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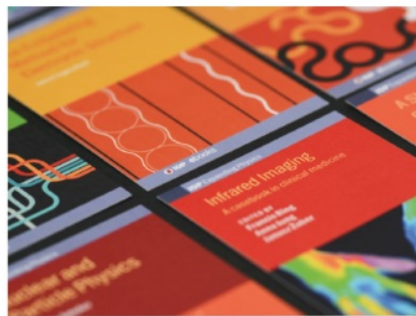
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## The application of Project Based Learning method in learning micro-hydro electrical power

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## The application of Project Based Learning method in learning micro-hydro electrical power

**I Prastyaningrum and H Pratama**  
Universitas PGRI Madiun, Indonesia

E-mail: ihtiyari.prastya@unipma.ac.id

**Abstract.** This research aims to determine the effect of a project-based learning model to improve the understanding of materials about electric machines. The majority of students who take electrical machine courses only understand the theory of electric machines but have not applied directly. In this research, students are directed to make learning media of micro-hydro power plant system. The research was conducted in Electrical Engineering Education Study Program of Universitas PGRI Madiun on the sixth-semester students who attended Electrical Machinery course. The sample consists of 17 students in the Electrical Engineering Department of the Education Universitas PGRI Madiun. The technique of collecting data using observation and test. The results showed that the implementation of project-based learning model with learning media of micro-hydro power plant can improve students' understanding of the given material. Through the learning process by utilizing micro hydro media students can understand the working principle of the electric machine directly and its relationship with the power plant system with the medium N-Gain score. These results suggest that micro-hydro power generation media can be an effective way to deliver fairly complex and abstract material to students.

### 1. Introduction

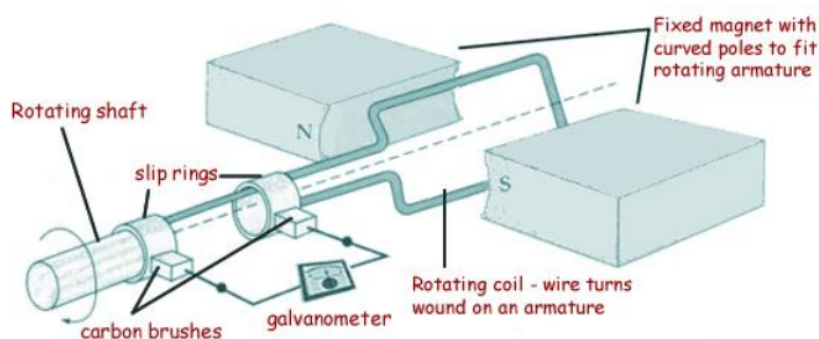
Changes in technological advancements, environment, and people's lives are increasingly rapidly demanding changes in ways and strategies in a learning process [1]. The learning process is a process that shows the continuous relationship between the responses that arise and the stimuli were given [2]. The learning process that takes place in the classroom should be able to make a learning meaningful. When learners (in this case students) are able to find a meaning when learning something, then it will motivate students to continue learning [3]. Student Motivation is related to Government Regulation No. 81A of 2013 [4], where the learning process is demanded not centered on lecturers, but should be centered on the students. In order to achieve student-centered learning conditions, project-based learning methods or better known as Project Based Learning can be applied in the learning process

Electrical Engineering Education Study Program students must understand and understand various powerful current electro devices. Both in terms of basic concepts and work system. During this time the learning model is mostly still writing and speaking [5]. It can be used later when the students graduate from college. Both who will work as teachers in vocational schools as well as other professions associated with strong current power [6]

Based on the observations made on Electrical Engineering Studies students of UNIPMA, there are some difficulties experienced by the students, one of them is about the relationship between a certain physical concept with the strong current electric device (in this case is dynamo). During this time

students are able to use the dynamo, but not yet understand the physical concept of the dynamo. Both from the system works as well as the basic theory of dynamo

The working principle of dynamo can be learned by using a project-based learning model. Project-based learning can be a model for learning in the depth investigations of worthy topics [7]. Project-based learning in this lesson is implemented through the project of making micro-hydro learning media. Through micro hydro learning, media students are expected to understand the basic concept and work system regarding dynamo. Similar previous research on how to identify the effectiveness of teaching KIT on the use of micro-hydro generators in remote areas. The aims of this is to improve the student's concept mastery [8]. In general, the concept of the working system of a dynamo in a generating system is to convert the mechanical energy into electrical energy [9]. The mechanical energy in the system is obtained from the rotation of the turbine that rotates the armature on the dynamo [10]. Notice Figure 1.



