Development of Lesson Plans and Student Worksheets Based Socio-Scientific Issues on Pollution Environmental Topic

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Abstract. The aim of this study is to develop lesson plans and student worksheets based socio-scientific issues on pollution environmental topic for seventh-grade junior high school students. Environmental pollution topic split into several subtopics namely air pollution, water pollution and soil pollution. The composing of lesson plans were developed based on socio-scientific issues with five stages, namely (1) Motivate; (2) Challenge; (3) Collect scientific evidence; (4) Analyse the evidence; (5) Build knowledge and make connections; and (6) Use evidence. While student worksheets contain articles on socio-scientific issues, practice, and there are a few questions to determine students' reasoning. The method that is used in this research is research and development (R & D method). Development model used in this study is a model of Plomp that consists of four stages, namely: (1) Initial Research; (2) Design; (3) Realization or Construction; (4) Testing, evaluation and revision; (5) Implementation, while the research was limited to the fourth stage. Lesson plans and student worksheets based on socio-scientific issues was validated through an expert validation. The result showed that lesson plans and student worksheets based socio-scientific issues on pollution theme have a very decent and be able to apply in science classroom.

1. Introduction
A teacher should be able to develop various learning strategies, using a variety of strategies that allow students to be able to carry out the process of active learning, creative, fun, and effective. Selection or the manufacturing method and strategy in implementing the curriculum that has been made must be in accordance with the material that will be given and the goals to be achieved. Formulation of learning methods should have been prepared since the formulation of the lesson plan. Lesson plan is a plan that describes procedures and learning management to achieve one or more of the basic competencies that have been outlined in the syllabus. Lesson plan can be used by any teacher as a general guideline for implementing the learning to the learners, because it contains the instructions in detail, meetings for the sake of meeting, the objectives, the scope of the material to be taught, learning and teaching, the media, and the evaluation should be used so that the learning process can be carried out systematically.

In addition to the lesson plan, teachers should also be able to develop the student worksheet as one way that students acquire and develop a set of knowledge possessed by lab / experimental. National Training Laboratories [1] found that students can only be considering the subject matter as much as 5% to 10% of the students read about in books, but they can be given up to 80% of what they have
experienced/do. This is similar to Edgar Dale Cone experience where learning is supported by an activity where learners experiencing or doing it yourself can directly improve the learning outcomes of students is higher when compared to see and hear it. Therefore, the lab needed to make the students better understand and interpret the science so that science last long in their memories. Experimental activity is an activity that is suitable to support the students in remembering and understanding the subject matter more through the direct experience. The advantages of the experimental activity are to make learners more confident of the correctness or conclusions based on experiments, make new breakthroughs in the discovery of the experiments, experimental results provide the valuable benefit of human life [2].

Learning with experimental activities will train students' skills in scientific thinking and have skills such as: make a quantitative observation, interpret data, formulate hypotheses, design and conduct experiments, as well as the conclusion that learning objectives can be achieved. Learning objectives to be achieved through practical activities can be carried out if practical tools and learning media are used appropriately. One of learning in the experimental activity is a student worksheet. Student worksheets indispensable as a medium of learning to guide in each activity step by step exactly in solving a problem in doing practical work. According to Heinich, learning media is a media that carry messages or information with the aim of containing instructional or teaching purposes [3].

The new learning methods in Indonesia is Socioscientific issues (SSI) based learning. SSI is a science topic which the participants in a particular society faced with issues involving science and social life [4]. Learning with Socioscientific issues (SSI) are learning to apply science and technology are critical to problem-oriented approach to learning that is relevant to the learners [5]. SSI is very well used in the teaching of science because it can be used as a tool to: (1) make learning science more relevant to students' lives; (2) a vehicle that directs the learning outcomes such as students' appreciation of the nature of science; (3) increase the ability of students in a discussion of argument; (4) improve students' skills in evaluating scientific data and information; and (5) an important component of scientific literacy [6]. SSI term is mostly used for designing real-world scenarios in which not only focuses on the facts related to science, but also of normative values [7].

