The effectiveness of using integrated science practice worksheet of integrated type to enhance environmental literacy

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Abstract. The aim of this study is to know the effectiveness of the use of integrated science practice worksheet of integrated type to enhance environmental literacy. The method used in this research was quasi experimental method. The research design uses non-equivalent pretest-posttest control group design. Students from two classes in one school took part in this research. The environmental literacy instruments are arranged by adopting and modifying problems from the MSELS (Middle School Environment Literacy Survey). Data was collected from 64 students divided into experiment class and control class. Data analysis uses statistical data analysis and impact effect (effect size). The results showed that there was a significant difference from the enhancement of environmental literacy of the control class and experimental class after treatment was given, whereas based on the size of the impact it has the value of the big categorical effect size. Therefore, integrated science worksheet of integrated type is effective to enhance students’ literacy ability.

1. Introduction
The national goal of the 21st century is to establish a quality human being in the form of an independent person. Independent person according to the learning paradigm of the 21st century. The 21st century paradigm according to R & D Ministry of Education and Culture, 2013 is a learning that emphasizes the ability of students in finding out various sources, formulate problems, analytical thinking and collaborate and collaborate in solving problems. Students are required to have the ability to actively seek, manage and construct a knowledge. Such knowledge can be gained through student-centered learning. Student-centered learning is a learning that makes students a subject of learning that should actively develop their interests and potentials and teachers as facilitators who assist students in linking initial knowledge.

Student-centered learning is in line with the demands of the 21st century. The 21st century is a century of scientific and technological development, therefore students must have many skills to deal with an increasingly complex and competitive world. In addition, the learning must be accompanied by 21st century themes in order to master the competence of these subjects to give widespread impact. The theme that emerges in the 21st century is global awareness; financial, economic, business and entrepreneurial literacy; awareness as a citizen; health literacy and environmental literacy. One of the themes related to science is environmental literacy [1].

The purpose of environmental literacy is to careness to the environment, so it can be prepared environmental reform agencies that have a positive attitude and action on the environment. Environmental literacy can be trained in school and formal learning. The use of various educational
activities can increase the literacy of the university level environment [2]. Students who are given various environmental education activities can increase the motivation to environmental issues [3]. Environmental literacy can be applied in learning materials as well as in the learning process. Environmental learning can cause an individual’s positive influence on the environment[4]. The background of schools, parents and sources of information affect the environmental literacy [5]. Environmental learning using concept maps with the Novak hierarchy approach [6]. The application of learning strategies related to literacy achievement resulted in significant differences after being given to the students' knowledge of the environment, environmental sensitivity, environmentally responsible attitude and behavior, the implementation of outdoor settings and experience directly with nature results in more effective cognitive skills [7].

The environmental literacy comprises four domains: knowledge domain, environmental affective, cognitive and behavioral skills [8]. These four domains can be determined through the analysis of the phenomenon of the problem and experiment. Evidence of science in experimenting enables the learning experience of students and is supported by direct interaction with observed objects so that learning becomes more real. By giving the students an opportunity to interact directly with a fact and issue that develops in the environment, it will train students' sensitivity to the environment while gaining learning experience [9].

Field facts show that practicum activities undertaken at school are taken from the work manual of the 2013 curriculum book. The practicum activities of a number of books labeled in the 2013 curriculum are only manual work in practice, but there are sub sections that should be put into practice but not practiced. From the result of the analysis of curriculum book of 2013 shows that the practicum activities conducted have not shown the skills of environmental literacy and have not shown integrity, whereas science learning now has started in mix between physics, chemistry and biology. The existence of science learning demand integrated in the curriculum 2013 requires a new breakthrough in learning tools, one of which is through the effectiveness of the use of integrated science Practical worksheet type integrated. Integrated type integration is chosen on the grounds that the subject matter used requires the incorporation of three disciplines, physics, chemistry and biology. The worksheet is an information presentation of the concepts learned through directional learning that can assist in the discovery and development of a learned concept and be an alternative in presenting the subject matter with student activeness approach and can also be used to motivate [10] [11]. In the selection of materials for learning needs to be considered well. Selection of appropriate teaching materials in learning should not be ruled out because the main cause of low student achievement is learning characteristics that do not match the selection of teaching materials and teaching practices [12]. Based on the above background, the authors are interested in conducting research with the title "the effectiveness of the use of integrated science worksheet type integrated to increase environmental literacy.

