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CONSTRUCTION OF INTERGRATED SCIENCE LEARNING MATERIAL INTEGRATED TYPE TO DEVELOP STUDENTS SCIENTIFIC LITERACY

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Abstract

Science learning in curriculum 2013 emphasizes to integrated learning approach that can improve the efficiency and effectiveness of learning and achievement of basic competencies. In addition, scientific literacy of junior high school students in Indonesian is low. Based on this, it is necessary to construction of integrated science learning materials. integrated science learning materials can be compiled by integrated type. The purpose of this research is to describe construction, determine the feasibility and effectiveness learning material. The research method used is Research and Development (R&D). Construction of learning materials refers to the 4-D development model that reduced into 3-D. Feasibility test using questionnaire whereas effectiveness of learning materials using objective test and questionnaire. The results showed that learning material is very feasible to used in limited test on average percentage of each aspect >76% whereas effectiveness of learning material showed that learning material can improve scientific literacy of student on probability value is (p) Sig = 0,000<a = 0.05 and average percentage of teacher and student response is 79.24 % and 80.90% with very good category. Thus, it is concluded that learning material very feasible to use in developing scientific literacy of student in the school.

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INTRODUCTION

To highlight the importance of science education in schools, it is expected to be a vehicle for students to learn for themselves, nature and its application to everyday life (Ministry of National Education, 2016). Science education in the 2013 curriculum is the field concerned with science teaching approach that integrates diverse science studies, such as physics, chemistry, biology and earth and space science into a unified theme. Integrated science education composes the knowledge, skills and attitudes of students towards solving problems teaching that exist in the surrounding environment. In addition, intact science learning will also increase the efficiency and effectiveness of learning and the achievement of expected basic competencies (Integrated Science Team, 2016).

According to Fogarty (1991) integrated learning could mix several concepts from science studies, such as physics, chemistry, biology and earth and space science (IPBA), and thus cohesiveness in forms of attitude and skills is overlapping among science studies. The benefits of integrated learning are the learning time throughout all mixed disciplines to be more efficient and effective learning, students are more easily directed to the relationship of concepts among various disciplines to solve crucial problems, increase student motivation in learning, due to integration processes between knowledge, skills and attitudes. This is in line with Lin's study (2014) that students with significant knowledge, skills and attitudes will have more complex abilities than those who only focus on knowledge. These abilities are related to student scientific literacy (OECD, 2013).

According to the Organization for Economic Cooperation and Development (OECD) on Program for International Student Assessment (PISA) it is familiarly recognized that student literacy in Indonesia has not been satisfactory. The science literacy score of indonesian students in 2012 was 382 with the highest score of 501. Indonesian students were ranked 64 out of 65 participating countries. In 2015, the score was 403 with the highest score of 556. Indonesian students ranked 63 out of 72 participating countries (OECD, 2013). Although there was an increase in the scientific literacy score of Indonesian students in 2015 but the scientific literacy of junior high school students in Indonesia was still in the low category. Such formulated findings are supported by a research conducted by Ekohariadi (2009) the factors that cause the low scientific literacy of students in Indonesia are that leraning materials used by teachers do not mostly contain scientific literacy.

Based on such obvious data, it is necessary to develop students' scientific literacy. According to Sarkar & C. Deborah (2012) in developing students to science literacy the necessary efforts to execute is the preparation of learning materials that have a component of scientific literacy such as contents, skills and attitudes. According to Idreez, Habib and Hafeez (2014) the quality of learning materials possess a large effect on improving the quality of teaching because it is the main source used by teachers throughout the world in teaching contents, skills and attitudes. According to Chiappetta, Fillman & Sethna (1991) science-oriented learning materials contain four categories, science as the body of knowledge, science as the investigative nature, science as a way of thinking and interaction of science, technology and society.

The obvious issues demonstrated that based on field studies through direct interviews with several science teachers in the Timor Tengah Selatan District, East Nusa Tenggara, science learning in schools could not be implemented in an integrated manner. This is due to limitations in learning resources center. In addition, the science books used by teachers in the field are only labeled Integrated Science, while the contents of the book tend to refer only a field of science study. The results of such formulated studies are supported by the research of Minarti, Susilowati and Indriyanti (2012) that the results of book analysis conducted on 9 books broadly used by teachers and students from different publishers tend to be still conceptually dominant, less associated with daily life, and still today, the science concepts are discussed separately. With regard to this issue, Yulianti's research (2013) also found that integrated science books used in schools were only labeled integrated science while the contents of the book still tended to refer to one field of science study.