The studies have been done about the potential SSI in science learning, namely: (1) an increase scientific literacy of students [8] [9] [10] [11]; (2) an increase in students' reasoning ability on the theme of climate change [12]; (3) an increase in cognitive, analytic thinking skills and the satisfaction of students in integrated science teaching on the theme of global warming [13]; (4) assist students in an effort to decision-making and increase the interest and curiosity of the students [14]; (5) an increase in the ability of reflective judgment students' [4]; (6) There is a growing mastery of concepts and decision making of students on environmental pollution material [15]; (7) SSI-based science learning helps contextualize science and provides the opportunity students have an awareness of the environment, and to help develop students' ability to argue [16]. However, there has been no research on development lesson plan and student worksheet.

SSI-based learning should be linked to the social issues emerging in the community such as the environment. Emergency environmental problems become an issue since the human domination of the environment one of which exploitation of environmental resources, and the development of technologies that are not environmentally friendly. Thus, education plays an important role in educating students to care for the environment. One of the environmental problems that occur is environmental pollution. The context in science literacy one about the environment [17] so that environmental pollution materials appropriate in science learning. In addition, the material environmental pollution has a complex concept, because it contains a variety of linkage various scientific fields such as biology, physics, and chemistry.

2. Experimental Method
This study is a development research Plomp model. Products are developed in this study a Student Worksheet and Lesson Plan. This study uses Plomp development model developed by Tjeerd Plomp. This development model consists of five stage: (1) the initial investigation (2) design; (3) the realisation/construction; (4) test, evaluation, and revision; (5) implementation. In this study is limited
to four stages, namely the test. Participants of this study were 33 students in SMP Negeri 2 Bandung. Characteristics of students in this study is 11-13 years old.

3. Result and Discussion
Research and development worksheets and lesson plans based on SSI starting with the initial investigation stage. At the stage of the initial investigation conducted: (1) analysis of requirements: a) that teacher had never known SSI-based learning that has never made lesson plans and student worksheets based SSI; b) the absence of air and soil pollution student worksheets in science subjects at the junior high school. (2) analysis of the syllabus: Researchers focus on environmental pollution topic with basic competencies 3.8 Analyse the impact of environmental pollution and its impact on the ecosystem. Based on these worksheets and lesson plans investigators divided into 3 sub-topics that are air pollution, water pollution, and soil pollution by indicators such as in Table 1.

Table 1. Indicators of each sub-material

| No. | Sub material         | Indicators                                                                 |
|-----|----------------------|-----------------------------------------------------------------------------|
| 1.  | Air Pollution        | 1. Explaining the phenomenon of air pollution                               |
|     |                      | 2. Analysing the impacts of air pollution on humans and the environment     |
|     |                      | 3. Analysing the social impact of air pollution                             |
|     |                      | 4. Explaining solutions or mitigation of air pollution prevention            |
| 2.  | Water Pollution      | 1. Explaining the phenomenon of water pollution                             |
|     |                      | 2. Analysing the impact of water pollution on humans and the environment    |
|     |                      | 3. Analysing the social impact of water pollution                          |
|     |                      | 4. Explaining solution or mitigation of water pollution prevention          |
| 3.  | Soil pollution       | 1. Explaining the phenomenon of soil pollution                             |
|     |                      | 2. Analysing the impact of soil pollution for humans and the environment    |
|     |                      | 3. Analysing the social impact of soil pollution                           |
|     |                      | 4. Explaining solution or mitigation of soil pollution prevention          |

Furthermore is a design stage, during the design stage discussed with 2 experts. The lesson plan is designed in accordance with the stages of learning SSI [18]: (1) Motivate; (2) Challenge; (3) Collect scientific evidence; (4) Analyse the evidence; (5) Build knowledge and the make connections; and (6) Use of evidence. The stage of the motivate, the teacher must give motivation to students by displaying related broadcasts of environmental pollution. The stage of the Challenge, students are directed to inquire and find problems related to a video aired by the teacher. Collect scientific evidence at this stage, students are given the opportunity to seek as much information related to environmental pollution through reading and experimental activity which had been created by teachers and is concerned with issues of social science. The stage of Analyse the evidence combined with stage build the knowledge and the make connections that students perform analysis with interpreting and evaluating facts that students get through practical work and discussion, then students make connections on the impact of environmental pollution on living beings and the connecting link between science and social issues of environmental pollution. In the final stage, namely the use of evidence, the students formulate conclusions and finding related concepts with practical activities and discussion, then communicate how to cope with environmental pollution.
Student worksheets design stage, designing three student worksheets for three sessions and each student worksheets consists of two activities to be carried out, namely experimental activity and discussion of social science issues. Student worksheets in the first activity have a structure that is the title of the lab, objectives, tools and materials, make a hypothesis, work steps, and the questions to be discussed. Then, the second activity has structures namely, title, discourse / social science issues, and questions for discussion. Lesson plan and student worksheets realisation stage are based on the design stage. The outcome of this is the realisation stage is lesson plan and student worksheets draft that is ready to be tested.

