Developing of electronic learning materials based on Simalungun potency of agriculture for improving student scientific literacy competencies in environmental context and awareness

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**Abstract.** Creating learning materials based on student local potencies are helping student to master their lesson and give a meaningful learning. This research aimed to produce learning materials based on Simalungun potencies on agriculture and measure the effectiveness of these learning materials, especially on Coffee. The type of this research was ADDIE (Analysis, Design, Development, Implementation and Evaluation) while for implementation of learning materials used quasi-experiment which consists of control and experimental group with pretest-posttest design. Samples of this study were Senior High School Students grade X consisted of 22 students for each group. Both group were used learning materials based on Simalungun potencies on agriculture and for experimental group was taught by reminding the step of scientific literacy competencies and environmental awareness during the learning process. Quality of learning materials was measured by expert judgment and experienced teacher. Data collection technique was conducted by using pretest and posttest. Normalized gain value of scientific literacy competencies for control and experimental group were medium. Result for environmental awareness for control group was favorable attitude and experimental group was more favorable attitude. Learning materials based on potency of local agriculture in Simalungun can be used as supplementary of teaching materials in learning process.

1. Introduction
Learning about environment is not talk about provide student with concept about environment but to stimulate them to understand the importance of environmental balance. The main goal of environmental education is creating student with knowledge about environment and stimulate them to understand environmental awareness and at the end knowledge and awareness will lead them to give real action about how to maintain environment. Maintaining the environment means the ability of community to fulfill their needs without disturbing the availability of resources for the future [1].

The urgency of environmental responsibility challenges the educational institutions especially for higher education to apply some principles, methods, and goals of education that focus on environmental education [2]. The importance of environmental education is to prepare people both
young and adult to have knowledge, abilities, and tools that they need as solution to solve the problem in environment that cannot be predicted by anyone in future [3]. Possible way to create someone can give real action for maintaining the environment by involving them with knowledge about environment. Environmental education will be applied effectively if personally related to daily lives of students. It is very important the environmental education directly related to the student area and gives them the opportunity to explore their own environment [4].

Environmental education is not a new thing nowadays. Learning process in some subject matter closely related with environmental especially biology. Higher education also prepares some materials and courses related with environment with the goal to create students who can master theory and apply those theory into real action for protecting the environment and prepare the future generations who environmentally friendly [5].

All forms of learning materials able to give contribution and motivation to students, it is important to develop learning materials with the content or objects inside of those directly contact with students so this way will create the way to make students easier understand about the lesson and get motivation [6]. Using of electronic learning materials not merely reducing the use of paper but it is supported by the demands of this era where students should provide with some important skills in 21st century such as innovation skills, information, media and technology skills [7].

PISA (2006) gives special attention about environment by measuring 15 years old students about their epistemological knowledge related with environmental issues. This attention arises after the large number of environmental problem occurs such as climate change and decreasing of plant and animal diversity [8]. The program called as Green at fifteen? It is measures the student’ scientific literacy in environmental context. OECD (2009) classified the students based on their score in scientific literacy which were followed by 60 countries and the result showed that Indonesia was ranked in 55th, result showed the scientific literacy of Indonesia’s students in environmental context was still far from average score [9]. Scientific literacy competencies in PISA (2015) consist of three main indicators are explain phenomena scientifically, evaluate and design scientific enquiry and interpret data and evidence scientifically [10].

Preliminary study had been done by researcher in one school in Simalungun and tried to collect some data from teacher and student, the result shown that the book that used is not innovative and contextual. Most of the examples on the textbooks do not match with the student environment. On preliminary study had found more than 60% students were lack of knowledge about how to protect their own environment. Previous research explained there are the same problem that occur in Indonesia textbooks that books just made to fill the criteria and standard of curriculum and is not closely related with student own environment [11]. Learning process should be related with students’ condition and environment to make them easier understand the lesson. This study conducted to create learning materials based on potencies of local agriculture in Simalungun and measure the effectiveness of these learning materials in learning process for improving student’ scientific literacy competencies in environmental context and environmental awareness.

2. Methods
The method in this study used ADDIE (Analysis, Design, Development, Implementation and Evaluation) and for implementation of learning materials by using quasi-experiment. Data collection technique was obtained through observation, documentation, and tests.

