

# Need Analysis for Integrated Physics E-Module on Renewable Energy Based on the Creative Problem Solving Model

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## ABSTRACT

Learning using digital teaching materials is an alternative to the independent curriculum. Developing creativity is the main focus of learning. Learning that introduces students to global phenomena is highly recommended, one of which is the energy crisis. This research is the initial part of development research, using EDR (Educational Design Research) development model. This research aims to determine the need for digital teaching materials that can develop student creativity. Through student analysis, document analysis, and teacher interviews, it can be formulated that digital teaching materials need to be developed in the form of e-modules based on the Creative Problem Solving (CPS) model integrated with renewable energy.

**Keywords:** need; analysis; e-module; CPS; renewable; energy;

## 1. Introduction

The government launched an independent curriculum to improve the quality of Indonesian education after the pandemic (Jufriadi et al., 2022). An independent curriculum allows schools to develop a curriculum by considering students, school conditions, and the surrounding environment (Lince, 2022). The independent curriculum emphasizes school flexibility to produce the best curriculum to be implemented (Sumarsih et al., 2022). Apart from that, the independent curriculum also emphasizes the development of student character, known as the Pancasila student profile (Ardianti & Amalia, 2022). The Pancasila student profile comprises six main components that mutually reinforce each other (Irawati et al., 2022). The Pancasila Student Profile illustrates that students also apply Pancasila values, and it is believed that this impact will contribute to social welfare in the future (Irawati et al., 2022). One of the Pancasila Student Profiles is creativity, and it is hoped that students will become individuals who can come up with new ideas and questions and try many choices (Ardianti & Amalia, 2022). Thus, the curriculum provides flexibility for schools to develop the curriculum according to the needs of educational units and focuses on developing students' Pancasila student profiles.

As facilitators, teachers are expected to be able to facilitate students in developing their creativity (Widya et al., 2020). Teachers can apply learning models that enable the development of student creativity. One of these learning models is the Creative Problem Solving (CPS) model. CPS is related to how students solve problems (Hariawan et al., 2014). CPS can develop divergent thinking, seeking multiple alternative solutions to solving problems (Nurfarida et al., 2021). CPS steps: 1) explore goals, 2) collect data, 3) formulate challenges, 4) explore ideas, 5) formulate solutions, and 6) implement (Creative Education Foundation, 2015). Thus, the CPS model is a model that allows problems to be solved through several alternative solutions. Creative students are students who can find various alternative solutions to a problem.

Apart from that, the independent curriculum also emphasizes that students have a spirit of global diversity, which is one of the profiles of Pancasila students (Irawati et al., 2022). One of the global problems that threatens the continuity of life in the future is the energy crisis (Siswono, 2016). The energy crisis not only threatens survival in Western countries but also threatens survival globally. This case is caused by an imbalance between energy needs and reserves (Chamdareno et al., 2019). This case becomes increasingly complicated as the number of people increases and technological developments occur in the future. Future energy needs are projected in Energy needs until 2050 will continue to increase. The increase in energy demand is not balanced with energy production, causing vulnerability to national and global energy security

vulnerable (Chamdareno et al., 2019). Therefore, educating the community (including students) is necessary to save energy use as a national defense (H. Khotimah et al., 2020). One form of education's role is to integrate renewable energy into learning to introduce it to students (Desnita, 2015). Based on the research results of Rohim, Ahmad Minanur et al., information was obtained that students' energy-saving awareness in Indonesia still needs improvement (Rohim et al., 2022). Through the introduction of renewable energy by integrating it into learning, it is hoped that students can develop energy-saving characters in students.

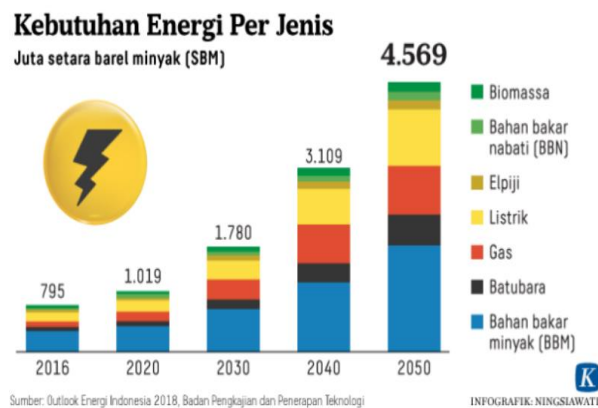


Figure 1: Projection of Future Energy Needs (Fahmi et al., 2022)

In learning in the Merdeka curriculum, teachers need to develop teaching materials that make it easier for teachers to carry out learning and easy for students to understand. E-modules are one of the teaching materials required by the demands of the Merdeka curriculum (Komang Ayu Miana Aprilia Dewi & Wayan Suniasih, 2023). The advantages of e-modules include being interactive and containing images, videos, audios, animations, and other multimedia. Online learning requires teachers to be able to provide digital teaching materials, and e-modules are one of them (Asrial et al., 2020). The use of e-modules allows students to study anywhere and anytime. Based on the problems above, the research team plans to conduct research related to developing an integrated renewable energy physics e-module based on the CPS model to instill energy-saving characters in students. Based on the problems above, the research team conducted research to develop an integrated renewable energy physics e-module based on the CPS model. However, before designing the e-module, it is necessary to analyze the need for an integrated renewable energy physics e-module based on the CPS model.

