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# *Development Of Student Worksheet Oriented On Steam With PjBL Model On Environmental Pollution Matter To Improve Creative Thinking Skill*

**Desta Alvionita[1], Joko Sudomo[2], Purwanti Widhy H[3]**

[1,2,3] Study Program of Science Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta

Keywords:
*creative thinking, environmental pollution, PjBL, STEAM, student worksheet.*

***Abstract***

This study aims to determine the feasibility of student's worksheet oriented STEAM with PjBL model on environmental pollution material to improve creative thinking skills based on validity, practicality, and effectiveness. This research method uses a 4-D model which is limited only to the development stage because at the dissemination stage a larger population is required, and a limited trials are carried out to eighteen students of MTsN 3 Jombang. The results of the research on the aspect of validity based on content and construct validity show the percentage score of 89.17% and 95.02% on very valid category. The practicality aspect in terms of activity observation and student response for each component obtained a percentage score of 98.53% and 97.02% on very practical category. The aspect of effectiveness in terms of the results pretest-posttest of students' creative thinking skills showed an increase in the average N-Gain score of 0.72 on very high category and declared effective.
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## INTRODUCTION

Education in Indonesia has now entered the 21st century which is marked by the rapid development of science and technology. 21st century education aims to build the intelligence capabilities of students in solving problems around them. Forming intelligence in the real world is not only by knowing, but can solve problems faced around the environment in a meaningful, relevant, and contextual way (Insyasiska, Zubaidah, & Susilo, 2015: 9). To answer the challenges of the 21st century, maximum efforts need to be made in training competencies and skills. US-based Partnership 21st Century Skills (P21, 2008) identify the competencies needed in the 21st century, namely "The 4Cs" are communication, collaboration, critical thinking dan creativity.

One of the government's efforts to improve the quality of education in Indonesia is to improve the curriculum. The empirical foundation point for improving the curriculum includes external and internal challenges that are currently and will be faced by the Indonesian nation. The internal challenge related to population development that will be faced by Indonesia in 2020 to 2035 is the peak of the productive age population (Kemendikbud, 2018:1). Efforts that need to be made in responding to these challenges are to train competencies and skills in the 21st century, namely collaboration, creativity, communication, and critical thinking. These skills are needed so that students have creative thinking skills and become better problem solvers.

Piirto (2011: 38) explain creativity as an effort to make something new or a prerequisite for innovation and divide it into creative thinking, working creatively with others, and implementing innovation. Meanwhile, scientific creativity emphasizes the activities carried out by scientists in learning science (Kind & Kind, 2007: 24). From these problems, it is necessary to apply a learning model that is able to encourage students to think critically, creatively, and innovatively. The Project Based Learning learning model that is integrated with the STEAM approach can train students' skills to think critically, creatively, and innovatively (Priantari, *et al*, 2020: 100).

Project Based Learning (PjBL) is a learning model that requires students to design and implement projects that produce products to be exhibited and presented to the public. The application of the PjBL model is very realistic for science learning that requires practical work, so that the practical work will produce a product that is useful for the real life of students (Astuti, Toto, & Yulisma, 2019: 93).

Andrew Miller (2017) explained that through STEAM students find creative and innovative meaningful ways to expand and connect many disciplines through experimentation and imagination. This will help students to apply learning to success in real life so that they are qualified to increase students' creativity.

The use of learning models and methods must be supported by appropriate teaching materials, such as student worksheets. Student worksheet is a sheet that contains materials, summaries, and instructions for implementing learning tasks that must be done by students with reference to the basic competencies that must be achieved (Prastowo, 2015: 204).

Based on observations at MTsN 3 Jombang, the student worksheets used are still just conventional student worksheets or student worksheets that only contain summaries and questions where the answers are only copied from reading books so that students feel bored. So that it is necessary to have student worksheets oriented to 21st century skills according to the 2013 curriculum. The recommended skills to practice 21st century skills are to include creative and innovative aspects through multidisciplinary learning and critical thinking (Kemendikbud, 2018: 3). Improving students'

creative thinking skills can be described in environmental pollution material.

Environmental pollution material is a topic that is closely related to daily life and an effort is needed to overcome these problems. Handling plastic waste into the basic competance of environmental pollution is very precise with the application of the STEAM approach, namely by combining science problems with ecobricks as part of the technological and technical aspects, while the mathematical aspect is in the calculation of needs to be precise in making products such as tables, chairs, etc. related to the number of bottles. and a lot of plastic waste is needed. Ecobrick products will look attractive if there is an art retreat in it. Researchers develop STEAM oriented student worksheets with PjBL models on environmental pollution material to improve creative thinking skills.

