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Empirical Validity of Collaborative-Learning Student Worksheet on Ecology Material to Practice Student's Scientific Literacy Skill of Ten\textsuperscript{th} Grade Senior High School

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Abstract. The demands of the 21\textsuperscript{st} century emphasize the importance of cooperation and collaboration in problem solving. Besides that, the element of scientific literacy is also needed by students to have a comprehensive learning experience in aspects of social attitudes skills, cognitive and psychomotor. Therefore, a collaborative learning media in the form of worksheets is required. The purpose of this study was to create collaborative learning student worksheets that is proper empirically on ecology material. This study used 3D model of development; Define, Design and Develop. The instruments used for empirical validity included student collaborative observation activity sheets, student scientific process observation activity sheets, student learning outcomes completeness sheets and student response sheets. Empirically, the result of student collaborative activities was very proper with 93.48%, the activity of students' scientific process was also proper with 85.15%, the completeness of student learning outcomes received 85.87% and the positive response of students got 84.44%.

1. Introduction

Now, the demand of 21 century is that students are expected to learn and to actively communicate. This case study emphasizes the importance of cooperation and collaboration in solving problems [9]. The collaborative-learning is one example of active learning or Student-Centered Learning (SCL).

Collaborative-learning is often considered synonymous with cooperative learning. Based on the literal meaning, both methods are conducted for students in group. The difference is that collaborative-learning emphasizes more on the collaboration initiated independently without modification from others in order to cooperate. Hosnan (2014) emphasizes that in cooperative learning students learn basic concepts, meanwhile in collaborative learning students can learn completely based on the development of the basic concept.

The steps in collaborative-learning are engagement, formation of groups, exploration, giving the task problem, transformation, process discussion, presentation, presenting the result of discussion, and reflection and Question-answer session [6]. Collaborative learning is one of learning model that is intergrated in social constructionists’ views. It says that knowledge is a result of social construction [16]. This model can practice student skill in scientific literacy by group.
Scientific literacy is declared on public since 21st century supported by an international program, PISA. Indonesia has joined Program of International Students Assessment (PISA) and in 2012, Indonesia placed 64th position of 65 country. In 2015, Indonesia was placed 69th position of 76 country [4]. Scientific literacy is one of the aspects in PISA. According to PISA in 2016, scientific literacy is an ability to use science for identifying problem and determining conclusion according to many proofs of nature exchanged by human activity [4]. PISA contends that there are three aspects of competence component/scientific process on scientific literacy, such as identifying scientific question, explaining a phenomena scientifically and using scientific proof scale. These aspects are relatible with 5M (mengamati, menanya, mengumpulkan data, mengasosiasikan, dan mengkomunikasikan) activities to understand the scientific skills of the students. 5M is divided into three aspects. The first is identifying scientific question; observing and asking. The second is explaining the phenomena using scientific proof; analysing and communicating. The last aspect is using scientific proof; collecting data.

According to Millers’ conclusion related to scientific literacy, scientific literacy level is low globally [5]. In the other hand, according to national exam data report from BSNP in 2015, the mastery of biology material was in good enough criteria that the students have equally or more than 50% in material mastery [3]. But, ecosystem material mastery with learning objectives that are analysing connection between ecosystem component, material and energy exchange along with human role on the ecosystem equilibrium was not satisfactory. Mastery of ecosystem material was just 63.84%.

Related to the previous point, ecosystem material has a wide range. Therefore, collaborative learning model is selected in order to practive student’s scientific literacy. Collaborative Learning Application, it can be concluded that the model can increase quality of Biology learning along with subject comprehension purpose [13]. It is also stated that there were some benefits after applying collaborative learning model such as students could develop teamwork to achieve collective objectives, students helped each other, understood problems faced by them and found solution, and gave positive responses for the other [18]. Benefit from the collaborative learning worksheet was the competence presented through comprehension questions to the students’ idea and thinking. In the learning process, the teacher should be able to teach higher level materials containing challenges [12]. According to that background above, the aim of this research was to create a valid worksheet empirically based on expert’s validation report according to students’ collaborative activity, scientific activities process, learning completeness, and responses.

2. Research Method
The type of this reasearch was development using a 3-D development model that has 3 stages, namely define, design, and development [7]. The study was conducted in the Department of Biology, FMIPA Unesa and SMA Negeri 1 Probolinggo. The study was conducted in January - May 2016. The target in this study were 16 students of X-MIA C class in SMA Negeri 1 Probolinggo. Then the trial subject was collaborative learning worksheet on ecology material.

