Instructional Design on The Environmental Pollution Theme in the Higher Education

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Abstract. Environmental pollution is a crucial topic for higher education to improve students’ environmental awareness. To ensure learning quality, the appropriate instructional design is the essential component. This study aimed to develop instructional design on the environmental pollution theme for undergraduate students. Instructional learning based on Dick and Carey model was applied in order to enhance students’ understanding on environmental pollution. The sample used in the research is students in physics education department who enrolled the Earth Science class. Research and Development with 4D model was applied to develop instructional learning. Development of learning material consists of lesson plans, subject matter, student worksheets and achievement tests that are validated by the validators. The validation results of the Dick & Carey instructional learning model are categorized as valid and appropriate to use. The results of the study revealed: 1) the implementation of learning through Dick & Carey instructional learning has a very good category. 2) Student activities expressed active level. 3) The result of students’ conceptual understanding showed high complete percentage. The research showed Dick and Carey instructional learning is valid, practical and effectively applied in improving concept understanding on the environmental pollution theme.

Keyword: instructional learning, environmental pollution, students’ understanding.

1. Introduction

The environmental pollution is an environmental problem that has a disturbing impact on society. In general, this phenomenon is a problem that has not been resolved in almost all countries. This is related to the results of previous studies which revealed that the environmental pollution becomes hot issue over the world which needs attention to this phenomenon [1] [2]. The World Wild Life Fund (WWF) notes that one of the environmental problems that require immediate management is the environmental pollution [3]. Scientists attempt to educate the society to protect the world [4]. Since a long time, the theme of environment has become a topic in science learning. Increased human activity is one of the reasons that oppose protection, so this becomes interesting to do. Less information and education is a challenge in inviting people to care about this phenomenon. As a young generation, students are expected to have an environment awareness of protecting the earth from damage[4]. Therefore, design teaching materials related to the environment with appropriate strategies and approaches is a crucial. The instructional learning is expected to improve students’ understanding of the environment pollution and motivated them to save the world from pollution.

For the realization of individuals who have a good environmental attitude, various efforts have been made by the government to instill the character of caring for the environment in the community, especially the next generation of the nation from an early age[4]. One effort is carried out through the internalization of environmental material in subjects. Through a contextual learning design, students can feel the connection of teaching material to the surrounding life so that students feel first hand the
need to plant an environmentally caring attitude since they are in school. This condition is in line with
the research [5] which shows that 82% of students’ mastery of environmental concepts are good, but
69% of the students’ environmental care attitude is still lacking. That is, students who have high
environmental knowledge do not guarantee students have a good environmental concern.

Generally, the students have had the knowledge about the environmental pollution. However, the
students feel bored in learning process and they cannot understand well about the content. According
to the researcher observation, this condition affected by many aspects such as the curriculum which
was designed by teacher not appropriate toward this material, teaching style, teaching and learning
preparation are not good. In terms of that condition, the purpose of the study is to develop instructional
learning on the environmental pollution theme by using Dick and Carey model [5].

The instructional has been developed by Dick and Carey who view the instruction system as an
important part of learning success [6]. They consider this step has not been developed much by educators
so that obstacles in instructional implementation are often encountered in learning activities. Dick and
Carey revealed that the components of students, instructors, instructional activities, materials,
delivery strategies and learning environments are interconnected and interact with one another in
meeting learning outcomes. The systems approach model that has been developed is known as the Dick
and Carey Model. The following are the instructional development stages according to the Dick and
Carey model:

1. Identify instructional objectives to be achieved: the components listed in the objectives
describe the knowledge, attitudes and skills expected by students.
2. Conduct an instructional analysis that will be developed: the analysis is done through
identifying what students must remember and identifying what students must do to be able to
do certain tasks.
3. Analyze the condition of students and the context to be taught: Characteristics of students who
will be the object of students need to be generally identified. Identification includes the skills
and initial knowledge they already have, prior experience and basic demographics. The
researcher also identified the characteristics of the skills being taught and the learning process
activities that students will experience.
4. Describe the performance goals to be achieved: a description of the objectives to be achieved
includes a description of the behavior, conditions and criteria that students will develop.
Components of the objectives to be achieved describe the criteria that will be used to assess
student performance.
5. Develop assessment instruments and the purpose of the assessment: In addition to developing
assessment tools, designers also need to determine the goals of the pretest and post test, the
objectives of the training items and the problem solving exercises.
6. Develop an appropriate learning strategy: need to develop learning strategies and methods that
include pre-instructional activities, presentation of material, participation and assessment of
student activity.
7. Develop teaching materials that are appropriate to the characteristics of learning.
8. Design and conducting formative evaluations of instructional components. Designers identify
material content that needs to be refined.
9. Revise the instructional that has been developed: the designer identifies the test items that are
not appropriate and identifies the instructional components that are not appropriate.
10. Design and prepare summative evaluations.

