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UNDERSTANDING MICROCONTROLLERS AND ROBOTICS THROUGH THE APPLICATION OF INQUIRY METHODS IN BASIC ELECTRONICS COURSES

By
Cut Susan Octiva[1*], Maryadi[2], Dikky Suryadi[3], Nursalim[4], T. Irfan Fajri[5]
[1]Universitas Amir Hamzah, Indonesia
[2]Universitas Islam As-Syafi'iyah, Indonesia
[3]STMIK Al Muslim, Indonesia
[4]Universitas Muhammadiyah Palu, Indonesia
[5]Universitas Islam Kebangsaan Indonesia, Indonesia
Email: [1]cutsusan875@gmail.com, [2]maryadimesinuia@gmail.com, [3]dikky98@gmail.com, [4]nursalimariestarahman@gmail.com, [5]teukuirfanfajri.sister@gmail.com

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Abstract: *This analysis aims to explain the understanding of microcontrollers and robotics through the application of inquiry methods in basic electronics courses. The type of research used is classroom research. The sample of this study was 40 private campus students in Medan City who were taken randomly. This quantitative method uses inquiry methods learning model. The results of the study indicate that the application of the inquiry method can make students understand microcontrollers and robotics in basic electronics courses*

INTRODUCTION

Learning is a stage of change in all relatively permanent individual behavior as a result of experience and interaction with the environment that involves cognitive processes. A person who learns will experience changes in behavior. The change is not only at that time, but also lasts for a relatively long time. If the changes that occur are only momentary, then the person has not been said to have learned.

A learning model is a conceptual or procedural example of a program, system, or process that can be used as a reference or guideline in achieving goals or an example of a form of learning that is depicted from beginning to end which is presented in a distinctive way by the teacher in class (Hamalik, 2005). A teaching plan that describes the process taken in the teaching and learning process in order to achieve specific changes in student behavior as expected. A good learning model has the following generally recognized characteristics or traits (Pidarta, 2000):

1.Has a systematic procedure. A learning model is not just a combination of facts arranged haphazardly, but a systematic procedure for modifying student behavior based on certain assumptions.

2.Has specifically determined learning outcomes. Each learning model determines the specific objectives of the learning outcomes that students are expected to achieve in detail in the form of observable performance.

3.Determines the environment specifically. Determines the environmental conditions specifically in the teaching model.

Basic electronics courses a compulsory courses for all undergraduate students in the

Electrical Engineering Study Program. This course will discuss how to assemble electronic components efficiently and effectively. After taking this course, students are expected to be able to implement circuit resistance calculations and standard units and units of force for measuring circuit electric current. At the end of the course, students are expected to be able to create circuit hacking projects and microcontroller and robotics programming. The benefits of learning basic electronics are expected to play a role in developing various types of businesses in fields related to electrical engineering expertise so as to contribute significantly to expanding employment opportunities (Mariani et al., 2023; Pandiangan et al., 2023; Tambunan et al., 2024). In addition, having the ability to use mathematics and science, as well as modern engineering devices to solve technical problems and meet the needs of society (Gultom et al., 2024).

A microcontroller is a very useful device, a microcontroller is only as good as the program written for it, here the importance of microcontroller programming enters the picture. This is a tool that only runs certain instructions, without special commands, it will not work. Robotics is a combination of various branches of engineering, such as mechanical engineering, electrical engineering, and computer science. The goal is to create machines that are able to perform tasks independently or with human guidance.

Inquiry methods is a series of learning activities that maximally involve all students' abilities to search and investigate systematically, critically, and logically so that they can find their knowledge, attitudes, and skills as a form of behavioral change. The main objective of the inquiry model is the development of thinking skills. Thus, this learning model is not only oriented towards learning outcomes, but also oriented towards the learning process. Therefore, the criteria for the success of the learning process using the inquiry model are not determined by the extent to which students can master the subject matter, but rather the extent to which students are actively searching and finding something (Pandiangan et al., 2024).

This analysis aims to explain the understanding of microcontrollers and robotics through the application of inquiry methods in basic electronics courses.

RESEARCH METHODS

The type of research used is classroom research. Classroom research is a research approach carried out by lecturers to improve classroom learning practices (Fransisco et al., 2024; Pandiangan, 2024). This research is conducted by lecturers with the aim of identifying problems or challenges in learning, formulating effective solutions, and implementing changes in learning practices. The purpose of this research is to improve the quality of learning, improve learning practices, and improve the professionalism of lecturers.

The population in a study is a group of individuals with distinctive characteristics that are of concern in a study. The population is not only limited to humans, but can also include animals, plants, and other objects (Sihombing et al., 2024). The population is the entire object or subject in a study, and the determination of the population is different from the unit of analysis, which can be at the individual, group, or organizational level. The population in this study was 40 private campus students in Medan City. The sample determination was carried out using saturated sampling, where the population is the sample. The sample of this study was 40 private campus students in Medan City who were taken randomly.

Data analysis in this study used quantitative methods. Quantitative methods are a research approach that uses numerical data and statistical analysis to collect and analyze data (Yoppy et al., 2023). This quantitative method uses inquiry methods learning model which is a learning strategy

that emphasizes the development of cognitive, affective, and psychomotor aspects in a balanced manner, so that learning through this strategy is considered more meaningful (Beyer, 1971).