2. Methods
The method used in this study is quasi experimental method. The research design uses non-equivalent pretest-posttest control group design. Research subjects of the seventh-grade students’ school in the Provinces of South Sulawesi. The sample was 68 students taken using cluster random sampling and divided into 34 students as experimental class and control class. The control class is treated with practicum activities taken from the 2013 curriculum book and the experimental class is treated with practicum activity using the Integrated type science worksheet type. The pretest and posttest assessment instrument for environmental literacy refers to the problem instrument by adopting and modifying problems from the MSELS (Middle School Environment Literacy Survey) which consists of knowledge domain, affective domain and cognitive skill domain. Problem domain knowledge and domain of cognitive skills in the form of multiple choice, while the affective domain is likert scale. Before the instrument is used in the school, validation is done by 3 expert lecturers and validated by the students. Pretest and posttest data in the analysis using statistical data analysis and influence effect (effect size). Statistical analysis was performed using SPSS 23 to test the significance by conducting prerequisite test ie normality test and homogeneity test. The normality test testing technique uses Kolmogorov-Smirnov test and Shapiro-Wilk test and homogeneity test using t test or Mann-Whitney U Tess test. If the data is normally distributed then hypothesis testing using t test but if the data is not
normally distributed then hypothesis test using Mann-Whitney U test. Next performs an effect size calculation to measure the extent to which the impacts of the Integrated science worksheet on the increase in environmental literacy (influential large, medium, small or no effect on environmental literacy). As for, the effect size formula used is as follows:

\[ D = (M_E - M_K)(SD_{pooled})^{-1} \]  

\[ SD_{pooled} = \left( \frac{(n_E-1)S_E^2 + (n_K-1)S_K^2}{n_E+n_K-2} \right)^{\frac{1}{2}} \]

**Information:**

\( D \)  = Effect size  
\( M_E \)  = Mean Experiment  
\( M_K \)  = Mean Control  
\( SD_{pooled} \)  = Standard Deviation  
\( S_E \)  = Standard Deviation Experiment class  
\( S_K \)  = Standard Deviation Class Control  
\( n_E \)  = Number of experiment class students  
\( n_K \)  = Number of control class students

The price of the impact size coefficient is interpreted using criteria [13].

| Effect Size (d) | Information          |
|----------------|----------------------|
| D< 0.1         | No effect            |
| 0.1≤D< 0.4     | Small                |
| 0.4≤D≤0.8      | Medium               |
| D>0.8          | Big                  |

### Table 1. Interpret impact Size.

#### 3. Result and Discussion

##### 3.1. Statistic Test

The first effectiveness test is the Statistics test. Before performing statistical test do a prerequisite test. The result of prerequisite test for normality indicates that the significant value of data for the experimental class is tested using kolmogorof-smirnov for α (0.200> 0.005) and using Shapiro wilk test of α (0.394> 0.005), so for the experiment class the data is normally distributed. The data for the control class were tested using kolmogorof-smirnov for α (0.200> 0.005) and using Shapiro wilk test of α (0.173> 0.005) so that for normal data control class distributed. The experiment class data and control class are normally distributed so the next step is to perform the next prerequisite test that is homogeneity test. Homogeneity test results showed the significant value of data for the experimental class and control class were tested using levene of α (0.000<0.005), so the data concluded that the research sample came from non-homogeneous or unlike data.

Normality test data shows the data is normal distribution and homogeneity test shows the data is not homogeneous, so tested the hypothesis by using parametric statistical test that is by using T test with the help of SPSS 23. The result obtained significance value equal to 0.000 with significance value α (0.000 <0.005). This shows the enhancement of the literacy ability of student’s environment of experiment class is higher than the control class. The enhancement of environmental literacy capability is assumed because in the experimental class using worksheet which presents the aspect of environmental literacy and in doing activities involving knowledge, cognitive and affective skills so that the students' environment literacy can be trained and enhanced well. Only individuals who have the literacy, awareness, and sensitivity that will contribute in handling environmental issues [14].
The worksheet developed also describes the phenomenon/environmental issues/discourses/issues related to the environment around the students so that they can train the students' literacy skills in identifying the problems/environmental issues that occur around the students so that the students are familiar with the problem. The use of facts contained in the environment around the students will facilitate students in understanding a lesson concept [15]. Besides, the worksheet shown is integrated so that the students are more focused on one topic. While in the control class using textbooks that are used in schools that have not included aspects of environmental literacy in particular.