2.1 Students Activities Analysis
Data analysis techniques used to measure the validity of collaborative learning worksheets towards students’ scientific literacy skills. Activities were carried out using student scientific process processing sheets. While to measure students' social attitudes skills, it was carried out by using student social attitude observation sheets. The results were analyzed using a Likert scale[17] and the percentage was calculated with this following formula:

\[
\text{Score percentage} = \left( \frac{\text{total score of all analyser}}{\text{maximum score}} \right) \times 100\%
\]
2.2 Students’ Learning Completeness Analysis

Students completeness learning analysis is done to know if they have mastered the competencies or indicators of the learning. The Minimum Completeness Standard in Biology lessons that have been established in SMA Negeri 1 Probolinggo was 75 or when they got test results $\geq 75$. The standart used related to the validity of the worksheet that has been developed was empirically valid if the percentage of the students who completed it reached until 61% of the students. The results were calculated by the following formula and analyzed using assessment criteria [15]:

$$\text{Score percentage} = \frac{\sum \text{total score of all analyser}}{\sum \text{maximum score}} \times 100\%$$

2.3 Students Responses Analysis

Student responses were identified by using student response questionnaires using the "yes" and "no" categories. Then, it was analyzed and calculated the percentage with the Guttman scale [17]. The results of the percentage calculation from the student response questionnaire in limited trials were interpreted into the modified assessment criteria from Riduwan [17]:

$$\text{Score percentage} = \frac{\sum \text{total score of all analyser}[\text{yes}]}{\sum \text{maximum score}} \times 100\%$$

3. Results and Discussion

3.1 Student Activity Sheet Validity reviewed from the Results of Observation of Students’ Collaborative Scientific Activities

Presented in Table 3.1 is the result of students’ collaborative activities observation using collaborative learning activities.

<table>
<thead>
<tr>
<th>No</th>
<th>Collaborative Activities</th>
<th>$\sum$ Students</th>
<th>Max. score</th>
<th>Average Score</th>
<th>(%)</th>
<th>Category.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Polite</td>
<td>16</td>
<td>3.70</td>
<td>93.75</td>
<td>Very valid</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Caring</td>
<td></td>
<td>3.50</td>
<td>87.50</td>
<td>Very valid</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Cooperative</td>
<td></td>
<td>3.96</td>
<td>99.21</td>
<td>Very valid</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>4</td>
<td>3.72</td>
<td>93.48</td>
<td>Very valid</td>
<td></td>
</tr>
</tbody>
</table>

Based on Table 3.1, it can be seen that collaborative activity had satisfactory results, 93.48% and it is categorized as very valid. Overall, the students are able to ask questions and express their opinions politely. Students are enthusiastic to participate in the learning activities especially when they cooperate with each other in practicing biotic and abiotic factors in an ecosystem and practicing observations of carbon cycles. This is in accordance with the statement of the Lembaga Kajian dan Pengembangan Pendidikan (LKKP) of Hasanudin University [11], that one of the important characteristics of classes that apply collaborative learning models is that students are not categorized based on their abilities, interests, or characteristics and students' opportunities to study together with other students are not reduced.

Furthermore, in the aspect of environmental concern, students' concern was observed in their teamwork to clean up the classroom environment after practicing and planting trees activity. Then in its implementation, there are also learning indicators and self-assessment in the collaborative learning student activity sheets which were developed. So, the students can indirectly know what social attitude skills are assessed, and they can train themselves. Prior to collaborative learning activities, the students must know the activities that would be carried out. In this worksheet, indicators, instructions for using worksheet, and command sentences to guide students in learning activities are presented [1].
3.2 Student Activity Sheet Validity Reviewed from the Results of Observing Student Scientific Process Activities

Presented in Table 3.2, is the result of observing students' scientific process activities using collaborative learning student activity sheets;

<table>
<thead>
<tr>
<th>No.</th>
<th>Scientific Process Activities</th>
<th>Σ Students</th>
<th>Max. Score</th>
<th>Average Score (%)</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Observing</td>
<td>16</td>
<td>3.71</td>
<td>89.84</td>
<td>Very Valid</td>
</tr>
<tr>
<td>2.</td>
<td>Questioning</td>
<td>4</td>
<td>3.15</td>
<td>78.92</td>
<td>Valid</td>
</tr>
<tr>
<td>3.</td>
<td>Collecting Data</td>
<td>16</td>
<td>3.34</td>
<td>83.59</td>
<td>Valid</td>
</tr>
<tr>
<td>4.</td>
<td>Analysing</td>
<td>4</td>
<td>3.46</td>
<td>88.28</td>
<td>Very Valid</td>
</tr>
<tr>
<td>5.</td>
<td>Communicating</td>
<td>4</td>
<td>3.40</td>
<td>85.15</td>
<td>Valid</td>
</tr>
<tr>
<td></td>
<td><strong>Average</strong></td>
<td><strong>4</strong></td>
<td><strong>3.41</strong></td>
<td>85.15</td>
<td><strong>Valid</strong></td>
</tr>
</tbody>
</table>

Table 3.2 shows that all students have good scientific process skills. For example, the students have been able to observe biotic and abiotic factors well during the practicum, they wrote their observations in the tables provided in the worksheet, and then they analyzed them according to the instructions in the worksheet. As for Table 3.2, it can be seen that students' scientific process activities show satisfactory results, namely 85.15% with a valid category.