RESULT AND DISCUSSION

Microcontrollers

A microcontroller is a very useful device, a microcontroller is only as good as the program written for it, here the importance of microcontroller programming enters the picture. This is a tool that only runs certain instructions, without special commands, it will not work. However, if you design it with even a hundred task capabilities it can perform each task without error, given it is programmed well, it can power the device as desired. What a microcontroller can do:

1.Enable and Disable Clock Features
2.Enable and Disable Light Capabilities
3.Configure Audio and Video Settings
4.Add External Monitors
5.Automatically Detect and Fix Errors
6.Automatically Upgrade Old Components
7.Increase the Performance of Electronic Devices
8.Remove Unwanted Features
9.Tighten Security Features

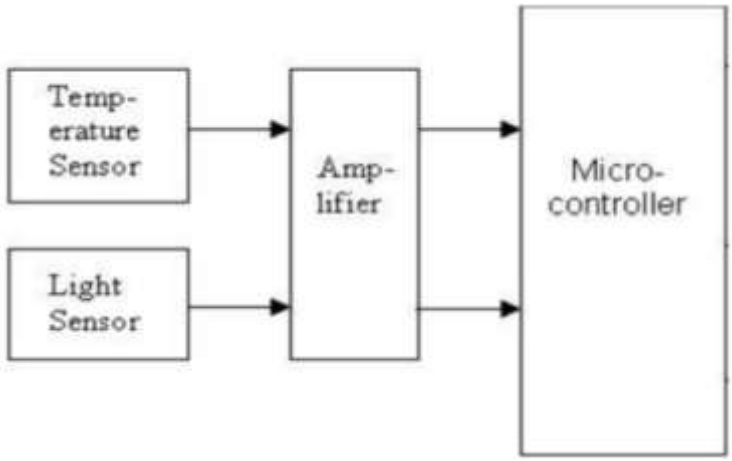

Figure 1. Microcontrollers

Robotics

Robotics is a combination of various branches of engineering, such as mechanical engineering, electrical engineering, and computer science. The goal is to create machines that are able to perform tasks independently or with human guidance. There are five main areas or specializations in robotics:

1.Operator Interface

Operator interface is the means used by humans to interact with robots. This area includes the design and development of user interfaces, control panels, and software applications that allow operators to command and control robots. The operator interface can be a simple button and switch or a more sophisticated graphical user interface and virtual reality system. The goal is to provide an intuitive and user-friendly interface to monitor and control the robot's behavior.

2.Mobility

Mobility is the ability of a robot to move around its environment. This field focuses on the design and implementation of mechanisms that allow robots to navigate and traverse different terrains. For example, wheeled robots use wheels to move, legged robots mimic the movements of humans walking or running, and aerial drones use propellers to fly.

3.Manipulators and Effectors

Manipulators and effectors are the components responsible for interacting with their environment. These parts are usually mechanical arms or limbs attached to the robot's body, which can perform various movements and actions.

4.Programming

In robotics, programming is the development of software instructions or algorithms that govern the behavior and actions of a robot. This field includes writing code to control the robot's movements, coordinating interactions with sensors and effectors. Robot programming can be done using a variety of programming languages and frameworks, depending on the robot's platform and the level of control desired.

5.Sensing and Perception

Sensing and perception are the robot's ability to collect and interpret information from its environment. Sensing is used to collect data, such as visual, auditory, or environmental information. While perception analyzes sensor data to recognize objects, detect obstacles, estimate distances, and understand the robot's surroundings. With sensing and perception, robots will be able to make decisions based on the information received, adapt to changes in the environment, and interact effectively with objects and humans.

The Application of Inquiry Methods in Basic Electronics Courses

Table 1. Result of the Application of Inquiry Methods

Understanding	Criteria (%)	Result
Microcontrollers	75	Understand
Robotics	75	Understand

The results of the study indicate that the application of the inquiry method can make students understand microcontrollers and robotics in basic electronics courses. The application of the inquiry method is learning that involves students in formulating questions that lead to investigations in an effort to build new knowledge and meaning regarding understanding microcontrollers and robotics in basic electronics courses. The learning process is in the form of an Inquiry model, namely building knowledge or concepts that start from observing, asking, investigating, analyzing, then building theories or concepts.

A microcontroller is a small device that functions as a computer in a circuit that can be found in remote controls, intelligent medical aids, office machines, sophisticated equipment, and machine control systems. With the rapid pace of various information retrieval operations, its function to overcome the problems of size, cost, time, and performance offers privileges to users with overall performance improvements. Usually embedded in a separate electronic device before or after the device is completed. In certain cases, it uses 4-bit words and low-frequency clock-rate operations.

Robotics is a field of science that combines science, engineering, and technology to create machines called robots. Robotics involves the design, construction, operation, structural

disposition, manufacture, and application of robots. Robotics is related to the science of electronics, machines, mechanics, and computer software. Innovation involves the development of more sophisticated robots to improve factory efficiency. These robots can perform repetitive and complex tasks with high precision, helping to increase productivity and reduce production costs. This innovation involves the development of personal assistant robots that can assist in daily tasks. These robots can perform tasks such as cleaning, lifting objects, and providing assistance in daily activities.

CONCLUSION

The results of the study indicate that the application of the inquiry method can make students understand microcontrollers and robotics in basic electronics courses.

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