Constructivist based students’ worksheet development in learning environmental pollution

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Abstract. Students’ worksheet is one of the learning tools to achieve learning objectives, to simplify teaching and learning process. However, the frequently used worksheet at schools was adapted from textbook with the key answers’ availability. This research aims to develop constructivist-based students’ worksheet to be feasible and useable for learning of environmental pollution. The research was carried out using research and development (R&D) with ADDIE model. The research was conducted at SMPN 4 Banda Aceh during the academic year 2017/2018 in class VII-2 and VII-3. Data were collected using students’ worksheet, written test and questionnaire and later the data were analysed with percentage equation. The finding exhibited that the constructivist-based students’ worksheet was very good in accordance with feasibility assessment validated within average score of 0.87. Besides, learning achievement was categorized as good with a percentage of 82.21%. The responses to the worksheet obtained average percentage of 72.8% (strongly agree); 26.5% (agree) and 0.7% (disagree). Based on the results, it can be concluded that the worksheet was excellent and feasible to be used to achieve success in learning as well as positive responses from students.

1. Introduction

Learning sources are commonly used by teachers during teaching and learning process directly or indirectly, partially or totally. One of the learning sources is students’ worksheet which consists of students’ activities made to be more interesting to help them master the learning materials more easily both individually and, in a group, thus learning objectives can be achieved [1].

The preliminary observation results on a case study conducted in 2016 at SMPN 4 Banda Aceh showed that students’ worksheet was frequently used at the school, despite it solely concerns on materials adapted from an integrated science book. The students were only motivated to copy the questions and solve them without generating any new ideas. Since only one book used, it can confine students in finding crucial concepts during the learning process [2].

Based on the problem mentioned above, the development of a learning tool that can be used in the learning process with reference to constructivist theory was essential. The use of constructivist theory generated in students’ worksheets is in conformity with Indonesian 2013 curriculum as it urges teachers and students to apply scientific approach in the teaching and learning process. Constructivists
perceive that knowledge is something that can develop new ideas on existing knowledge so that students can conclude their own concepts that are easier to understand and to master [3].

The constructivist-based students’ worksheet developed in this study contains worksheets that must be done by students by following the guiding questions in them. Students are given the opportunity to develop existing ideas, find other ideas upon previous ideas, conduct experiments, collect data, and analyse data so that students can draw their own conclusions about existing concepts [4]. Thus, they would be contended and excited in learning science because they can utilize all their potential and this results in an increase in their learning achievement.

The material developed in this worksheet is about environmental pollution. This is due to the fact that in recent years there have been numerous issues regarding environmental pollution with various natural phenomena, and also low public awareness favouring to environmental sustainability [5].

The research conducted by Ongowo [6] found that the views of teachers in constructive learning are better than learning that has been applied previously using conventional methods. In addition, Wu & Tsai [7], Gurses et al. [8], explain that students in constructivist-oriented instruction groups achieve better learning outcomes than those in groups without the application of constructivist learning methods. This increment is observable through the students’ ability of students in terms of understanding concepts, thinking ability, reasoning ability, and creativity.

2. Methods
This study employed to research and development method (R&D). The product development is carried out with the ADDIE model. This research was conducted from March to May 2018, consisting of needs analysis, constructivist-based worksheet development, feasibility assessment of the worksheet, implementation of the worksheet, and questionnaires. The population of this study was all seventh-grade students at SMPN 4 Banda Aceh in the academic year 2017/2018. Samples were taken by purposive sampling technique and the selected samples were the students of class VII-2 and VII-3. Data were collected using the worksheet assessment sheets, test questions, and questionnaires. The feasibility scale of the worksheet assessment is as shown in the Table 1.

| Assessment | Score | Information           |
|------------|-------|-----------------------|
| VTR        | 3     | Valid without revision|
| VDR        | 2     | Valid with revision   |
| TV         | 1     | Invalid               |

(Source: Yusrizal, 2016)

The percentage was used in analysing the data obtained from the developed worksheet assessment containing the analysis of the feasibility of content, language, presentation components, and graphic components and questionnaires. Meanwhile, the test questions were directly analysed by item weight addition.