The formulated theme in the recent study is land and life on earth. It is finally selected because there are numbers of considered things by the researcher, such as 1) The soil condition at the place where the researcher would conduct

the research (in the Timor Tengah Selatan District, East Nusa Tenggara) is currently arid and barren thus students and teachers could use it as a source of knowledge. In solving problems that exist in such obvious place through direct experience. 2) After analyzing the 2017 Junior High School Science syllabus regarding the scope of the material (concepts) of science education in the 2013 curriculum there is currently integrated materials under the land and life on earth. The material contained in basic competencies 3.9 connects the physical and chemical properties of soil, organisms that live in the soil, and the importance of soil for sustainability of life and as well the basic competencies 3.8 analyzes the occurrence of environmental pollution and its impact on ecosystems. Based on the description above, one significant solution to overcome the obvious problems is to construct learning materials on integrated science under the theme of land and life on earth to develop scientific literacy among students in junior high school.

The objectives of the current study were as follows (1) to describe the construction of integrated sciences learning materials about land and life on earth, (2) detemine the feasibility and effectiveness of integrated sciences learning materials about land and life on earth, (3) to figure out the improvement of students' scientific literacy after using integrated sciences learning materials about land and life on earth.

METHODS

The current research uses the Research and Development method that develops integrated sciences learning materials (Khairani, Asrizal & Amir, 2017). The formulated research procedure was adapted from Rosidi's research design (2015:16), the 4-D development model which consisted of four formulated stages as follows, defining, designing, developing and disseminating. In this study it has not reached the stage of dissemination only until limited trials (Kurniawati, 2013).

In the defining stage, restrictions are made on the integrated sciences learning materials of 2013 curriculum analysis, concept analysis and formulation of indicators and learning objectives. Moreover, in the design stage, selection of material, preparation of materials and preparation of instructional materials are produced thus an initial draft of integrated sciences learning materials is produced which could develop students' scientific literacy under the theme of land and life on earth. The development stage was carried out by experts who produced integrated sciences learning materials integrated type (draft II) and limited testing which produced teaching integrated sciences materials integrated type (draft III).

The expert assessment was carried out by 3 generally considered academic experts in the construction of laeraning materials using a closed questionnaire adopted from the assessment of the quality of instructional material: textbooks and work books / worksheets (Sinaga, P. 2014). In limited trials carried out in class IX SMP Satap Koa in the Timor Tengah Selatan District, East Nusa Tenggara to determine the effectiveness of learning materials by using objective tests and closed questionnaires adopted from the assessment of the quality of instructional material: textbooks and work books or worksheets (Sinaga, P. 2014).

Most importantly, analysis of the feasibility instrument of learning materials employs the percentage criteria for the leraning materials according to Sinaga (2014) shown in table 1.

Table 1. Feasibility Percentage of integrated sciences learning materials

No	Percentage (%)	Criteria
1	0 – 25	Not feasible
2	26 – 50	Less feasible
3	51 – 75	Feasible
4	76 – 100	Very feasible

Furthermore the instrument analysis of the effectiveness of learning materials uses student learning outcomes data obtained from pre-posttest scores. The following are the steps of the analysis:

Calculating the average student learning outcomes before and after the use of integrated sciences learning materials from the scores obtained by each student is calculated from the number of correct answers. The scores are then changed in the form of values provided:

Student value = student score / maximun score x 100%

Furthermore, the value obtained by each student is summed and divided by the number of students (Ashri & Hasanah, 2015).

Calculate normalized gain (N-Gain) to obtain data on the results of enhancing student scientific literacy (Meltzer, 2002). Based on the following formula:

N-Gain= posttest score – pretest score / maximun possible score – pretest score

Criteria increase Gain normalized as follows:

G < 0,3 : low increase

0,3<G<0,7 : medium increase

G>0,7 : high increase

Hypothesis Test: To find out whether there is a significant increase in students' scientific literacy after using integrated sciences learning materials, the differences between posttest and pretest scores of scientific literacy were tested with the following details. If parametric statistical assumptions are met, that is, data are normally distributed and the second variance is homogeneous data, then it can be analyzed using parametric statistics. Data obtained from one-group-pretest-posttest design can be analyzed using dependent samples t-test or also called paired sample t-test. Dependent testing of samples t-test was performed using SPSS 22. If the significance value of sig (2-tailed)> 0.05 thus H_o is accepted and it can be concluded that the mean score of posttest is equal to or smaller than the pretest score. If the significance value is sig (2-tailed) <0.05 thus H_o is rejected and it can be concluded that the mean score of posttest is higher than the score in pretest.

Furthermore, the data from the responses of teachers and students using the criteria for the percentage of teacher and student responses according to Sinaga (2014) are shown in table 2.

