Development of learning tools education for sustainable development (ESD) integrated problem-solving for high school

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Abstract. The purpose of this study is to develop integrated learning tools for problem-solving for continuing education on the material changes in the environment of the X grade high school. The learning tools developed contain dimensions of knowledge, attitudes, and skills that are consistent with Education of Sustainable Development (ESD) demands and contain issues of sustainable development. The research method used is Research and Development (R&D). The data collection techniques used in this study are the analysis of learning design documents currently used in high school and the rubric of the assessment of integrated ESD learning tools for problem-solving given to experts to assess whether the learning tools are following the ESD context. The learning design used is an integrated learning tools to solve problems. The results of this study are products in the form of integrated ESD learning tools to solve problems by the curriculum-13 in Indonesia on environmental change material. Based on the results of assessments from experts, the learning tools still need an explanation of the concept of sustainable development with the context of the material so that students can associate the concept of sustainable development with environmental change materials.

1. Introduction

Sustainable development is now becoming an important issue in preparing the global community to face the emerging challenges on environmental changes globally. This concept has emerged as a response to environmental problems due to the impacts of social life [1]. The center of the 2030 Sustainable Development Agenda approved that Education for Sustainable Development (ESD) as a key enabler of sustainable development and an integral element of quality education. More efforts have been exerted to raise awareness regarding sustainability, international conferences and conventions were assembled to come up with concrete solutions for this problem, such as the United Nations Conference on Sustainable Development (Rio+20), its Agenda 21 and the Kyoto Protocol [2]. Many initiatives have been launched to educate for sustainable development, mainly focused on a curricula change and awareness campaigns [3].

There is general agreement that sustainability students need to have certain key competencies that allow them to engage constructively and responsibly with today’s world. Therefore, ESD have a competencies to achieving sustainable development goals (SDGs). There are 8 ESD competency: system thinking competency, anticipatory competency, normative competency, strategic competency,
collaboration competency, critical thinking competency, self-awareness competency and integrated problem-solving competency [4]. This is especially apply with sustainability problems, which require flexible, integrative, multidisciplinary problem-solving approaches, rather than singular solutions. In addition, students learn that problem solving is often more than the product of an intellectual exercise. Problem-solving requires implementation, and good solutions may nonetheless face barriers to implementation. Through problem-solving, students can acquire additional skills, often social and political skills, necessary to implement solutions [5].

In general, development is considered as a vision for a better world in balanced environmental, social, economic and cultural considerations. ESD acts to raise awareness and change behavior and attitudes and enable people to make decisions about their lives [6]. The ESD program is not a new innovation and very potential to be implemented and developed in Indonesia because learning by integrating ESD concepts and values, completely integrated planning in the curriculum both in the learning process/learning methods as a hidden curriculum [7]. Learning tools can be used as a reference in teaching and learning activities in class. In addition, it can be used as a medium for increasing professionalism, as professional teachers are those who meet the competency standards, namely mastery of knowledge, skills, and attitudes.

In Indonesia, research about developing learning tools ESD integrated problem-solving is rare. So, writer wants to make learning tools for ESD and it will help another teachers to implement learning tools ESD easily. This research focus on how to develop a learning tools ESD for high school which integrated to another ESD competences, and also focused on how to train knowledge, attitude and skills for student. The purpose of this research is to creating a learning tools ESD which integrated problem-solving based on the environmental issues for high school. The rationale for the measurement is the importance to develop student’s problem-solving on aspect knowledge, attitude and skills in learning by using ESD.

2. Method
The method used in this research is a research and development method with ADDIE design (Analyze, Design, Development, Implementation, Evaluation). The stages of the development research method with the ADDIE design carried out in this study follow the stages of the ADDIE design development research method proposed [8]. First step of this research is analysis a document learning tools that used by teacher in SMA Negeri 4 Palembang. After that, in design step was designing learning tools and make another instrument. Instrument needs judgment before the implementation. Judgment is given to experts, the one is a lecturer and another one is a biology teacher. Next step is a implementation, this step will show you about the response students after learn using learning tools ESD integrated problem-solving. And the last one is evaluation, this step have been done for every step start from analysis, design and development. The validation assessment for learning tools ESD integrated problem-solving used by The National Education Standards Agency (BSNP) assessment. It is divided into two aspect, material feasibility assessment [9] can be seen in Table 1 and media feasibility assessment can be seen in Table 2. The results of the score calculation in the form of a percentage would then be grouped based on criteria score [10] and can be seen in Table 3.