2.1 Population and Sample
The implementation of learning material had done in one of the Senior High School in Simalungun at tenth grade. The school was chosen by using purposive sampling. It means that there are several criteria such as the location which is close with the potencies of local agriculture in Simalungun. Both group selected by using random sampling method, both of them was taught by using learning materials based on potencies of local agricultural in Simalungun but experimental class taught by
reminding the step of scientific literacy and environmental awareness inside of these learning materials.

2.2 Instrument
The instruments in this study consist of judgment paper for experts that was used to measure feasibility of learning materials, multiple choice questions to measure the student’s scientific literacy competencies, questionnaire to measure student’ environmental awareness. Multiple choice questions for measuring the student scientific literacy competencies made in pretest and posttest design.

2.3 Data Analysis
The first data collected from expert lectures tested the teaching materials based on potencies of local agricultural in Simalungun. The research data were processed using software SPSS version 22 to find out the normality test with Shapiro Wilk Test. The result of pretest and posttest of scientific literacy competencies calculated by using Normalized Gain (N-Gain) and matched the criteria based on Hake [12]. The improving number on N-Gain for both classes is the main way to find out the effectiveness of electronic learning materials. Measuring the category of environmental awareness determined based on the result of modification from Haseen Taj [13].

3. Result and Discussion
The result of validity test for feasibility of learning materials validated by an expert lecturers and experienced teacher is shown in Table 1.

Table 1. Criteria of learning materials’ feasibility

| Indicator     | Validation Result |
|---------------|-------------------|
| Score         | Criteria          |
| Content       | 70.31% Feasible   |
| Presentation  | 70.45% Feasible   |
| Language      | 84.47% Very Feasible |
| Contextual    | 75.00% Feasible   |
| Graphic       | 76.75% Feasible   |
| Average       | 75.40% Feasible   |

There are five as main indicator to measure the feasibility of learning materials. Based on the table above shown the average score for feasibility of learning material with average score is 75.40% which means the learning materials is feasible and can be used in teaching process in classroom.

Data of pretest got by researcher prior to implement the learning materials. The average score of pretest from both groups will be compared and measured with their posttest by using Normalized gain find out their learning outcomes. The form of normality, homogeneity, and differences in mean value for learning outcomes from pretest data for both groups analyzed by using statistical test for the. The results of statistical test on pretest data from both groups are shown in Table 2.

Table 2. Statistical test on pretest data for scientific literacy

| Data               | Control | Experimental |
|--------------------|---------|--------------|
| Number of student  | 22      | 22           |
| Score of Pretest   | 54.00   | 51.09        |
| Normality          | 0.67    | 0.70         |
| Homogeneity        | 0.168   |              |
The statistical test for pretest shown that the data is distributed normally and there is no difference between mean value of their scientific literacy for control and experimental group. Average of pretest score for each component of scientific literacy competencies and attitude toward environment are shown in Table 3.

**Table 3. Average score for pretest in each competencies of scientific literacy**

| Competencies                          | Group       |
|---------------------------------------|-------------|
|                                       | Control     | Experimental |
| Explain phenomena scientifically       | 52.60       | 61.36         |
| Evaluate and design scientific enquiry| 45.45       | 41.82         |
| Interpret data and evidence scientifically | 53.90       | 48.05         |
| Attitude toward environment            | 53.90       | 51.95         |

For the increasing of their scientific literacy carried out by using posttest score and statistical test that presented in Table 4.

**Table 4. Statistical test on posttest data for scientific literacy and attitude toward environment**

| Data                  | Group       |
|-----------------------|-------------|
|                       | Control     | Experimental |
| Number of student     | 22          | 22           |
| Score of Posttest     | 67.45       | 80.55        |
| Normality             | 0.26        | 0.91         |
| Homogeneity           | 0.007       |              |

Table 4. above shown that the mean differences on posttest score which indicate that the significance value is 0.007 is smaller than \( \alpha = 0.05 \) so there is differences of mean value of posttest between control and experimental group. The average score of posttest score for each competency in scientific literacy presented in Table 5.

**Table 5. Average score of posttest on scientific literacy competencies**

| Competencies                          | Group       |
|---------------------------------------|-------------|
|                                       | Control     | Experimental |
| Explain phenomena scientifically       | 76.52       | 82.58         |
| Evaluate and design scientific enquiry| 50.00       | 65.45         |
| Interpret data and evidence scientifically | 68.83       | 88.96         |
| Attitude toward environment            | 70.78       | 83.12         |

Table 5. comparison between pretest and posttest for Scientific Literacy Competencies on both groups with their normalized gain are shown in Table 6. Data shown the increasing number on N-Gain that obtained by two groups after implementing the electronic learning materials with different treatment.