Table 2. percentage of teacher and student responses to learning materials

Percentage (%)	Criteria
0 – 25	Very less
26 – 50	Less
51 – 75	Good
76 – 100	Very good

RESULTS AND DISCUSSION

Construction of integrated sciences learning materials refers to the 4-D development model which is reduced to 3-D. Such collaborative model consists of 3 major stages, defining, designing, developing. At the stage of defining the 2013 curriculum analysis by examining the 2013 curriculum syllabus covering basic competencies about learning materials on land and life on earth hence two basic competencies were obtained. Then an analysis of the concept is carried out by identifying and systematically arranging the main concepts that students will learn. These concepts are arranged hierarchically based on their role in the material to be taught in the form of concept maps. Furthermore, the formulation of indicators and learning objectives refers to basic competencies, concept maps and scientific literacy.

The design stage is conducted by selecting material adapted to the formulation of indicators and objectives of both learning achievement and analysis of prepared concepts. Most importantly, the preparation of material from the material was selected to be 4 sub-themes integrated in physics, chemistry, biology and IPBA based on an integrated type. Furthermore, the compilers of learning materials were elaborated in terms of integrated science learning materials consisting of covers, preface, table of contents, competencies to be achieved by students, concept maps, material consisting of 4 sub-themes such as soil formation process, soil fertility, soil role and soil pollution, student worksheets, supporting information, summaries, evaluations and answer keys and references. The first one design of the learning material was produced by integrated sciences learning materials which have one major theme, land and life on earth consisting of four sub-themes as follows, the process of soil formation, soil fertility, soil role and soil pollution called draft I.

The development stage is carried out by experts. Integrated sciences learning materials integrated type (draft I) produced at the design stage is in turns assessed by 3 validators to assess whether it is feasible to examine. The feasibility test of integrated sciences learning materials covered aspects of content feasibility, presentation feasibility, language feasibility and integrated type in forms of closed questionnaires. The following is the acquisition of scores and the percentage of each aspect of the feasibility of learning materials in Table 3.

Table 3. recapitulation results of learning materials feasibility

Validator code	Content	Presentation	Language	Integrated type
	%	%	%	%
Val 01	87.5	75	83.33	80
Val 02	79.17	89.29	75	75
Val 03	83.33	85.71	75	85
Average	83.33	83.33	77.78	80
Category	Very feasible			

Based on the results of the feasibility analysis of learning materials, the content feasibility aspect received score percentage > 76%, which was 83.33%, the feasibility aspect of the presentation obtained score percentage > 76% which was 83.33%, the feasibility aspect of the language was score percentage > 76%, which was 77, 78% and integrated type earned score percentage > 76%, which was 80.00%, therefore it can be argued that each aspect of feasibility obtained an average percentage of feasibility > 76%. These results fall into the very feasible category which means that integrated sciences learning materials integrated type are very feasible to be used in limited trials. This is in line with the Ministry of National Education 2016 which stated that the high percentage of the feasibility test results is an illustration that the developed learning materials can be utilized. Yusup's research conducted in 2017 also stated that learning materials included in the very feasible category can be used.

Besides, the results of the feasibility also get advice from the validator. These suggestions related to the appearance or design of learning materials and also suggestions relating to the material. Suggestions relating to the appearance conveyed by one of the validators is the small image size thus the image is not clear. Valuable suggestions relating to the material are the use of inconsistent words or terms and explanations of some materials using sentences that are not easily understood so as to make the reader difficult to understand the message conveyed in the teaching material. These collaborative suggestions are taken into consideration when revising learning materialsto be better. Integrated science learning material integrated type that has been revised based on the results of the evaluation and input from the validators is called draft II.

Furthermore, a limited trial of the revised learning material (draft II) was carried out in class IX of the SMP Satap koa. Based on the results of the tests obtained data on student learning outcomes. The following picture 1. The average of student learning outcomes before and after integrated science learning materials are used in trials.

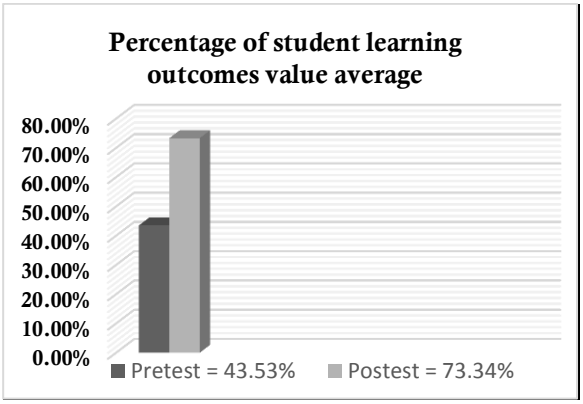

Figure 1. Graph of student learning outcomes average

Based on student learning outcomes before and after the trial using integrated science learning materials as in the graph above, the mean score on pretest was obtained at 43.53%. It was carried out to determine the students' prior abilities before conducting the trial. While the value of student learning outcomes after the trial obtained mean score of 73.34%. Such scores indicated that students learning outcomes have significantly increased. In addition, the score of N-Gain is 0.54. These results fall into the medium category.