## 2. Methods

This research follows the EDR (Educational Design Research) development model, which includes the following stages:

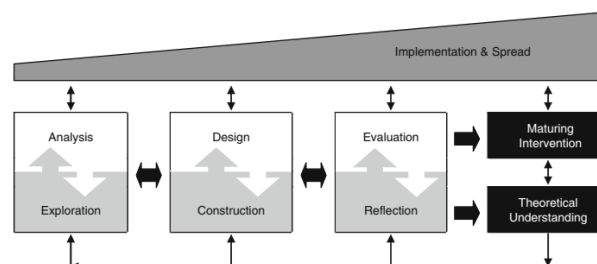


Figure 2: General Model for Conducting Educational Design Research (McKenney & Reeves, 2021)

This article will explain the sections related to Analysis and Exploration. This section aims to analyze the need for developing educational products. Needs analysis is carried out to define basic problems through analysis of literature studies and field studies. Some of the literature analyzed includes legislation regarding the independent curriculum, 21st-century skills, national and global issues (energy crisis), and several other references related to the availability of digital teaching materials in schools today. Meanwhile, field studies were carried out through teacher interviews and student questionnaires. The interviews will explore the obstacles that teachers encounter during teaching and the difficulties that students face in

learning. Data from literature analysis and field studies will be the basis for deciding the need to develop an integrated renewable energy physics e-module based on the CPS model.

### 3. Result and Discussion

Researchers distributed questionnaires to students. This questionnaire aims to examine their learning styles, interests, and initial knowledge regarding renewable energy. Forty-three students responded to this questionnaire. Below are the results of the questionnaire:

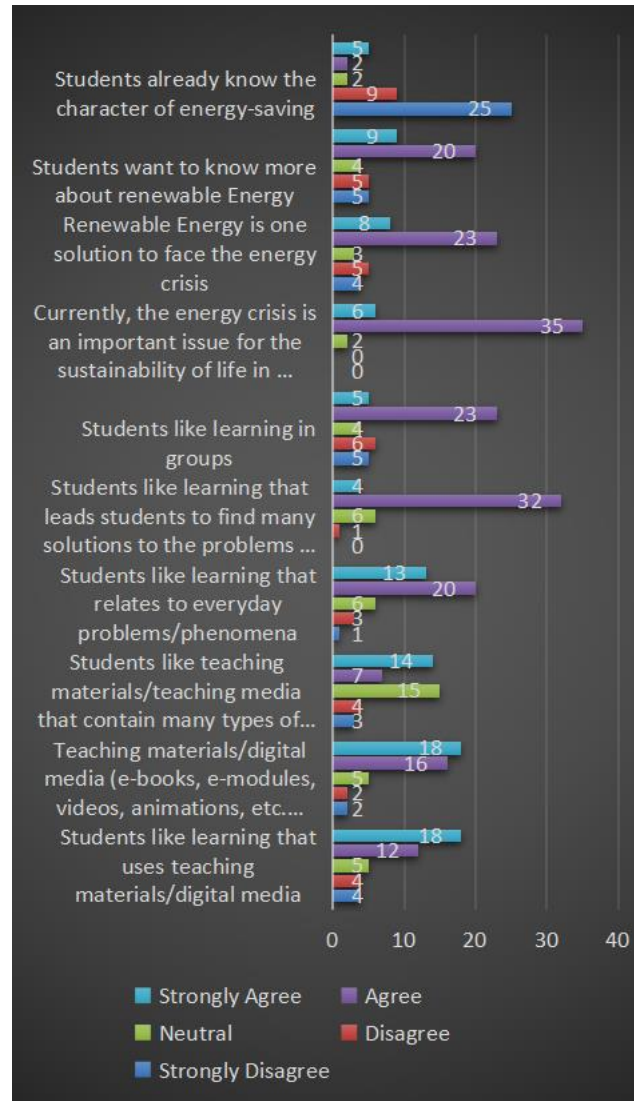


Figure 3: Results of the Analysis of Student Characteristics

Figure 3 illustrates several things: 1) 18 students strongly agree to using digital teaching materials in the learning process, 2) 18 students state that digital teaching materials can be accessed anytime and anywhere, 3) 14 students state that students like digital teaching materials because they can contain various kinds of media such as video, animation, images, and audio) in one teaching material, 4) 23 students like learning that is linked to everyday problems/phenomena, 5) 36 students like learning that leads students to find many solutions to the problems given, 6) 28 students liked learning in groups, 7) 41 students stated that the energy crisis was an important issue in the sustainability of life in the future, 8) 43 students agreed that renewable energy was one solution to facing the energy crisis, 9) 25 students stated that they want to know more about renewable energy, 10) only 7 students know what the characteristics of energy saving are. Based on this data, the majority of students like learning that uses digital teaching materials as one of the teaching materials.

Apart from that, students also like learning in groups and related to problems or phenomena in everyday life.

In addition to distributing questionnaires to students, we also collected information through interviews with three physics teachers. The results of the information are that students' learning motivation is still low, and teachers have difficulty preparing teaching materials or media that students can access anywhere and anytime. Apart from that, the teachers also said that digital teaching materials are one of the teaching materials that are suitable to be developed in the independent curriculum because they allow students to access them at any time so that independence in learning can be realized well. In the learning process, most students like group learning by presenting problems related to students' daily lives. Students do not yet understand the issue of the energy crisis because there has been no specific outreach to them. Additionally, the teacher stated that integrating renewable energy into teaching materials can enhance students' understanding of energy sustainability and promote more efficient energy use in daily life.

Subsequently, an analysis of documents related documents was conducted. We reviewed several documents, including Permedikbudristek Number 16 concerning Process Standards for Early Childhood Education, Basic Education Levels, and Secondary Education Levels and Decree of the Head of the Educational Standards, Curriculum and Assessment Agency of the Ministry of Education, Culture, Research and Technology Number 008/H/ Kr/2022 Concerning Learning Achievements in Early Childhood Education, Basic Education Levels, and Secondary Education Levels in the Independent Curriculum. These documents provide information on the learning outcomes that students must achieve at each phase of their education. Specifically for high school physics learning, information is obtained regarding learning outcomes: At the end of phase F, students are able to apply vector concepts and principles to kinematics and dynamics of motion, work and energy, fluids, harmonic vibrations, sound waves, and light waves in solving problems, as well as applying the principles of heat and thermodynamics, with various changes in machines heat. Students are able to apply the concepts and principles of electricity (both static and dynamic) and magnetism in various problem-solving and various technological products, and apply the concepts and principles of electromagnetic wave phenomena in solving problems. Students are able to analyze the relationship between various physical quantities in the special theory of relativity, quantum phenomena, and demonstrate the application of core physics concepts and radioactivity in everyday life and technology. Most of the competencies expected from physics learning are high-order thinking abilities.

Then, we also analyzed several documents related to the energy crisis that has hit the world. The information obtained includes:

- Energy sources in Indonesia are dominated by fossil fuels, which are greatly influenced by external supply and price changes (Rohim et al., 2022)
- Renewable energy production continues to decline every year (Malahayati & Masui, 2021)
- The conflict between Ukraine and Russia has increased the possibility of a global energy crisis (Huka & Kelen, 2022)

Based on this data, it was found that there is a threat of a very large energy crisis in Indonesia, so there needs to be a real effort to overcome it.

Based on the data found above, several solutions need to be taken, including:

- It is necessary to develop teaching materials in digital form, one of which is an e-module. This is because students prefer learning in digital form. Digital teaching materials have several advantages, including that they can be accessed anywhere, are easy to carry, allow students to learn independently, have a more attractive appearance, and are more interactive (Siahaan, 2021). Apart from that, the development of digital teaching materials is also in order to strengthen the implementation of the Merdeka curriculum, where the application of technology in learning is a necessity.
- Teaching materials are developed based on learning models that can increase student creativity. One of these learning models is Creative Problem Solving (CPS). The CPS model can increase student creativity because it facilitates students to find several solutions to solving problems, and students are also involved in choosing the best solution to solve the problem (Harahap et al., 2020) Apart from that, the development of the CPS learning model is considered to be in accordance with the characteristics of students who like problem-based learning that is close to students' daily lives. The CPS model begins with a problem and guides students to find a solution to the problem. Then, the CPS model is also in accordance with the expected competency demands, namely HOTS.

- The integration of renewable energy in learning is expected to introduce students to the types of renewable energy, remind them about the energy crisis, and foster energy-saving characteristics in students (K. Khotimah, 2017).

#### 4. Conclusions

Based on the results of the analysis above, it is concluded that it is necessary to develop digital teaching materials in the form of e-modules, which are developed based on the CPS model integrated with renewable energy.

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