| No. | Validation Aspect                     | Maximum Score |
|-----|---------------------------------------|---------------|
| 1.  | Component of Eligibility Content      | 32            |
| 2.  | Component Language                    | 16            |
| 3.  | Component Presentation                | 16            |

Table 1. Material Feasibility Assessment
Table 2. Media Feasibility Assessment

| No. | Validation Aspect                | Maximum Score |
|-----|----------------------------------|---------------|
| 1.  | Component Presentation           | 32            |
| 2.  | Component Writing Rules and Punctuation | 16            |

Table 3. Scoring Criteria

| Score Criteria | Classification |
|----------------|----------------|
| 0% - 20%       | Very weak      |
| 21% - 40%      | Weak           |
| 41% - 60%      | Enough         |
| 61% - 80%      | Strong         |
| 81% - 100%     | Very strong    |

Table 4. Student’s Responses Toward Learning Tools ESD Integrated Problem-Solving

| No. | Statement                                                                 | Attitude Scale (%) |
|-----|---------------------------------------------------------------------------|--------------------|
| 1.  | Learning to use LKPD ESD helped me understand the material                | 5                  |
| 2.  | The study of biology applied has made me realize the importance of protecting the environment | 4                  |
| 3.  | I have never thought about the impact of environmental changes on life in the future | 3                  |
| 4.  | I have never felt responsible for the environment                         | 2                  |
| 5.  | I do not believe I can bring change to the environment                    | 1                  |

5: Always, 4: Often, 3: Sometimes, 2: Rarely, 1: Never

3. Result and Discussion

3.1 Analyze
Research starts from the potential or problem. The potential for implementing ESD learning in SMA Negeri 4 Palembang can actually be implemented considering that the school has now become a National Adiwiyata School’s. As you know, the adiwiyata program is an ESD program implemented by the Ministry of the Environment. The target of the adiwiyata program is the education unit from elementary school / MI, to high school / MA and vocational school. In this program schools generally have implemented Social, Environmental and Economic values. The implementation of values in the three perspectives cannot be done separately but mutually support and influence [11]. The program also seems to be going well, but this is not applied during the teaching and learning process. Based on the results of interviews with several teachers at the school, it is very difficult to apply ESD into the teaching and learning process due to the lack of information obtained and the lack of training regarding the implementation of ESD for learning. Document analysis of learning tools is needed to analyze the extent to which the ESD context exists in the teaching and learning process. Based on the analysis of the learning tools document shows that attitude planting has been carried out, but to develop knowledge and skills in ESD competence has not been fully implemented.
3.2 Design
In this study the resulting product was in the form of an integrated ESD student’s worksheet solving problems. Worksheets that are made namely on the subject of environmental change learning. Environmental change is one of the goals of sustainable development. Worksheets are divided into two types namely individual can be seen in Figure 1 and group worksheets can be seen in Figure 2. The problems contained in the worksheet are taken based on sustainable development issues.

3.3 Development
The learning device validation was carried out by two experts. The results of the validation carried out by experts are used to determine the feasibility of an integrated ESD learning tool for problem solving for environmental change learning materials in high school. Based on the integrated ESD learning tool assessment instrument there are 5 components in the form of problem solving: component of eligibility content, component language, component material presentation, component media presentation, component writing rules and punctuation.

The validity of the material’s worth relates to the preparation of products in accordance with predetermined designs. There are 16 assessment: extent of material in accordance with core competencies (KI) and basic competencies (KD), depth of material in accordance with KI and KD, ability to encourage students to carry out classification activities, accuracy of facts, accuracy of concept/theories, conformity with the development of science and technology, appropriateness of examples and references, contextual, comprehension of messages, accuracy of sentence structure, rigidity of symbolic terms, interrelation between sentence/paragraph structure, systematic presentation in worksheet, conceptual concordance, suitability of illustration use with worksheet material, ESD presentation (containing illustrative sustainable development issues).

