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# The urgency of the multi-model approach in learning environmental physics to achieve learning goals

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## Abstract

Some learning models that can improve creative thinking skills are CPS (Creative Problem Solving), IBL (Inquiry-Based Learning), JUCAMA (Problem Submission and Solving), PBL (Problem Based Learning), SSCS (Search, Solve, Create, Share), Quantum Learning, PjBL (Project Based Learning) and PQ4R (Preview, Question, Read, Reflect, Recite, Review). However, the combination of IBL, PBL, and PjBL models in one teaching activity is essential to create exciting and dynamic learning conditions. These three models have a more structured learning syntax than the other models. The IBL learning model has advantages in cognitive aspects, helping students develop advanced cognitive abilities such as creative thinking, problem-solving, and communication skills. The PBL model has advantages in the affective part, namely, making students active in learning. The PBL learning model has advantages in the psychomotor aspect, namely being able to assist students in improving the skills of the questioning process and communicating their knowledge. By applying these three models in learning, it is hoped that a model can be realized to improve students' creative thinking skills more optimally in order to achieve learning goals.

**Keyword:** Inquiry-Based; Problem-Based; Project-Based; Multimodel; Learning model

## 1. Introduction

Learning is a process that is intentionally designed to create learning activities within the individual. In other words, learning is an external thing that is intentionally designed to create an internal learning process within the individual; defines the term learning as a set of events embedded in purposeful activities that facilitate learning, namely learning is a series of activities that are deliberately created to facilitate the learning process (1). Learning models are defined as plans or patterns that can shape curricula (2), design instructional materials (3) and guide the teaching process in different classrooms or settings (4). The learning model is also defined as a conceptual framework that describes and describes systematic procedures in organizing learning and learning experiences to achieve particular learning objectives and serves as a guide for educators in planning teaching in learning activities (5).

The use of the suitable learning model is one of the efforts to achieve the objectives of learning physics. The learning objectives themselves include improving cognitive, affective, and psychomotor aspects. Each learning model is designed according to the element to be developed. A learning model focuses on only one part, and a learning model focuses on two aspects and all three features simultaneously. However, a good learning model should cover all three elements at once. Therefore, the learning model should focus on cognitive, affective, and psychomotor aspects (6).

The application of more than two models in the learning process combines several learning models of multi-learning models. Learning using several models in an integrated manner, which actively involves students in the learning process, is called a multidimensional learning model. This learning multimodel can be applied to Physics subjects (7).

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Physics is a branch of science (science), which is essentially a collection of knowledge, ways of investigating, and thinking. But in reality, the physics learning process is more likely to place physics as information that students must convey and memorize. Teachers tend to be the information center in charge of informing their students of the formulas and laws of physics. For this reason, learning science (Environmental Physics) which should be presented using a more varied learning model and a student-centered learning process, makes students active and creative learners. Applying these three learning models is intended to support the physics learning process to achieve learning goals.

## 2. Research Methodology

The methodology in this research is a field study through classroom observation, documentation, and interviews. Class observations were carried out to find information about the implementation of lectures. Documentation studies were conducted on the curriculum and learning tools, and interviews with students were instructed to obtain their interest in Environmental Physics.

## 3. Results and discussion

The results of observations of the implementation of Environmental Physics lectures in two classes indicate that Environmental Physics Lectures have not used a particular model with clear syntax. Lessons are held where students in groups (5-6 people) present group assignments through presentations in the form of power points. Group assignments have been determined at the beginning of the course by the lecturer. After the presentation, there was a question-and-answer session where the lecturer acted as a facilitator. During the question-and-answer session, it was seen that only a small number of students were active in the discussion (students sitting in the front). The video recordings showed that most students chatted and did not attend lectures. Some even did not follow from beginning to end. Based on the presentation with the PowerPoint media presented by the students, the design looks less attractive because it is only in the form of writing. One person only does presentation presentations with poor communication skills and minor mastery of the material. In the question-and-answer section, it can be seen that the students who are in charge of also presenting often answer. These things are likely the cause of many students who do not follow and are involved in lectures. At the end of the course, the lecturer provides reinforcement about the lecture material and the results of the questions and answers that have been carried out. In addition, the implementation of Environmental Physics lectures is still in the lecture hall, with lecturers tending to be a source of knowledge even though the course material includes physics concepts related to the environment, such as sound physics related to noise in the background, environmental pollution, and others. However, the learning is still around issues; only global ecological problems can be done by direct education in the environment (field study). The increase in students' ability occurs because the stages provide flexibility in building knowledge from their own experiences because of curiosity (8). Therefore, inquiry-based learning (IBL) refers to the steps developed (9), so that students are led to find data about the environmental phenomenon of climate change (PI). The results of unstructured interviews with five groups of students (5-6 people per group) about the reasons for their interest or disinterest in Environmental Physics lectures showed that most of the students were not interested in the lecture material (Table 1).