3.2. Impact Test (effect size)
The second effectiveness test is the impact test. Table 2 shows the value of the impact of environmental impact literacy (Effect Size) as follows:

| Criteria | Me  | Mk  | Se  | Sk  | D   |
|----------|-----|-----|-----|-----|-----|
|          | 30.25 | 12.18 | 15.75 | 8.78 | 1.42 |

Based on Table 2 can be explained that the effect (Effect Size) of the impact calculation (Size) earns a value of 1.42 and if interpreted by Cohen criteria then impact test effect or have a big impact. The developed worksheet has a great influence on improving students' literacy skills. The selection of appropriate teaching materials in the learning process gives the same effect even greater than even qualified teachers [16]. This is because student interaction with teaching materials can take longer than student's interaction with teacher. Students can interact with teaching materials whenever and wherever they are, both at school and at home, while student interaction with teachers is limited, occurs only in schools, especially in the face-to-face class. The great enhancements and effects of the worksheets developed because the worksheet uses multimodal representations. The use of this multimodal representation helps the students in using their individual learning styles so that different learning styles and styles of each student can be accommodated in the presence of such multiple representational modes and the students are easier in understanding a concept than using one mode only, the students will easier to analyze the issues, determine the questions, hypotheses and so forth because the discourse presented not only using the text mode, but instead graphics, graphics and tables. The use of multimodal representations is considered effective for improving the quality of teaching materials [17]. Multirepresentation is a model that re-presents the same concept in several different formats [18]. Multimodal representations have three main functions: providing representations that contain complementary information or helping to complement a cognitive process, a representation used to limit misinterpretation in using other representations and can encourage students to build an understanding of the situation in a way more deeply [19].

4. Conclusion
Based on the findings there is a significant difference from the enhancement of environmental literacy of control and experimental class students after treatment is given, whereas based on the size of the impact it has the value of the big-size effect. Therefore, integrated science worksheet of integrated type is effective to enhance students' literacy ability.

5. References
[1] Daryanto dan Karim S 2017 Pembelajaran Abad 21 (Yogyakarta: Gava Media)
[2] Moody G, Alkaff H, Garrison D and Golley F 2005 Assessing the environmental literacy requirement at the University of Georgia The Journal of Environmental Education 36 4 3-9.
[3] Poudel D D, Vincent L M, Anzalona C, Huner J, Wollard D, Clement T, DeRamus A, Blakewood G 2005 Handson activities and challenge test in agricultural and environmental education The Journal of Environmental Education 36 4 10-22.
[4] Hsu, Jang Shih 2004 The Effects of an Environmental Education Program on Responsible Environmental Behavior and Associated Environmental Literacy Variables in Taiwanese College Students The Journal of Environmental Education 35 2 42.

[5] Chu H E, Lee E A, Ko H R, Shin D H, Lee M N, Min B M, Kang K H. 2007 Korean Year 3 Children Environmental literacy: A Prerequisite for a Korean Environmental Education Curriculum International Journal of science education.

[6] Meagher T 2009 Looking inside a student’s mind: can an anAnalysis of student Concept Maps measure Changes In Environmental literacy Electronic journal of science education 13 1 1-28.

[7] Erdogan M 2015 The effect of summer environmental education program (SEEP) on Elementary school students’ environmental Literacy International journal of environmental & sains education 10 2 165-181.

[8] McBeth W 2010 The National Environmental Literacy Project: A Baseline Study of Middle Grade Students in the United States The Journal Of Environmental Education 41 1 55-56.

[9] Eggen, P and Kauchak D 2012 Strategi dan Model Pembelajaran Mengajarkan Konten dan Keterampilan Berfikir (Jakarta: Indeks)

[10] Trianto 2011 Mendesain Model Pembelajaran Inovatif-Progresif (Jakarta: Kencana Prenada Media).

[11] Prastowo A 2015 Panduan Kreatif Membuat Bahan Ajar Inovatif (Yogyakarta: Diva Press)

[12] Ozdilek Z and Ozkan M 2009 The effect of Aplying Elements of Instructional Design On Teaching Material for The subject Of Classification Of Matter The Turkish Online Journal Of Technology 8 1 84-96.

[13] Cohen J 1992 Statistical Power Analysis Current Direction in Psychological Science 1 3 98-101.

[14] Kose S 2011 Investigation of under graduate students' environmental attitudes International Electronic Journal of environmental education 1 2 85-96.

[15] Achyani 2010 Meningkatkan kepedulian siswa terhadap lingkungan ekosistem persawahan dengan model penulisan buku aj ar bilogi SMA berwawasan lokal dan ekologi (Bandung: Universitas pendidikan Indonesia).

[16] Chingos, Matthew M and Whitehurst, Gro-ver J Russ 2012 Choosing Blindly Instructional Materials, Teacher Effective-ness, and The Common Core (Washing-ton, DC: Brown Center on Education Policy at Brookings).

[17] Sinaga P, Suhandi A and Liliasari 2015 The effectiveness of scaffolding design in training writing skilll physics teaching materials International journal of instruction 8 1 9.

[18] Irwandani 2015 Multi representasi sebagai alternatif pembelajaran dalam fisika http://ejournal.iaiindenintan.ac.id/index.php.

[19] Ainsworth S 1999 The Foundation of Multipel Representation Computer and Education Journal 33 131-152.

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