Through this model, components are executed iteratively and in parallel rather than linearly [5].
Referring to Dick and Carey’s instructional system design it has two models of instructional diagrams, they are hierarchy and cluster chart. In this study, the researcher prefer to apply hierarchy chart because the lesson objectives or instructional objectives have connection with each other. To perform a task correctly, students have to have prerequisite skill that is the first a skill that students should understand before continue to another skill that indicated on the second level of hierarchy [7]. Specifically, in the first step students should be able to understand the first knowledge with a particular skill then continue to second level of knowledge and soon.

Generally, through this subject the students are able to understand the phenomena of environmental pollution that has become an urgent issue which has impacted on environment, health and social life [3]. After studying this topic, the students are expected to have a good knowledge about the environmental pollution phenomena that affected positive attitude toward protecting the earth.

2. Methods

This type of research is development research that emphasizes development learning devices based on Dick and Carey models to improve students’ understanding of environmental pollution material. Dick & Carey based learning tools are implemented in 36 physics education students who are taking Earth Sciences courses. Instructional learning based on Dick and Carey models was developed on the environmental pollution theme.

The procedure for developing learning devices in this study uses a development model from [8] which consists of four stages, namely 4D model (Four-D Model) including define (defining stage), design (design stage), develop (stage of development), and disseminate (stage of spread). In developing this device researchers only use three stages of 3D, namely define, design, and develop, while the disseminate stage is not done because of limited time, cost, and energy.

The trial was carried out using the research design of One Group Pretest-Posttest Design [9]. The data collection techniques in this study were carried out by examining data, observations, giving tests, and questionnaires. The research instruments used were learning device validation sheets, learning device implementation observation sheets and concept understanding assessment sheets. The data that has been obtained is then analyzed by descriptive qualitative and quantitative descriptive.

3. Result and Discussion

3.1 Results of Learning Tool Development

Learning tools developed in this study include lesson plans, subject materials, students’ worksheets and conceptual understanding tests. Learning material was explained into 10 learning objectives. The lesson plan was taught by learning methods which are discussion, collaborative learning and presentation. The development of a Dick and Carey based learning device model focuses on the relevance of concepts that are appropriate to the context and learning content. Lesson planning is based on mapping content and contexts that want to be integrated. Activities in the lesson plan are designed by paying attention to the components of teaching material, the condition of the instructor and students, the delivery system and interaction in the learning environment to support the
achievement of learning objectives [10]. This is the basic characteristic of Dick and Carey instructional model.

Learning materials developed in this study have different specifications than the general one. Learning material developed based on the characteristic of Dick and Carey instructional models. Characteristic material developed in this study describes the suitability of the material with evaluation indicators [10]. The material is described using the hierarchy model that shows the interrelationship of matter with each other. The integration seen in the material makes it easier for students to connect concepts with one another [11].

In this study three students' worksheets were developed. The discussion steps are equipped with supporting images so that the students can carry out the experiment directly. Student worksheets are used by students as a guide in conducting discussions to answer and solve problems. Discussion of observations contains findings based on the results of observations and directs students to make conclusions. This discussion activity is believed to be able to increase the understanding of students' concepts, by discussing they dare to ask questions, provide solutions, convey their thoughts, and respond to their friends. This is similar to what has been written by [12] in his research that the discussion method is able to provide an increase in understanding of students' concepts. The learning outcomes test developed consisted of 10 multiple choice questions developed from 10 learning objectives about conceptual understanding. Tests for understanding concepts that have been prepared are based on learning objectives, so that they can be used to measure the achievement of learning objectives through understanding concepts.

3.2 Results of Learning Device Validation
Validation is carried out by two experts who are competent in the field of Physics education so that the device learning developed and appropriate for research. Assessment aspects on the validation sheet are stated to be good if they get an average score of 3-4. The scores obtained in each aspect show the validity of the devices developed. The average score of all aspects of assessment on the Dick and Carey model lesson plan is 3.71 which means that the developed lesson plan has very good criteria for use without revision. While the average score of all aspects of learning materials assessment is 3.69, meaning that the learning materials developed are very feasible and can be used. Achieving quality learning material with a very feasible category developed according to the steps of developing material learning based on the Dick and Carey model.

