Development of Environmental Knowledge Textbooks Using the Dick and Carey Model to Improve Pro Environmental Behavior for Industrial Engineering Students

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Abstract

At this time, industrial processes must support sustainable development that guarantees the market needs of the population. By managing natural resources a Industrial activities can continuously damage the environment which has an impact on health, ecological and other problems. Considering the importance of environmental effects on industrial processes, it is hoped that engineers and people who work in industry have an appreciation and understanding of the environmental impacts of industrial processes without sacrificing the sustainability of future society. Where industrial processes are considered sustainable when they are innovative and maintain safety and waste processing. Education is a means of Sustainable Development Goals to achieve the country's target goals of changing society.This of course affects the quality and effectiveness of lectures. There are no teaching materials that are in accordance with the Industrial Environmental Knowledge course curriculum . This research uses the Dick & Carey model development procedure, namely a learning model developed through learning which includes the analysis, preparation and product development and evaluation stages and following the learning process using the Problem Base Learning method .This research has been applied to industrial engineering students class 2020/2021 and 2021/2022 .The research results ,81% are not interested in studying Industrial Environmental Knowledge and 15.2% of students are bored, 3% of students fail to complete their assignments. 48.5 % of students did not understand what the lecturer explained, 48.5% of students understand the course , 3% of students feel that lecturers teach not according to the curriculum . N experiments = 33 and N controls = 34 . Confidence level 95% and α=5%. Reliability testing with Cronbach's Alpha = 0.863, which means the instrument is accurate and reliable. This Pro Environmental Behavior teaching material is very important to teach to Industrial Engineering students and even to all Engineering students. It will be more effective if taught using Problem Base Learning.

Keywords: Teaching materials, models, Industrial Engineering

Introduction

In the future, the world will face many environmental or natural resource challenges, including global climate change, and also oil depletion to accommodate consumption from industrialized countries (Palinkas & Wong, 2020). Industrial activities can continuously damage the environment over time which has an impact on the environment leading to various health, ecological and other problems. Considering the importance of environmental effects on industrial processes, it is hoped that engineers and people who work in industry have an appreciation and understanding of the

environmental impacts of the industrial process (Singh & Kumar, 2017)

Pluralistic, liberal or emancipatory approaches to education signify that science from real-world dilemmas related to environmental degradation must use education as a tool to acquire knowledge and skills that nurture future generations to overcome environmental problems. (Kopnina, 2019)

Environmental Education is an effort to change behavior and attitudes and increase awareness about environmental values and environmental issues for the preservation and safety of the environment now and in the future (Liesnoor et al., 2014)

Pro-environment is an attitude that shows that a person really cares about harmony with nature. According to Kaiser there are six aspects of pro-environment behavior. The following six aspects are Energy conversion, Mobility and transportation. avoiding waste, recycling, consumerism and conservation (Pronityastut, 2017)

Industrial Ecology states that industry must focus on product design and manufacturing processes. Companies must be agents for environmental improvement because they have technology that is very important for the successful implementation of environmental information for successful product and process design. Industry is the part of society that produces the most goods and services and is a source of environmental damage (Ayres et al., 2015).

Industrial policy has a central role in the transformation structure towards the future to stimulate green manufacturing and low-carbon innovation(Anzolin & Lebdioui, 2021). Green manufacturing is to save the environment and to reduce product costs(Paul et al., 2014).

Students as part of the younger generation have a responsibility as educators, planners and policymakers on environmental issues in a sustainable future so there is a need to increase pro-environmental behavior which focuses on environmental attitudes and self-confidence in environmental protection (Annisa Rika May, 2022).

There are no teaching materials that are in accordance with the Industrial Environmental Knowledge course curriculum. This of course affects the quality and effectiveness of lectures.

Method

This research uses the Dick & Carey model development procedure, namely a learning model developed through learning which includes the analysis, preparation and product development and evaluation stages. And it is a mix method research. Carried out using three methods, namely survey, evaluation and experiment. The survey was carried out by collecting data which was then analyzed and used to prepare teaching materials based on Problem Based Learning for Industrial Engineering Students to improve Pro Environmental Behavior. The evaluation was carried out to determine the suitability of Problem Based Learning-based teaching materials for Industrial Engineering students to improve Pro Environmental Behavior.
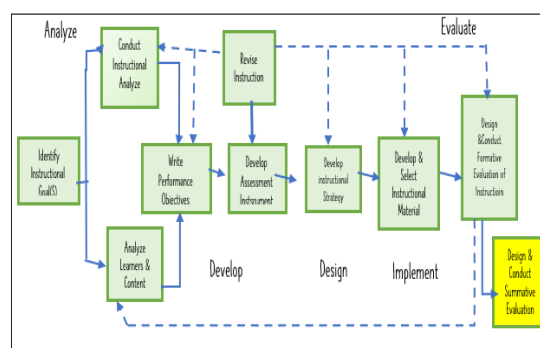
source (Dick, 2013)

Figure 1. Dick & Carey System Model

Problem Base Learning is a learning approach that starts by posing a problem and continues by solving the problem. To solve problems, students need new knowledge to find solutions. These problems can improve students' high-level thinking abilities which include analytical thinking abilities (Assegaff & Sontani, 2016).

The steps for Problem Base Learning as stated by John Dewey, an education expert, he explained six steps (Syamsidah & Hamidah, 2018), namely formulating the problem, the teacher guides students to determine the problem that will be solved in the learning process; analyzing problems, students review problems critically from various points of view; formulate hypotheses, students formulate various possible solutions according to the knowledge they have; collect data, students search for and describe various

information needed to solve problems; hypothesis testing, students formulate and draw conclusions according to acceptance and rejection of the proposed hypothesis; formulate recommendations for solving problems. students describe recommendations that can be carried out according to the formulation of the results of hypothesis testing and the formulation of conclusions

Result and Discussion

The research results ,81% are not interested in studying Industrial Environmental Knowledge and 15.2% of students are bored, 3% of students fail to complete their assignments. 48.5 % of students did not understand what the lecturer explained, 48.5% of students understand the course , 3% of students feel that lecturers teach not according to the curriculum . N experiments = 33 and N controls = 34 . Confidence level 95% and α=5%. Reliability testing with Cronbach's Alpha = 0.863, which means the instrument is accurate and reliable. This Pro Environmental Behavior teaching material is very important to teach to Industrial Engineering students and even to all Engineering students. It will be more effective if taught using Problem Base Learning

Conclusion

Development of Environmental Knowledge Teaching Materials based on Problem Based Learning with Pro Environmental Behavior material for Industrial Engineering students using the Dick and Carey development model are proven to significantly increase Environmental Knowledge in accordance with the semester learning plan for the Industrial Engineering curriculum

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