All students scientific process activities are more than 71%. This shows that the collaborative learning student activity sheets that were developed are categorized as valid and can make students accustomed to conducting scientific method activities. The activity is intended to train students' scientific literacy skills. Scientific literacy can provide opportunities for students to learn how to find facts, concepts and principles through their experience directly [8]. Thus, the students' scientific literacy skills can be trained through learning activities using the student activity sheets where students describe the real evidence of the experience gained by generalizing their explanations, arguments and questions.

3.3 Validity of Students Activity Sheet Reviewed from the Result of Learning Completeness

Based on table 3.3 which explains the completeness of student learning outcomes, it can be seen that there are 13 students who completed the post-test of ecological material. The completeness of student learning outcomes as a whole is 85.87% or in a very valid category. Three other students did not complete the post-test of ecological material after using collaborative learning student activity sheets which were developed. Each of them who did not complete the post test were students F, I and O with score 65, 63 and 69. Based on the observations during the try out, it was also known that the students who received the lowest scores were students who were less serious in working on the post test.

According to the biology teacher who teaches in the class, information was obtained that students who got the lowest grades are students with less good grades. The highest results of the completeness of each individual is 99 obtained by one student. This is because the student is a careful and focused student. In addition, based on observations during the try out, the student worked on the student activity sheet in a coherent and correct manner. Besides that, students were also assisted with their learning experience when they used collaborative learning worksheet. Based on Kusumastuti's research [10], Application of Collaborative Learning Model with Simple Media in Physics Learning in Middle School showed that there were significant differences of 5%, obtained 0.046 <0.05 therefore there were significant differences in student learning outcomes using collaborative learning models. It shows that through the LKS Collaborative Learning developed it is expected that it can improve the students learning outcomes. The following Table 3.3 presents the observation result of the completeness of student learning outcomes using collaborative learning student activity sheets;
3.3 Tabel 3.3 Ketuntasan Hasil Belajar Siswa

<table>
<thead>
<tr>
<th>No</th>
<th>Students' Names</th>
<th>Indicators Completeness Result</th>
<th>Individual Indicator Result</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>1.</td>
<td>Student A</td>
<td>30</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>2.</td>
<td>Student B</td>
<td>30</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>3.</td>
<td>Student C</td>
<td>30</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>4.</td>
<td>Student D</td>
<td>30</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>5.</td>
<td>Student E</td>
<td>30</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>6.</td>
<td>Student F</td>
<td>5</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>7.</td>
<td>Student G</td>
<td>30</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>8.</td>
<td>Student H</td>
<td>30</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>9.</td>
<td>Student I</td>
<td>4</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>10.</td>
<td>Student J</td>
<td>15</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>11.</td>
<td>Student K</td>
<td>30</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>12.</td>
<td>Student L</td>
<td>30</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>13.</td>
<td>Student M</td>
<td>30</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>14.</td>
<td>Student N</td>
<td>30</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>15.</td>
<td>Student O</td>
<td>12</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>16.</td>
<td>Student P</td>
<td>30</td>
<td>13</td>
<td>15</td>
</tr>
</tbody>
</table>

Total Percentage (%)
- Indicators Completeness: 82,50
- Individual Indicator: 78,34
- Completeness: 91,25
- Percentage: 89,21
- Standard Deviation (SD): 12,09
- Very Valid

**Indicators information:**
- I. Analyzing ecosystem components
- II. Analyzing interaction among ecosystem components
- III. Analyzing energy exchange
- IV. Identifying biogeochemistry cycle process based on scientific inquiry using practicum procedures

3.4 Student Activity Sheet Validity Reviewed from Student Response

According to Widjajanti [19], qualified worksheet must be able to invite students to be active in the learning process. The collaborative activity steps can encourage students to be active in learning activities, so students can engage in the same activities in positive dependence. Besides that, collaborative learning is one model of learning that is connected to the social constructionist view which believes that knowledge is the result of social construction [16].

In the last aspect or question about whether the collaborative learning worksheet developed attracts students' interest to learn, it also obtained a very satisfying 100% positive percentage. All students expressed positive answers. This shows that students were enthusiastic towards collaborative learning worksheet which were developed. In addition, a very large percentage is also due to an interesting presentation of the worksheet. The appearance of worksheet was designed as attractive as possible to attract students' attention so that they are moved to learn it [19].

Student response results after using collaborative learning student activity sheets were also used to determine the empirical validity of student activity sheets developed. In the student response questionnaire given to 16 students there were 15 questions or criteria assessed by students. Based on Table 3.4 which describes the results of student responses developed, there are 84.44% of students who responded positively or can be categorized as very valid. The following are the results of the recapitulation of student responses to collaborative learning student activity sheets developed.
Based on the discussion above, it can be concluded that LKS collaborative learning developed can be categorized as valid empirically. Besides that, in the try out process, the LKS was also examined using more than one instrument.

4. Conclusion

The results showed that the collaborative learning student worksheet was empirically valid. The result of student collaborative activities was very proper with 93.48%, the activity of students' scientific process was also proper with 85.15%, the completeness of student learning outcomes received 85.87% and the positive response of students got 84.44%.

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