Students' worksheet ratings are 3.62, which means they have very good criteria and can be used without revision. Overall content and linguistic aspects, concept understanding test questions have a mean score of 3.75. According to the criteria, the understanding test of the concept developed has a very good category and can be used without revision.

| No | Component of Learning | Instructional Validity Score | Categories   |
|----|------------------------|-----------------------------|--------------|
| 1  | Lesson Plan            | 3.71                        | Very Valid   |
| 2  | Learning Materials     | 3.69                        | Very Valid   |
| 3  | Students' Worksheet   | 3.62                        | Very Valid   |
| 4  | Test of Conceptual Understanding | 3.75 | Very Valid   |

3.3. Implementation of Lesson Plan
The average percentage of lesson plan implementation in the first meeting was 92.31%, with the implementation category very good. At the second meeting the average percentage of lesson plan implementation was 96.15%, with the implementation category very good. While at the third meeting the average lesson plan implementation was 100%, with the implementation category very good. Overall the average lesson plan implementation of the first, second, and third meetings was 96.15% with a very good category. All aspects of the lesson plan observation were carried out well, except the time management aspects in the first and second meetings.
3.4 Student Activities During Learning

The percentage of student activities in learning are: 15.13% paying attention to teacher explanations, 7.20% asking teachers, 7.17% answering teacher questions, 7.93% reading, 28.27% working on Student Discussion Sheets, 10.98% presenting the results of the discussion, 16.78% expressed ideas or opinions, 4.70% noted, 1.84% of irrelevant behavior.

The most dominant student activity is working on the Student Discussion Sheet with an average percentage of 28.27% of the total learning time. Discussion activities have a fairly high percentage. Group activities such as discussion and working on Student Discussion Sheets can support students in developing students’ concepts and understanding. [13] states that science learning that uses constructive and inquiry-based approaches can facilitate students to actively build conceptual knowledge. [13] further said that teachers who design their classes with instructional learning in accordance with the conditions and needs so that students can actively participate in discussions, express opinions, speak up, the teacher has encouraged their students to improve their thinking skills.

Overall the development of Dick and Carey instructional learning produces learning devices that are tailored to the conditions of students, teaching materials, learning environments and learning objectives [14]. These characteristics are the hallmarks of Dick and Carey instructional learning, making it easier for students to master the understanding of the environment pollution concept.

Based on the explanation above, it can be seen that student activities during the learning process describe good activities. This is caused by the implementation of good learning so that it increases student activity during the learning process. This statement is supported by the conclusions of [15] that student learning activities experience a significant increase through the application of instructional learning that is in accordance with the objectives of learning to be able to maximize students' understanding. In line with [16] that conclude the appropriate instructional learning able to enhance students’ conceptual understanding and creative thinking skill

3.5 Understanding of Concepts

Learning objectives are said to be complete if 75% of the overall learning objectives are complete. The completeness of the learning objectives for understanding concepts can be seen in the figure 1.

According to the chart, understanding the concepts of students has increased before being taught with instructional learning based on Dick and Carey models and after being applied to the instructional model. Questions about the material of the environmental pollution consist of 10 items that explore students' understanding of being able to be answered by students correctly, so that all questions are declared complete. So that it can be concluded that all indicators of understanding the concept in the posttest have been mastered by students well. Based on the explanation of the results of the above research, the development of instructional learning based on Dick and Carey models was able to improve students' understanding on the environmental pollution theme.

Figure 1. Concept Understanding Completion Diagram

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4. Conclusion

The conclusions that can be drawn from the findings in this study are that instructional learning based on Dick and Carey models has proven valid to improve understanding of concepts on the environmental pollution theme. Lesson plan based on Dick and Carey models are well implemented in the learning process. Student activities during the learning process using learning tools based on the Dick and Carey model show process activities that lead to an increase in students' conceptual
understanding. Understanding students' concepts after learning with instructional learning based on Dick and Carey models shows improvement. The researcher gave recommendations for further research to conduct further research related to the influence of the application of Dick and Carey instructional learning on the development of environmental caring attitudes through various other learning approaches.

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