Media validity refers to how to construct, in this study is how to develop a product. In the validity of this construction there are 10 assessments namely worksheet size, density of worksheet pages, cover design, accuracy of image placement, colour composition selection, font type and size selection, well-structured sentences, instructions for unambiguous student activities, appropriateness of titles with material, using proper punctuation. Following are the results of the validation of the material feasibility can be seen in Table 5, Table 6 & Table 7 and the media feasibility can be seen in Table 8 & Table 9.

| Table 5. Component of Eligibility Content |
|------------------------------------------|
| **No.** | **Validator** | **Score** | **Percentage (%)** | **Category** |
|--------|--------------|----------|-------------------|-------------|
| 1      | Validator A  | 26       | 81.25             | Very Strong |
| 2      | Validator B  | 27       | 84.375            | Very Strong |
| Average|              | 39.5     | 82.81             | Very Strong |
Table 6. Component Language

| No. | Validator | Score | Percentage (%) | Category |
|-----|-----------|-------|----------------|----------|
| 1.  | Validator A | 15 | 93.75 | Very Strong |
| 2.  | Validator B | 16 | 100  | Very Strong |
|     | Average    | 15.5 | 96.875 | Very Strong |

Table 7. Component Material Presentation

| No. | Validator | Score | Percentage (%) | Category |
|-----|-----------|-------|----------------|----------|
| 1.  | Validator A | 14 | 87.5 | Very Strong |
| 2.  | Validator B | 15 | 93.75 | Very Strong |
|     | Average    | 14.5 | 90.625 | Very Strong |

Figure 3. Percentage of Material Feasibility Component

Table 8. Component Media Presentation

| No. | Validator | Score | Percentage (%) | Category |
|-----|-----------|-------|----------------|----------|
| 1.  | Validator A | 21 | 80.76 | Strong |
| 2.  | Validator B | 24 | 100  | Very Strong |
|     | Average    | 22.5 | 90.38 | Very Strong |

Table 9. Component Writing Rules and Punctuation

| No. | Validator | Score | Percentage (%) | Category |
|-----|-----------|-------|----------------|----------|
| 1.  | Validator A | 21 | 80.76 | Strong |
| 2.  | Validator B | 24 | 100  | Very Strong |
|     | Average    | 22.5 | 90.38 | Very Strong |
3.4 Implementation
The result of responses student toward learning tools ESD integrated problem-solving can be seen in Table 10.

Table 10. Student’s Responses Toward Learning Tools ESD Integrated Problem-Solving

| No. | Statement                                                                 | Attitude Scale (%) | 5   | 4   | 3   | 2   | 1   |
|-----|----------------------------------------------------------------------------|-------------------|-----|-----|-----|-----|-----|
| 1.  | Learning to use learning tools ESD helped me understand the material       |                   | 0   | 0   | 0   | 40.63 | 56.25 |
| 2.  | The study of biology applied has made me realize the importance of         |                   | 0   | 0   | 0   | 37.50 | 67.50 |
|     | protecting the environment                                                |                   |     |     |     |      |      |
| 3.  | I have never thought about the impact of environmental changes on life in |                   | 43.75 | 50 | 6.25 | 0   | 0   |
|     | the future                                                                 |                   |     |     |     |      |      |
| 4.  | I have never felt responsible for the environment                          |                   | 59.38 | 6.25 | 34.38 | 0   | 0   |
| 5.  | I do not believe i can bring change to the environment                     |                   | 43.75 | 56.25 | 0   | 0   | 0   |
|     | **Average**                                                               |                   | 29.376 | 22.5 | 8.126 | 15.626 | 24.75 |

Based on the results of students’ questionnaire regarding learning using ESD learning tools solutions to solving learning problems using ESD learning tools can help them learn learning materials and make them aware of the need for the environment. However, this does not conflict with responses about environmental change to the future and there are still many students who doubt about the responsibility of individuals in environmental care. However, they believe they can make a difference in their environment.
4. Conclusion
There are some interesting findings related to the following research: (i) the development of an integrated ESD learning tool for problem solving shows very good results. Shown that the learning tool can be used for other schools. (ii) based on the results of students' responses regarding the use of integrated ESD learning tools problem solving can help them understand learning, but it appears that there are still students who are hesitant in their responsibilities as individuals to protect the environment. This should get more attention, bearing in mind that the school bears the adiwiyata national level.

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