**Table 6. Normalized gain for scientific literacy competencies**

| Data                          | Control | Experimental |
|-------------------------------|---------|--------------|
|                               | Pretest | Posttest     | Pretest | Posttest |
| Score                         | 52.73   | 67.45        | 52.55   | 80.55    |
| N-Gain                        | 0.29    | 0.60         |
| Criteria                      | Medium  | Medium       |

Data on the Table 6 are shown the increasing number of score between both of group. Both of group made an increasing for score but the experiment class get the higher prove that teaching by reminding
the step of scientific literacy in every step of their lesson is helping the experimental class to get the good understanding on the competency of scientific literacy. This result is supported with the previous study explained the way to increase the scientific literacy of students by helping and guide the students on learning process especially through their inquiry [14]. There are three indicators of scientific literacy based on PISA (2015) and all the result of each indicator from control and experimental group is explained in Table 7.

Table 7. Scientific literacy competencies skill of control and experiment group

| Competencies                        | Control       | Experiment   |
|-------------------------------------|---------------|--------------|
|                                     | Pretest       | Posttest     | N-Gain  | Pretest | Posttest | N-Gain  |
| Explain phenomena scientifically    | 52.60         | 76.52        | 0.50    | 55.30   | 82.58    | 0.55    |
| Evaluate and design scientific enquiry | 45.45       | 50.00        | 0.08    | 39.09   | 65.45    | 0.41    |
| Interpret data and evidence scientifically | 53.90   | 68.83        | 0.32    | 57.14   | 88.96    | 0.79    |

Data shown on Table 7 present the increasing score from the pretest to posttest that control group got after using learning materials without any reminding of explanation about scientific literacy competencies during the teaching process. The lowest score found on second competencies with N-gain value 0.08 and classified as low criteria. The research location does not support high technology-based yet. Moreover, due to pandemic COVID-19 the researcher needs to teach the student through some application which is possible to reach by, such as, WhatsApp and Email. In some cases, students who can’t afford the cell phone and had bad signal will be facilitated by researcher in the following ways by visiting students’ home, teaching them directly used the electronic learning material that provided by researcher’s laptop.

The data on table showed result for experimental group that there was an increasing number of score in each competency. The teaching process in experimental group is similar with control group. The difference of experimental group from control group is located by reminding the student with competencies of scientific literacy in each chapter of learning materials while learning was conducted. Based on N-Gain criteria, there is good progress obtained by experimental group especially in first and third competencies with N-gain score were 0.55 and 0.79, respectively. Integrating the local potencies and bring it into learning process is a good ways for learning process. There are several study who support this result stated that combining local potencies with learning process was able to increase the processing skill of student and also their cognitive learning [15]. Another previous study [16] shown that there was an improving on student learning outcomes in science by integrating local potencies in learning process. Data about the environmental awareness for control group is presented on Table 8.

Table 8. Percentage of environmental awareness criteria of control group

| Group       | Implementation |           |
|-------------|----------------|-----------|
|             | Before    | After    |
| Control     | 73.94    | 75.72    |
| Experimental| 68.90    | 82.05    |

Table 8 shows the increasing score for both groups in the environmental awareness aspect. Both of group provided with the electronic learning materials but for the experimental group during the lesson the researcher keeps reminding the students about the importance of environmental awareness and good attitude toward the environment especially that can be found on electronic learning materials. Before implementing the learning materials both group belong to favorable attitude criteria and after implementing the learning materials there is some increasing number for both group but for control group still classified as favorable attitude while for experimental class classified as more favorable attitude with 82.05%. Creating environment awareness on people is the best way to create someone who has responsibility for their environment [17].
Based on data obtained that implementing electronic learning materials based on potencies of local agricultural in Simalungun has influences student for their learning outcomes especially for their scientific literacy and environmental awareness. The potencies of Indonesia’ resources creating the way to provide student good knowledge about environment so there are recent study that develop environmental education textbook based on student needs to provide student with to learn about environment based on their own environment [18]. Indonesians have a great potency for education by implementing local elements such as culture, diversity, ethnicity, and natural resources [19]. Integrating local element on learning process can improve some aspects on student like environmental literacy and problem solving [20].

4. Conclusion

Based on the result and discussion from the research can be concluded the electronic learning materials was effective to improve scientific literacy competencies in environmental context and awareness and can be used as supplementary for teaching materials in learning process.

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