## METHOD

### Types of research

This type of research uses the type of Research and Development (R&D). The development of student worksheets refers to the four-D method (4-D) designed by Thiagarajan and Semmel. The 4-D development model consists of four stages, namely (1) define, (2) design, (3) develop, and (4) disseminate. This study aims to test the feasibility of the developed student worksheets, so that it is only carried out until the develop stage through a limited trial process (Ibrahim & Wahyukartiningsih, 2014).

### Research Time and Place

The research was carried out from March to April 2021 for the 2020/2021 academic year. The product trial was carried out on April 5-13, 2021. This research was carried out at MTsN 3 Jombang, Jombang, East Java.

### Research Subject

The research subject was conducted in a limited manner to 18 students of seven grade at MTsN 3 Jombang who were selected heterogeneously based on academic abilities and formed small groups. This is suitable with Vygotsky's theory that students can learn through interaction and help from others who come from expert peers (Slavin, 2011). The feasibility of the developed student worksheet in terms of validity, practicality, and effectiveness (Nieven, 2010: 127)

### Procedure

This research procedure uses a 4 D model (Define, Design, Develop, Desseminate). At the define stage aims to establish and define the learning objectives to be achieved. At this stage, planning for the manufacture of student worksheet is carried out according to the results of the analysis at the define stage starting with the selection of the format and initial design of the student worksheet. At the develop stage, it aims to produce a product of teaching materials, namely student worksheets that have been repaired based on suggestions from a supervisor and validators through a validation process.

The trial design used in this study was the One Group pretest-posttest design. The design under study is described as follows:

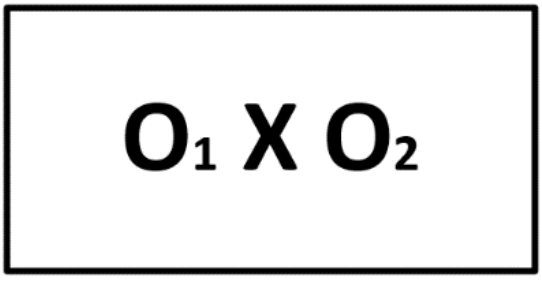


*Figure 1. Research One Group Pretest-Posttest design*

Keterangan :
O1 = Pretest Score (given before treatment)
O2 = Posttest Score (given after treatment)
X = Treatment
(Sugiyono, 2015: 415).

**Data, Instruments, and Data Collection Techniques**

The data collection technique in this study used a validation sheet instrument to assess the validity, then an activity observation sheet instrument and student response questionnaires to assess practicality, as well as the effectiveness of the developed student worksheet in terms of increasing students' creative thinking skills through pretest and posttest scores.

**Data Analysis Techniques**

The assessment of the validity of the student worksheets was carried out by two science lecturers and one science teacher who scored each criterion for content validity and construct validity (presentation, linguistics, graphics). The validation results were analyzed descriptively quantitatively using a Likert scale value of 1-4. Furthermore, calculations are carried out to obtain the percentage of validity assessment by comparing the number of scores obtained and the criteria score. The criterion score is the calculation of the highest score × the number of aspects × the number of validators. After obtaining the percentage of validity, interpretation is carried out according to the criteria in Table 1.

***Tablq 1. Interpretation Criteria for Media Feasibility Assessment Score***

| Percentage **(%)** | Criteria |
|---|---|
| **75-100** | Very Good |
| **50-75** | Good |
| **25-50** | Less |
| **< 25** | Veru Less |

The developed student worksheets are said to be valid if they get a percentage of 50% (Sugiyono, 2015 : 418).

The student worksheet that have been validated and declared suitable for use, then limited trials can be carried out. The data obtained from the results of the limited trial include student observations and student responses that can be used to determine the feasibility of student worksheets on practical aspects. Data analysis was carried out using the Guttman scale, which then obtained the percentage of practicality of student worksheet. the developed student worksheets are said to be practical if they get a percentage of 61% (Riduwan, 2016: 13).

The aspect of effectiveness in terms of increasing creative thinking skills through pretest and posttest scores was analyzed using the N-gain score with the aim of knowing the increase in students' creative thinking skills before and after learning using the STEAM-PjBL student worksheet. The increase in creative thinking skills obtained by students is interpreted according to the criteria in Table 2.