3. Results and Discussion
Analysis of learning needs includes field studies and literature studies. Field studies were carried out to gather information about the learning that had been done at school, identifying the problems faced at schools and analysing the availability of learning resources in the field. The selection of research locations is based on the results of a case study conducted in August 2016 at SMP 4 Banda Aceh regarding the obstacles in the process of learning Science.

| No | Analyzing Aspects        | Results                                                                 |
|----|--------------------------|-------------------------------------------------------------------------|
| 1  | Learning process         | The unpreparedness of students to begin learning.                       |
|    |                          | Students tend to listen and not to be actively involved during learning |
|    |                          | Students tend to be busy with activities beyond learning such as going  |
Based on experience in learning science, students have used the worksheet provided by the teacher. The results of interviews with the teachers also proved that they had provided the worksheet in learning, but the worksheet provided only contained questions taken from the textbook and then distributed to students. According to responses given by students and teachers, they never used the constructivist-based worksheet in learning especially in environmental pollution material. The use of constructivist-based worksheet as one of the learning variations in the learning process can facilitate students in optimizing the learning process and improving the ability in concept understanding. In addition, it can make students be more active because the learning process is more student-centred while the teacher only acts a facilitator [9]. The results found by Zain et al. [10] state that learning with constructivist-based worksheet can train students to be more active and independent in learning because students can construct their own knowledge so that cognitive values and learning activities will be increased. Thus, the development of constructivist-based worksheet can help students develop their abilities by utilizing the basic knowledge that is already possessed by each student and making students more active in learning.

3.1. Development of worksheet
The development carried out on constructivist-based worksheet is designed in a more interesting form with bright colors and the appearance of animated images. The aim is to attract the attention of students so as not to get bored during learning. This is in line with Rahmatillah et al. [11] who state that the appearance of students’ worksheet can influence students’ interests and motivations in learning. The following is a display of constructivist-based worksheet.

![Image of a worksheet]

**Figure 1.** Display of constructivist based LKPD

The preparation of worksheet was done by creating a constructivist-based framework. The worksheet is composed of various kinds of information whether in the form of text, simple questions, images, and simple experiments. Each part of the activity on the worksheet can direct and guide students to analyse and understand the concept offered so that students can draw their own conclusions on the concepts in the material being studied. This is in accordance [12] that providing stimulus to students by using simple and complex questions can enhance students in using their imaginative level of thinking. Thus, students can develop logical reasons, such as the ability to compare, classify, sequence, connect causes and effects, describe patterns, make analogies, compile sequences, predict, plan, formulate hypotheses, and submit a criticism.
The draft worksheet compiled and assessed for its feasibility by experts can be described as follows:

- The cover is the front page of the worksheet which contains the worksheet title, author's name and student identity. Cover designed to describe environmental pollution material.
- Competencies that are in need to be achieved in the learning process are the ones taken in accordance with the indicators of environmental pollution material. Each indicator is used for the implementation of learning in three meetings so that from these indicators, three types of worksheet were developed in environmental pollution material namely worksheet about (1) environmental changes, (2) practicum on environmental pollution practice, and (3) to the effect of environmental pollution and its prevention.
- Learning Instructions are seen as the learning guide created to help students work on the worksheet at each meeting. These instructions are also made in procedural sections such as the steps students deduce concepts, fill in the observation table, and solve problems.
- The contents of the worksheet embody the titles of the sub-chapter on environmental pollution, short concepts, instructions through guided discussions, and simple experiments on environmental pollution material. The learning process is carried out through discussions in groups and individuals.

3.2. The worksheet validation

The results of validation constructivism-based worksheet validation on environmental pollution material are reviewed from (1) content and material suitability, (2) language, (3) presentation components, and (4) graphic components. Validation instrument assessment was adapted from BSNP which was re-developed based on the characteristics of the worksheet developed in this current study. This assessment was carried out by 9 experts consisting of 6 lecturers and 3 science teachers. The assessment process was accomplished by providing the worksheet draft LKPD design and product quality sheets to be reviewed by each validator.

The validation process is performed repeatedly for approximately 2 months by experts who are tailored to their respective fields of expertise such as language experts, evaluation experts, and material experts until the worksheet is feasible to be used as teaching material. The first validation stage was carried out by the lecturers, then revisions were made until they were deemed appropriate to use. The next stage, the results of the printed worksheet validation was further validated by the science teachers in order to assess the suitability in the material aspects with the criteria of the students.