The last stage is the test phase. At this stage, student worksheets and lesson plan drafts are tested. Student worksheets are given to students and lesson plans are given to teacher. Teacher is given a week before learning to read lesson plans and researchers also do guidance on the teacher related important matters to be considered during the SSI-based learning takes place. When the SSI learning takes place teacher conducts preliminary activities and asks students to divide groups of 6 students per group. Student worksheets are given to each group and start work activity 1 then proceed activity 2.

Based on the observation, the whole group is very active in SSI learning and has great curiosity in doing activity 1, so when they do activity 2 activeness during discussion also seen. After completing all activities, the group representatives are asked to present their work and the teacher invites other groups to ask the presenter group. The class discussion looks active because many students are asking questions on the group of presenters. Discussions by students in both study groups and class discussions involving all students can improve students' reasoning [19] [20].

The implementation of SSI-based learning observed by 3 observers, at first meeting (water pollution sub-topic) 85.1% implementation, second meeting (air pollution sub-topic) 90.2% implementation, and third meeting (soil pollution sub-topic) the implementation of 94.5%. There is an increase in every meeting, this is because teachers have started accustomed to learning based on SSI. Based on average on table 2 it can be concluded that the implementation of SSI-based learning in class is decent. Table 2 shows the recapitulation of the implementation of SSI learning in the class.

| No. | Activities                              | Water Pollution (%) | Air Pollution (%) | Soil Pollution (%) |
|-----|-----------------------------------------|---------------------|-------------------|-------------------|
| 1.  | Preliminary activities                  | 83                  | 91                | 100               |
| 2.  | Core activities                         |                     |                   |                   |
|     | (1) Motivate                            | 100                 | 100               | 100               |
|     | (2) Challenge                           | 83                  | 91                | 91                |
|     | (3) Collect scientific evidence         | 100                 | 91                | 100               |
|     | (4) Analyse the evidence                | 75                  | 83                | 91                |
|     | (5) Build knowledge and make connections; and | 66                  | 75                | 83                |
|     | (6) Use evidence                        | 83                  | 91                | 91                |
| 3.  | Closing activities                      | 91                  | 100               | 100               |
|     | **Average (in percent)**                | **85.1%**           | **90.2%**         | **94.5%**         |

Researchers make an assessment of the results of student worksheets done by students. 4 of the 6 groups of students can perfectly reveal the facts that occur on environmental pollution, make sense of a given argument, make decisions, and use the evidence to draw conclusions. This is consistent with that expressed by Lenz and Willcox that when SSI is applied, an issue-oriented curriculum teaches
science content while simultaneously improving students’ reasoning and use of evidence to support a particular position or conclusion about SSI [18]. In addition, SSI learning will concoct them to contemplate critically about the issues that face society now and in the future.

Researchers conducted interviews with 6 students to capture their opinions about the student worksheets we developed. Based on the interviews, the linguistic used in the student worksheets is easy to understand, the student worksheets provoked the curiosity and the spirit of student discussion, by working on their knowledge student worksheets increasing not only the science but also the social impact of the environmental pollution problem. In addition, researchers conducted an interview with teacher related to learning SSI. Based on the results of an interview with teacher, SSI learning improves student discussion activities and improves conceptualization. This is in line with research conducted by Rizal that SSI-based learning helps students have the ability to make decisions based on facts and master the concept [15].

4. Conclusion
Based on the results obtained from this study can be concluded that this study has resulted in student worksheets and lesson plans SSI-based that can be used in class VII in junior high school. Student worksheets developed consists of three experimental activities and three discourse of social science issues are air pollution, water pollution and soil pollution. While lesson plan developed consists of three meetings by following SSI based learning stages.

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