**Figure 1.** A simple design of generator/dynamo structure (an original Cyberphysics Graphic, 2017)

Based on Figure 1, a dynamo consists of two main parts, namely the magnet, and coil. The magnet is placed around the coil (Figure 1). An electric dynamo works on the principle of magnetic induction. An emf is induced in a coil as a result of a magnetic field, or a magnetic field cutting through a coil. As long as there is a relative motion between a conductor and a magnetic field, a voltage will be induced in the conductor [11].

If we want to count the magnetic flux, we can choose a simple flat surface with area  $A$  as our test area. And then we can set an angle  $\theta$  between the normal to the surface and a magnetic field vector (magnitude  $B$ ). By mathematically equation the magnetic flux is showed by equation 1,

$$\Phi = BA \cos \theta \quad (1)$$

The working principle of the dynamo is studied with a project-based learning model using learning media of micro-hydro power plant system. The flow of water will move the turbine on the micro hydro. The rotation of the turbine will also rotate the shaft that connects the turbine with the dynamo. From this rotation coil in the center of the magnet in the Dynamo will also rotate so that will cause magnetic flux. The total flux that can be produced depends on the number of magnetic poles present in the dynamo.

$$\Phi_{total} = \Phi \times P \quad (2)$$

The total flux generated by the magnetic field is a reference that can be used to determine the total induced emf in the dynamo [12].

Basic principles like this that can not be understood well by most students. Students have known only that the dynamo can produce an electric current in accordance with Faraday's legal principles. But

not yet understand how the relation of the concept of Faraday law with the dynamo working system to be able to produce output power. By using learning media of micro-hydro power plant, it is expected that the students will be able to understand it.

**2. The Research Method**

3 This research method using pretest and posttest method. The subjects in this study were students at the PGRI Madiun University who took a course in Electrical Machine (17 students). The data are collected through the first pretest with the conceptual type concerning the dynamo and power plant. Then the class after pretest, students are treated (treatment) using the model of learning project-based learning. Students are given a project of making learning media of micro-hydro power plant. From the media, students should also explain the concept of generators and dynamo and their relationship. At the end of the learning, the students are given a posttest about what they have learned. Posttest results are analyzed to determine the effect of a project-based learning model on student conceptual analysis capability

**3. Result and Discussion**

3 From from 17 respondents (students) we can obtain the main result. The first problem is understanding the concept of the electric dynamo and the second about the relationship between the electrical dynamo concept with the power plant system. The initial stages of research after pretest is the project planning. The class will be divided into two distinct groups, where each group member is responsible for one field as shown in Table 1.

**Table 1.** List of field divisions for micro-hydro projects

Scheme	Number of Students
Set micro-hydro turbine	2
Set micro hydro shaft	1
Set micro-hydro dynamo	2
Set acrylic	1
Set pump and inverter	2-3

The next step students do an analysis of the concept of making micro-hydro power plants either sourced from books, journals, and mass media. After understanding the system of making students make design tools that will be made after the design is determined to start the project work guided by lecturers course.

The initial process of making micro-hydro power generation media is done by an analytical approach. Where the analytical approach used is generally parametric [13]. Theoretically, the power that can be obtained from a micro-hydro power plant can be calculated by the equation,

$$P = 9,8 \cdot \rho \cdot Q \cdot H \tag{3}$$

Where  $\rho$  is the density of water (kg / m<sup>3</sup>),  $Q$  is the water discharge (m<sup>3</sup> / s) and  $H$  is the height of the fall of water. The power that is blessed theoretically will practically diminish after passing through turbines and generators so that the output power equation becomes,