Besides providing a scaled assessment, the comments and suggestions on the quality assessment sheet regarding the worksheet were also presented. Suggestions and inputs from validation results from the validators are more adaptable to daily occurrences, the sentence used in the worksheet are effective and easy to understand. It is also necessary to pay attention to the use of punctuation, table, and picture layout in worksheet to make it look more attractive and efficient.

The worksheet that was validated and revised was printed and carried out for trials in the field. To find out the results of the worksheet feasibility assessment by experts, see Figure 2.
Figure 2. Assessment of Constructivist-based worksheet quality

Based on data from Figure 2, it was found that the material aspects, language, presentation components, and graphic components were 0.96 (very good); 0.78 (good); 0.89 (very good); and 0.81 (very good). The average score of the quality assessment by product validators is 0.87 with an “almost very good” category. This is in accordance with Aiken [13] who stated that the results of the assessment of 0.085 already have a very good level of validity. Thus, constructivist-based worksheet then can be used by students at SMPN 4 Banda Aceh. In the study of Rahmatillah et al. [11], they explained that the worksheet can increase the capability of the students.

3.3. Applying worksheet

Learning science using constructivist-based worksheet was conducted three times. During the treatment process, it was clear that students were enthusiastic about the lesson. Constructivist-based worksheet promotes learning by involving the holistic attention of students during the learning process. This is because students are required to investigate the new information and new knowledge that they do not yet know and to adjust it to their existing knowledge to facilitate conclusions on the concepts being learning [14].

This worksheet was applied for all students, whether for active or passive students who usually only become listeners. They were required to pay more attention to the assignments and material offered in the worksheet because each student has the obligation to learn both independently and in groups. Consequently, all assignments are completed at its time and all the students got better results. This is supported by Afolabi and Akinbobola [15] who mentioned that constructivist learning can encourage students to take responsibility independently and build their own understanding of each scientific concept.

In addition, assessment of learning outcomes that are offered through the questions have been validated by the validators and given to students. The assessment was analysed using PROANALTES to find out the level of difficulty, difference power, and reliability. There were ten questions to represent each indicator [16].

The learning outcomes of students using constructivist-based worksheets obtained an average value of 82.21 indicating that learners using of the worksheets had a positive effect on learning outcomes. This is supported by the results of the study of Akinoglu and Tandogan [17] who clarify that the use of appropriate teaching materials can help the teacher to guide the learning process which leads to the escalation of the learning outcomes. In addition, Bodner [18] mentions that constructive theory can provide activities to students to find their own competencies and knowledge to develop themselves.
Bogar et al [19] urge that learning using constructivist-based worksheets has a positive effect on learning outcomes and it is able to develop the contracting concepts learned. Bhattacharje [20] states that constructivist-based worksheets were developed effectively to improve student learning activities which can be seen from the enthusiasm of students during the learning process. Furthermore, Meini et al. [21] explained that constructivism-based worksheets can facilitate students to express the knowledge that students have so that the knowledge is not limited in the 'remembering' phase only. Thus, learning will be meaningful and can improve the students’ activeness during the learning process.

3.4. Questionnaire Distribution
A questionnaire set was distributed at the end of the learning process to students in order to find out their responses toward the use of constructivist-based worksheets in learning. The overall percentage of their responses was represented by strongly agree (72.8%) and agree (26.5%), while the rest chose to disagree. This shows that students give a positive response to the implementation of constructivist-based worksheets. Briefly, more students are prone to the application of the constructivist-based worksheets in learning. This statement is in accordance with the research of Alfana et al. [22] that the overall response from students to constructivist-based worksheets was 86%, which showed that the worksheets developed positive response among students. The use of the worksheet also benefits students more as the teacher only acts as a facilitator who facilitates students to learn and provides teaching methods appropriately [23].

4. Conclusions
Based on the findings shown above, it can be concluded that the development of students’ worksheet is excellent so that it is appropriate to be used as teaching material. In addition, the use of this worksheet helps students obtain good learning outcomes. Besides, the students also have positive responses toward the use of this worksheet. Through this worksheet, students are given the opportunity to retrieve the knowledge that they have previously possessed as well as express ideas and opinions from their prior experiences by involving the five senses. In this case, the students were later guided by the teacher to find concepts from the material being studied. Then, a suggestion for future research is gently addressed. It is expected that the worksheet development process can be more widely validated for science teachers to obtain better quality of the worksheets so that it can be used on the broader domain in its dissemination.

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