***Table 2. Category N-Gain Score***

| **Score** | **Category** |
|---|---|
| $g < 0,3$ | Low |
| $0,7 \geq g \geq 0,3$ | Moderate |
| $g > 0,7$ | High |

The developed student worksheet is said to be effective if the results of the increase obtained get a minimum value of $0,7 \geq g \geq 0,3$ with a medium category (Hake, 1999: 68).

**RESULT**

This study aims to determine the feasibility of STEAM oriented student worksheet with the PjBL model on environmental pollution material to improve creative thinking skills based on validity, practicality, and effectiveness. The development process uses a 4-D model, namely define, design, develop, and disseminate which is limited only to the development stage because at the dissemination stage a larger population is required.

**Define Stage**

At this stage the aim is to determine and explain the terms of learning. This stage consists of five steps, namely initial analysis, student analysis, task analysis, concept analysis, and analysis of learning objectives

(Ibrahim & Wahyukartiningsih, 2014). The result of the define stage is that students lack creative thinking skills, so to practice creative thinking skills, it is necessary to develop teaching materials in the form of STEAM oriented worksheet with the PjBL model by making experimental product design innovations to solve real-life problems.

**Design Stage**

At this stage, planning for the manufacture of student worksheet is carried out in accordance with the results of the analysis at the define stage. The student worksheet that will be developed is a STEAM-oriented student worksheet with the PjBL model. The steps taken at the design stage are the selection of the format for the preparation of the student worksheet and the initial design of the student worksheet. Figure 2. is an example of the LKPD design that will be developed.

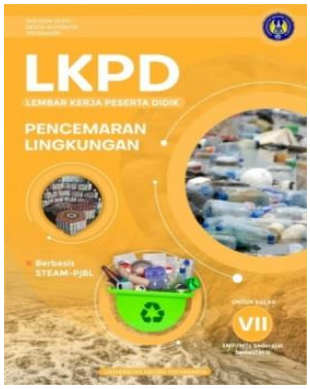


*Figura 2. Cover Student Worksheet Design*

**Develop Stage**

At this stage, it aims to produce a product of teaching materials, namely student worksheets that have been repaired based on suggestions from a supervisor and validators through a validation process. After the student worksheet is said to be valid, it can be used for limited trials. The student worksheet product used contains all aspects of STEAM. Science learning with the STEAM approach integrates the integration of various fields of science, technology, engineering, art, and mathematics (Spiko *et al.*, 2017: 5-6). In the field of science, it can be taken from the events of environmental pollution of water, air, and plastic waste pollution. The field of technology can be taken from the use of internet and video technology to find references in making products. The field of engineering can be taken from the ability of students in designing ecobricks making procedures. The field of art can be taken from making posters related to products produced from project activities and students' creativity in decorating ecobricks. In the field of mathematics can be taken from the calculation of the need to be precise in making a product.

**Validity**

The validity of student worksheet is viewed from two criteria, namely content validity and construct validity (Nieven, 2010: 127). Validation aims to determine the correctness and feasibility of the developed student worksheets. Validity results were obtained from two science lecturers and one science teacher who gave an assessment score through a validation sheet. The following are the results of the validation of the student worksheets obtained in Table 3.

***Table 3. Student Worksheet Validation Results***

| Assessment Indicators | Aspect | Score(%) | Category |
|---|---|---|---|
| **Content Validity** | Content Criteria | 89,17 | Very Valid |
| **Construct Validity** | Presentation Criteria | 95,37 | Very Valid |
| | Language | 93,05 | Very |

| | | | |
|---|---|---|---|
| | Criteria | | Valid |
| | Graphic Criteria | 95 | Very Valid |

Content validity is seen from the suitability of the material with the learning objectives. Construct validity includes three criteria, namely language, presentation, and graphics with the aim of producing a design of teaching materials that can support the quality of the developed student worksheet (Nieveen & Theerjd, 2010). Based on the data from the validation results as a whole, the developed student worksheet is said to be very valid with an average of 89.17% in terms of content validity and 95.02% construct validity.

After the validity test was carried out, a limited trial was conducted at MTsN 3 Jombang to 18 seven grade students to obtain data on the practicality and effectiveness of STEAM-PjBL-oriented student worksheet.