$$P = 9,8 \cdot \rho \cdot Q \cdot H \cdot eff_r \cdot eff_g \tag{4}$$

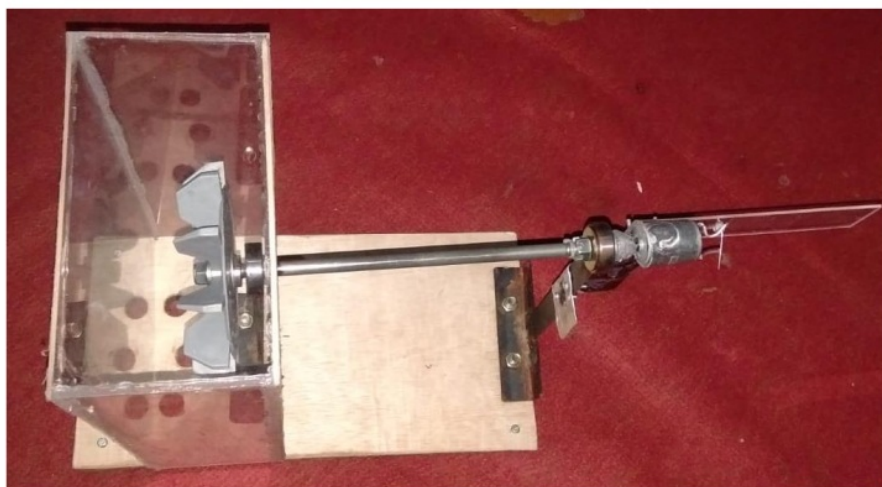
Where  $eff_r$  and  $eff_g$  are the efficiency values of turbines and generators which range in value from 0.8 to 0.95.

Based on the results of the initial analysis, the students began making micro-hydro power plants. Where after getting the theory about generators, students must also be able to apply generators in a

generator media. So that in the future students will understand starting from the basic concept to the application. Micro-hydro power plant media has made by students is shown in Figure 2.

Figure 2 is the results of the implementation of student project-based learning. Where students after learning about the concept of a generating system (in this case a system on a generator), students create a learning media for micro-hydro power plants. From the media made by students, students must be able to explain the physical concepts regarding the application of an electromagnetic field to the media, a mathematical concept which is the basic calculation of media making and the working principle of micro-hydro power generation media. With the existence of a complex learning process beginning with explanations in theory and practice, it is expected that students' understanding of the concepts of electromagnetic fields in electric devices with strong currents can increase. So that when plunging into a teacher at a vocational school students will be able to provide explanations not only how to use a tool, but more deeply about the basic concepts and working principles of the tool.

The expected results can be achieved by students after going through the stages of theoretical understanding of generators, making media, until the analysis of the working principle of generators in a power plant. regarding the concept of the relationship of the effect of fan width on the turbine to the turbine rotation speed. So that in the future students will be able to analyze until where the efficiency of a generator is reviewed in theory and practice.



**Figure 2.** Set of micro-hydro power generation media

Some of the constraints experienced by students during project work are the making of turbines. The size of the turbine fan and its diameter should be precision according to the calculation results, so as to be able to rotate the dino. Achieving the final stages of the learning model is the project conclusion. At this stage, students should be able to explain and link the concept of the project with the learning materials. The results are shown in Table 2.

The results shown in Table 2 indicate that the learning-based learning model is appropriate if it is used for materials on power generation. Students are able to understand the concept of electric dynamo working principle and analyze the working principle in relation to the power plant system. This is indicated by an increase in the percentage of students' understanding of the value of medium gain, which is equal to 0.5.

**Table 2.** Percentage of understanding concepts for electrical dynamo and micro-hydro power

Test	Aspect of Research	Result		
		Before	After	N-Gain
<b>1.</b>	<b>Magnetic field connection and dynamo output power</b>			
	The magnetic field penetrates the coil surface causing a magnetic flux. The change of magnetic flux due to coil rotation leads to induction emf. The existence of an induction emf will activate the electrical charge present in the conductor cable so that an electric current will emerge [11].	60.3 %	94.1 %	0.54
<b>2.</b>	<b>The rotation of the dynamo is affected by the turbine spin</b>			
	The type of turbine used for micro hydro has an effect on the rotation of the dynamo. Turbine fan width and turbine diameter will affect the rotational speed of the dynamo. So in addition to high water discharge also required a precision count for a turbine so as to rotate the dynamo [14].	37.3 %	75.3 %	0.56

#### 4. Conclusion

The conclusion obtained from this research is the learning process using the learning model of project-based learning with micro-hydro power generator media can be used to improve understanding of student concept. The first concept is about the working principle of the dynamo and the second about the relationship between turbine rotation and rotation of the dynamo and its ability to produce output power. The gain value is a medium category that is 0,5. It shows that there is still need to be improved again the learning process with the same model but different practice.

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