspect of scientific literacy in the control class and the experimental class can be seen in Figure 1.

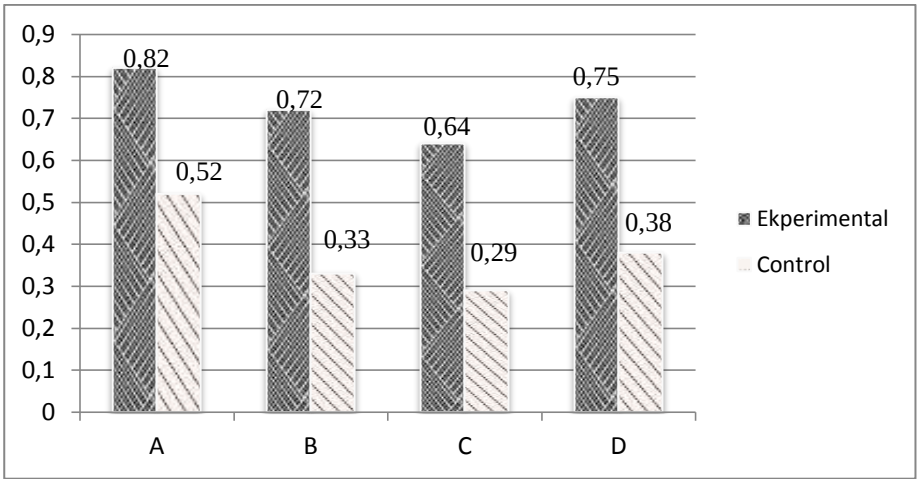


Figure 1. The Students' Scientific literacy Improvement Chart

Notes:
A = Science as the body of knowledge
B = Science as the process of investigation
C = Science as the process of scientific thinking
D = Interaction of sciences, technology and society

Figure 1 shows that the improvement of learning outcomes of every aspect of students' scientific literacy in experimental class is higher than control class. The highest gain in students' scientific literacy ability lies in the science aspect as the body of knowledge, while the lowest aspect is in science as the way of thinking. These results are in line with Hidayani, et al (2015) study which states that the lowest improvement of students' scientific literacy lies in the aspect of science as the way of thinking. The lowlevel of students' thinking ability is realized in the way students not been able to understand the concept of object changes, analyze and link cause and effect in everyday life. Students also experienced difficulties at the discovery stage of ideas in the activities of the scientific thinking process caused by the lack of understanding. For more, understanding of a concept is needed in the process of problem solving (Trianggono, 2017). This is supported by the statement of Rusilowati, et.al (2016), that one of the factors that indicates a lack of literacy skills of students' knowledge is the skills of learners in critical thinking, inductive deductive reasoning, analyzing causality and analyzing scarce scientific data. Due to the student's high critical thingking, the student's are expected to be able to analyze problems in everyday life (Fembriani et. al., 2015). Therefore, to improve learning outcomes, there is a need to habituate the understanding of concepts and good reasoning and high critical thingking so as to facilitate someone in linking the concept with other concepts and everyday events. In line with this, the scientific literacy based teaching materials direct students to science literacy, that is not just move the concept of memorization, but understand the concept and apply it in everyday life. This is in accordance with the opinion of Fives (2014), who states that scientific literacy is realized as the ability to understand the process of science with scientific information in everyday life.

Based on the results of N-Gain, the improvement of scientific literacy learning result of experimental class studentswas in high category, while the control class was in medium category. By which theexperimental class which used science literacy-based teaching materials of integrated sciencebeing developed was higher than the control class which used the materials from the government. This shows that the application of the developed teaching materials in learning has an impact on the increase of students' scientific literacy learning outcomes. The increase of students'learning outcomes is in accordance with Safitri, et al (2015) study that the students' scientific literacy skills taughtby using scientific literacy based teaching

materials of integrated science are higher than the students who utilize books commonly used in schools. The results are also consistent with Budiningsih, et al (2015) study that the average increase of learning outcome of scientific literacy in experimental class is better than control class. The developed learning materials is effective to improve the student's capability of scientific literacy (Rusilowati, et. al., 2016).

## CONCLUTION

Based on the results of the study, it can be concluded that the characteristics of the scientific literacy based teaching materials of integrated science with theme of Objects in surrounding environment have balanced scientific literacy proportions aspects, namely 40% of science aspect as the body of knowledge, 20% of science aspect as the way of investigating, 20% of science aspect as the way of thinking, and 20% of science aspect as the interaction of science, technology and society.

Meanwhile, the scientific literacy aspects contain in teaching materials sub-topic, namely Ayo Belajar (Let's Learn), Mencoba Yuk (Let's Try), Ayo Berpikir Ilmiah (Let's Think Scientifically) and Sains dalam Kehidupan (Science in Life).

Additionally, the developed scientific literacy based teaching materials of integrated sciencemeet very valid criterion. Also, the readability of the scientific literacy based teaching materials of integrated sciencebelongs to easy-to-understand criteria.

At last, the effectiveness of the developed teaching materials is proved to be able to improve the learning outcomes of students' scientific literacy characterized by the higher increase in the experimental class than the control class. Moreover,the same result also goes to the average of students' learning outcomes of science literacy.

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