**Practicality**

The practicality of the developed student worksheet is viewed from the results of student responses which are supported by the results of observations of student activities. Practicality aims to determine the level of convenience of student worksheet when used in the learning process (Lestari et al., 2018). After the learning process uses student worksheets, students are given a response questionnaire to determine the practicality of the developed student worksheet. The student response questionnaire contains questions related to content criteria, presentation and graphics, language, and implementation. The results of student responses show an average percentage score of 97.02% with a very practical category kategori.

Furthermore, to obtain data on the results of student activities during learning, it refers to the PjBL stage which is STEAM-oriented. The results of student observation data are presented in Table 4.

***Table 4. Student Activity Observation Results***

| The Meeting | Score | Category |
|---|---|---|
| 1 | 100% | Very Practical |
| 2 | 98,4% | Very Practical |
| 3 | 97,2% | Very Practical |

The data obtained from the observations of student activities indicate that the student worksheet are very qualified to be used in the learning process. The average percentage obtained from the results of observing the activities of these students is 98.53%. The lowest percentage is in irrelevant activities of 83.8% because students when doing practicum there are some students who talk and joke on their own but can still be conditioned.

**Effectiveness**

The effectiveness of the developed student worksheets can be seen from the increase in students' creative thinking skills determined through the N-gain Score. The results of the creative thinking skills test were obtained from the pretest and posttest question sheets carried out by students. The pretest questions are given before the test phase, the student worksheet aims to determine the students' initial understanding of environmental pollution material, while the posttest is given after the student worksheet test phase is completed which aims to determine the students' understanding after conducting the limited trial phase of the worksheet developed learners. The following are the results of improving the creative thinking skills of class VII students, which are presented in Table 5.

***Table 5. Results of Improving Creative Thinking Skills***

| Average Pretest | Average Posttest | N-Gain Score | Category |
|---|---|---|---|
| 46,67 | 84,86 | 0,72 | High |

Based on the N-Gain analysis in Table 5 shows an increase in the posttest value to the pretest value. The average N-Gain score obtained by students is 0.72 and is included in the high category. This shows that the developed student worksheet are very effectively used in learning to make students more creative, critical, collaborative, and communicative. (Rachmawati, *et al.*, 2017).

Creative thinking skill has 4 aspects, namely originality, fluency, flexibility, and elaboration. Creative thinking skills can be analyzed through the competence of students to obtain several possible answers to questions that reflect these 4 aspects (Anggreani & Mirtalis, 2021). Table 6 is a table of the percentage increase in creative thinking skills in each aspect.

***Table 6. Percentage of Increase in Students' Creative Thinking Skills Seen from Every Aspect***

| Competence | *Pre-Test* (%) | *Post Test* (%) | Enhancement (%) | N-Gain | N-Gain Category |
|---|---|---|---|---|---|
| **Fluency** | 49,53 | 81,48 | 31,95 | 0,63 | Moderate |
| **Flexibility** | 30,5 | 93,52 | 63,02 | 0,91 | High |
| **Elaboration** | 64,35 | 80,56 | 16,21 | 0,45 | Moderate |
| **Originality** | 31,95 | 76,39 | 44,44 | 0,65 | Moderate |

Based on Table 6, it can be seen that there is an increase in every aspect of creative thinking with the highest increase in the aspect of flexibility, this is in accordance with Siswono & Novitasari (2007: 2) that the level of creative thinking emphasizes divergent thinking with the order of the highest being originality and flexibility. then fluency and elaboration. Originality comes first because it has the main characteristics in assessing creative thinking products that must be different from before. The highest improvement lies in the ability to think flexibly.

The increase in the N-gain value on the creative thinking skills test that has been carried out is influenced by STEAM-PjBL-oriented teaching materials as previously mentioned that the average student response results to teaching materials is 92.06%.

## CONCLUSION

Based on data analysis and research results, it can be concluded that the development of STEAM-oriented student worksheets with PjBL models on environmental pollution materials to improve creative thinking skills is feasible in terms of validity, practicality, and effectiveness. The validity in terms of content and construct validity obtained a score with a very valid category. The practicality of the student worksheets in terms of observing the activities and responses of students obtained a score with a very practical category. The effectiveness of the student worksheets in terms of the results of the pretest-posttest creative thinking skills showed an increase in the average N-Gain score with a very high category and was effectively used. Thus, the STEAM-oriented student worksheet with the PjBL model on environmental pollution material to improve creative thinking skills developed is suitable for use in learning.

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