Based on results obtained in this line of research, it can be interpreted that the formulated learning materialshave contributed to the improvement of students' scientific literacy.

Table 4. Summary of test results to data normality and homogeneity

Data testing	Data group	Sig (ρ)	α	Conclusion
Normality	Pretest	0,08	0,05	Normal
	Postest	0,08	0,05	Normal
Homogeneity	Pretest Postest	0,58	0,05	Homogeneous

The significant difference in increasing students' scientific literacy before and after the use of integrated science learning materialswas tested statistically using paired sample t test.

Before tested statistically, data on increasing scientific literacy of students before and after the use of integrated science learning materials tested the normality and homogeneity of data as a prerequisite test for paired sample t test. From such observations, the following table 4. Findings summary of testing data for normality and homogeneity.

Based on the results of testing data for normality obtained a probability value (p) Sig pretest of 0.08> a = 0.05 and probability value (p) Postest Sig of 0.08> a = 0.05. These results indicated that the data from the pretest and posttest are normally distributed. Besides the results of homogeneity testing obtained probability value (p) Sig of 0.58> a = 0.05. These results indicate that the data from the pretest and posttest spread homogeneously. From the two results, paired sample t test can be continued. The following table 5. Summary of paired sample t-test results from the pretest and posttest data.

Tabel 5. Summary of paired sample t-test result to pretest and postest data

Data testing	Data group	Sig (ρ)	α	Conclusion
paired sample t-test	Pretest Postest	0,000	0,05	H_0 Rejected

Based on the results of paired t-test in the table above, it is known that the sample data obtained a probability value (p) Sig = 0,000 <a = 0.05. The results of testing the hypothesis are rejecting Ho, thus it can be explained that in the population (from which the sample was taken) there is a statistically significant difference between the average value of student learning outcomes before and after treatment using integrated science learning materials integrated type. The score of student learning outcomes after tested is much higher than before, it demonstrated that there is an increase in students' scientific literacy after using integrated science learning material integrated type about land and life on earth. This is in line with Yusup's research conducted in 2017 stating that the use of integrated science learning materials integrated type in schools can improve students' scientific literacy in terms of content and science process skills. The research of Khairani, Asrizal and Amir, conducted in 2017 also stated that the use of integrated science learning materials can enhance students' scientific literacy.

On the following figure 2. The average data on the results of student and teacher responses to integrated science learning materials.

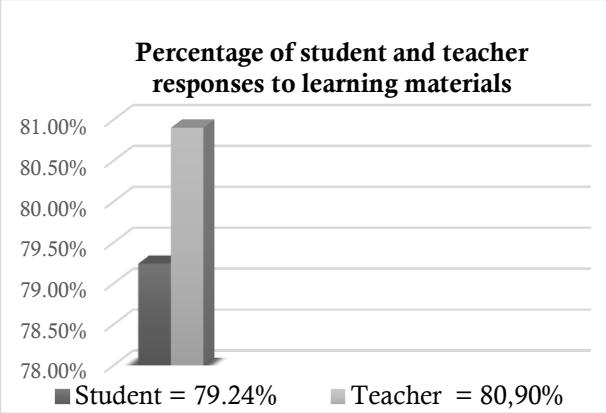

Figure 2. Graph of student and teacher response

Based on the results of student and teacher responses to tested integrated science learning materials, the percentage of average scores for student responses is 79.24% and for teacher responses is 80.90%. The percentage of such crucial values is in a very good category, it is therefore argued that learning materials can be employed as alternative learning materials for teachers and students in the learning processes. This is in line with the research of Ihwanudin, Astuti and Yulianto in 2018 which stated that the use of integrated science learning materials in the minimum category can be used during the learning process. In addition to Yusup's research in 2017 also established that integrated science learning materials can be used easily during the learning process.

After the trial is carried out, the resulting data is used to revise integrated science learning materials. It is obtained from this revision are called draft III (final draft in this stage of development).

CONCLUSION

Construction of integrated science learning materials integrated type using a 4-D development model reduced to 3-D. At the design stage obtained in Draft I, the findings of validation and revision of Draft I is performed by 3 validators obtained by Draft II which showed that integrated science learning materials obtained an average percentage of feasibility>76%. These results fall into the very feasible category which means that teaching integrated science materials is very feasible to be used in limited trials. From the results of the testing of integrated science learning materials integrated type, it is obtained data on student learning outcomes by using integrated science learning materials that provided a significant contribution in improving students' scientific literacy. Based on results obtained in this line of research, it is therefore argued that there is a significant difference between the mean scores of student learning outcomes before and after treatment using integrated science learning materials. The response data of teachers and students after the trial shows that such formulated learning materials can be used as alternative learning materials used by teachers and students in the learning process. This is indicated by the results of student and teacher responses to integrated science learning materials tested in a very good category.

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