**Table 1** Student Interest in Environmental Physics Courses

| Group | Interest | Reasons |
|---|---|---|
| 1 | Not interested | There are no other elective courses |
| 2 | Interested | Want to know physics formulas related to the environment and want to know what physical theories can be applied to the environment |
| 3 | Not interested | Because the course material is related to other subjects, such as Biology, Chemistry, Social Society, Economics |
| 4 | Not interested | Just learn the theory, and the task is to make papers and presentations. Do you want an action to be useful for others? |
| 5 | Mostly not interested | Some are interested in the reason that the lecture material discusses environmental damage, which is a trend worldwide like global warming<br>Some are not interested because they are forced to contract because they have no other choice |

Table 1 presents the reasons for interest or disinterest in Environmental Physics courses. Group 1 stated that they were interested in Environmental Physics. Still, the reason was that there was no other choice of classes, so it was concluded that the students were not interested. Likewise, all group members gave the same answer in groups 2, 3, and 4. However, in group five, some said they were interested, and some were not, for different reasons. So, in group five, it was concluded that most of them were not interested in Environmental Physics lectures. If you pay attention, the reasons for interest are curiosity about physics concepts related to the environment. Still, most of them are not interested in compulsion causes or are not interested in environmental problems. The material is related to lecture material outside of Physics, and the lecture approach tends to be conceptual. This fact is supported by the results of lecture observations where most of the students are not involved in class discussions due to their lack of interest in the lecture material. Based on psychological theory, interest essentially gives pleasure, interest, self-awareness, solid drives and motives, and a person's active involvement in a particular field (10). The results showed that interest in learning affects learning achievement because it can remember learning in the long term (11) As a strong drive from within, interest is a form of intrinsic motivation that can be developed (12). In the context of learning, research results show that inspiration can increase due to the influence of approaches, methods, or learning models (13).

Based on the literature study and field studies, it was found that there was a discrepancy between the planned learning outcomes and the real ones. Likewise, learning activities are not by the objectives of the lecture. The description of ecological competence through interviews with lecturers of Environmental Physics courses and student interest in Environmental Physics shows weaknesses and deficiencies in Environmental Physics lectures that need to be improved. For this reason, it is necessary to design lessons with a specific syntax with directly relevant lecture materials on environmental issues that can improve student competence as a whole (cognitive, affective, and psychomotor/skills) (14).

The study results revealed that students were not actively involved in lectures, and Environmental Physics lectures were carried out using the method and approach of giving group assignments, discussions, and presentations. In order to obtain information about the competence of talks, interviews were conducted with the Environmental Physics course lecturers. Through this interview, it was revealed that the assessment carried out was only on cognitive competence.

The field study found a description of the problems of environmental phenomena, which are environmental issues globally and locally. Three ecological issues are interrelated with each other and of global concern, namely climate change (PI), deforestation (DeF), and the use of energy sources (PSE). The different characteristics of these three environmental issues require the design of lectures with a specific syntax to teach the environment through physics concepts. The lecture approach is in the form of assignment of lecture topics as group assignments communicated through presentations in front of the class (15). Material enrichment was obtained through group question and answer presentations with other groups. Lecturers become facilitators in completing questions and answers and giving conclusions on the display material (16). In this condition, the observations show that there are students who are not involved in in-class discussions and do not even pay attention at all. For this reason, it is necessary to design lectures with learning tools and instruments that can stimulate student interest in environmental physics lessons.

### 3.1. The Importance of Application of Environmental Physics Learning Multimodel

The combination of three learning models in Environmental Physics learning refers to the syntax (17) (Table 2) of these three models, which significantly support students' creativity and critical thinking patterns in understanding and solving problems related to environmental physics.

**Table 2** Syntax of Inquiry-Based Learning (IBL)

| Stage | Syntax |
|---|---|
| 1 | Orientation (Teacher gives problems) |
| 2 | Formulate the problem |
| 3 | Formulating Hypotheses |
| 4 | Collecting data |
| 5 | Testing Hypotheses |
| 6 | Draw a conclusion |

Scientific inquiry learning consists of various approaches that are widely used in science material, including investigations with systematic levels: discovery learning (Discovery Learning) (18), at this stage, students build concepts and knowledge from experience (2) interactive demonstration (Interactive Demonstration) (19), one way that is done at this stage is by giving questions that present student responses so that they can think critically (3) inquiry learning (Inquiry Lesson) (20), at this stage science experiments are presented which are more complex than demonstrations (4) Inquiry Lab (21), at this stage students are guided to conduct discussions, (5) the application of the natural world (Real-world Application) (22), at this stage students are expected to be able to provide alternative problems in the context of real life, and (6) hypothetical inquiry (Hypothetical Inquiry) (23). This stage is intended so that students can use hypotheses to explain phenomena. Inquiry involves observing, asking questions, examining relevant sources, planning research, re-examining what is known according to evidence, using tools to collect, analyze, and interpret data, propose answers, explanations, and predictions, and communicate results.

Problem Based Learning (PBL) is learning that confronts students with real-world problems to start learning. Issues are given to students before students understand the concept or material relating to the problem to be solved, thus to solve the problem. Students will know that they need new knowledge that must be learned to solve the given situation. Problem-based learning is an activity of interaction between stimulus and response, which is the relationship between two directions of learning and the environment (24). The environment provides input to students in the form of assistance and problems. The brain's nervous system interprets the gift effectively so that what is faced can be investigated, assessed, analyzed, and searched for a good solution (25). PBL is a learning approach that presents contextual problems to stimulate students to learn. PBL is a learning model that challenges students to learn, working in groups to find solutions to real-world problems, as illustrated in the PLB syntax in (Table 3) (26). This problem binds students to curiosity about the learning in question (27).

**Table 3** Syntax of Problem Based Learning (PBL)

| Stage | Syntax |
|---|---|
| 1 | Student orientation to problems |
| 2 | Organizing students to learn |
| 3 | Guiding individual and group investigations |
| 4 | Develop and present the work |
| 5 | Analyze and evaluate the situation solving process |

Project-Based Learning (PjBL) is a learning method that uses projects/activities as a medium (28). This method requires students to do exploration, assessment, interpretation, synthesis, and information to produce various forms of learning outcomes. Project-based learning or project-based learning is a student-centered learning model to carry out an in-depth investigation of a topic. Students will constructively deepen learning with a research-based approach to serious, accurate, and relevant problems and questions by the PjBL syntax itself, as shown in (Table 4) (29). Objectives of Project-Based Learning Each learning model must have a purpose in its application. The goals of project-based learning, among others, are to improve student's ability in solving project problems, acquire new knowledge and skills in learning, make students more active in solving complex project problems with accurate product results, develop and improve students' skills in managing materials. or tools to complete tasks or projects, and enhance student collaboration, especially in group PjBL (30).

**Table 4** Synthax of Project-Based Learning (PjBL)

| Stage | Syntax |
|---|---|
| 1 | Define basic questions |
| 2 | Making project designs |
| 3 | Scheduling |
| 4 | Monitor project progress |
| 5 | Result assessment |
| 6 | Experience evaluation |

The multimodel learning model is intended as a pattern of student-teacher interaction involving approaches, strategies, methods, and learning techniques applied in implementing teaching and learning activities in the classroom (15). Learning is intentionally designed to create learning activities in students (31). While the learning model used is a plan or pattern that can shape the curriculum, develop instructional materials, and guide the teaching process in different classrooms or settings (32). This learning model is intended to be a conceptual framework that describes and describes a systematic procedure in organizing learning and learning experiences to achieve specific learning objectives and serves as a guide for educators in planning teaching in learning activities (33). The use of a Multimodel is one of the efforts to achieve environmental physics learning objectives. The learning objectives themselves include improving cognitive, affective, and psychomotor aspects. The Multimodel is designed according to the integrated aspects to be developed, namely cognitive, affective, and psychomotor aspects, by paying attention to the syntax of each integrated learning model, namely IBL, PBL, and PjBL (34).

Multimodel learning can be applied to Environmental Physics subjects. Environmental Physics is an elective subject in the physics education study program, which is essentially a collection of knowledge, methods of investigation, and ways of thinking. But in reality, the learning process tends to place this course as information that students must convey and memorize. The teacher tends to become an information center tasked with informing students of physics formulas and laws. For this reason, environmental physics learning must be presented using a more varied learning model and a student-centered learning process to make students active and creative learners. That is why it is necessary to apply three learning models to support the physics learning process to improve students' creative thinking skills to be more optimal.

## 4. Conclusion

The basic principles of IBL (Inquiry-Based Learning) learning help students formulate questions, find solutions or problem solving to satisfy their curiosity and help students find theories and ideas about the world. With this stage, the teacher can influence students' abilities and more conducive learning because of its role as a motivator who creates interaction with students.

The application of PBL to environmental problems also plays a role in developing ecological problem-solving skills. In addition to students understanding physical science content in environmental physics, students are expected to find solutions to issues regarding the environment they are facing. Solving this problem can be different for each student so that several alternatives problem-solving can be seen that can be followed up to improve the environment. This is by the characteristics of PBL itself, which can create real solutions to problems encountered by students in authentic contexts. While the PjBL is closely related to inquiry activities in exploring learning content. Problems in PjBL are presented at the beginning of learning in driving questions. The inquiry process occurs, and the facilitator (teacher) guides students to work collaboratively.

Integrating IBL, PBL, and PjBL in learning will increase student interest in environmental physics. Students learn interactively and collaboratively to solve problems and create real solutions and ideas for ecological physics problems.

## Compliance with ethical standards

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### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

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