ATLANTIS PRESS
Advances in Social Science, Education and Humanities Research (ASSEHR), volume 201
International Conference on Indonesian Technical Vocational Education and Association (APTEKINDO 2018)

Development of Learning Tool Control with Inquiry Based Learning To Improve Learning Motivation of Students of Electrical Engineering

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***Abstract*—The objective this study is to arrange and develop control technique device learning to motivate students industry-oriented with Inquiry Based Learning. The development of this learning tool resulted in a learning module trainer equipped with trainers in accordance with the demands of the curriculum by considering the needs of learners. So that the teaching materials have a fit between the needs of the industry and the approach to the students. With the increasing knowledge and industrial technology in the field of current control. The increasingly intense competition between industries (du / di) will certainly lead to the need for professional and competent workforce increased to support in carrying out the industrial process well. So that educational institutions or training continue to try to improve the ability through candidates according to the demands of the world of work. The design of this research using research methods and development based on multi disciplines with quantitative approach. The learning of control techniques with inquiry based learning using experiment tool can significantly increase students' interest and attention in motivating learning independently. Learning module development outcomes based on a limited trial 90% of respondents stated that this learning module is interesting and the material can be understood. While the results of the learning development response with the use of computers and aids in the form of trainers, all respondents (100%) argue that they feel happy and motivated by the learning of Engineering Settings**

Keywords— learning devices, Control techniques, Inquiry Based Learning, oriented to industry

I. INTRODUCTION

With the rapid development of knowledge and industrial technology in the field of current control. Creating competition among industries in the recruitment of professional and competent personnel in the field of control. So that institution or institution of education / training always try to improve graduate candidate competence according to work world demand.

In the modern world that emphasizes comfort and speed, more systems are needed that work automatically. Industrial control techniques are the areas of science in studying control techniques of equipment or systems [19]. Automation learning is not enough through learning with the delivery of theory alone. Learning utilization of this automation technology requires equipment to learning tool to espouse the theory receive by learners. The main difference between the vocational education and formal education is how to give training to the students to have life-skill and competence in their field. The latest equipment will be the main key in the organization of vocational education [4][5][10]. The limitation of practical equipment will be the main obstacles in producing the competent vocational education.

The learning environment regulated by faculty includes learning objectives, learning materials, learning methodologies, and instructional research. These elements are commonly known as the teaching component. The purpose of teaching is the formulation of the abilities and skills students are expected to have after taking various learning experiences.

With the media of learning, learners easily understand what the content of the material of a lesson. This is in accordance with the definition of the learning medium itself [6][8]. The learning medium is a mean of communication that can be used to stimulate the brain, sense, interest and students' ability or students' skill so that it can support the learning process. The examples of learning tools are book, module, film, video, trainer, included hardware technology.

The process of controlling the variables or parameters consisting of one or several quantities to obtain price or value within a certain limit is a system control technique. The control system technique can set its own system or other system to get the desired system output. The relationships of the components in the system eventually form a system configuration.

Mathematics is the "spirit" of Control techniques. To understand the control system must first get the mathematical model. This is because the relationship between system variables and mathematical models on the control system can be dynamic, changeable. A commonly used equation is a differential equation and is made linear in order to make the solution easier by using Laplace transform. In practice, the system is so complicated it makes assumptions about how the system works. Therefore, it is necessary to consider a physical system by making assumptions and linearizing the system. Finally, in completion take advantage of some mathematical equations, which has been a scourge for students.

DC motors (Direct Current) or direct current motors are included in the category of the most widely used motor types in industrial environments, household appliances or as devices supporting electronic instrument systems. DC motors have various types ranging from permanent magnet type,

series, shunt etc. The identification of DC motors can be done by simulating computer programs so that it will help a lot in observing the dynamic characteristics of the motor.

A review of the behavior or system characteristics in the planning from control systems of both large and small scale, requires an assumption of how the system will run well. Starting current spikes, transient voltage profiles to transient analysis at the time of fault system, are electrical characteristics that need to be considered in electrical motor control system technique.

The results of good and optimal planning is determined ability to know the actual condition of the system. The process of interpreting or interpreting system behavior is not an easy task as it will be related to the static and dynamic behavior of the system. The use of matlab software in modeling and simulation can be done in an interactive and real time.

Research priorities Development of Learning Tool Control With Inquiry Based Learning To Improve Motivation Learning Student with Orientation Industrial Needs consisting of (a) compiled competence and sub-sub competence which have been synchronized and validated at the user party (b) integration of relevant essential topics, (c) compilation of Control Learning Techniques with Inquiry Based Learning Oriented Industrial Needs.

This research is conducted by applying the development research design with the aim to produce the product in the form of learning tools based on contextual learning based on the technique of Electrical Engineering to improve the skills of students.

Seeing the success of research from previous research [3][15][16][17],Student learning outcomes show the achievement of learning completeness of all students (100%) after attending lectures using the learning module.

To facilitate the learning of regulatory techniques, learning tools are needed in the form of learning modules. This developed module is a module to support control technique competence with examples of ultrasonic sensor-based PID applications using Arduino and PID circuit experiments that control DC motors. So that students can simulate measurements and test digital electronic components directly and effectively and efficiently

PID controls are noted for their simplicity of structure, as well as the ease of tuning their control parameters, reliability, ease of repair and, more importantly, PID controls provide excellent control over other techniques that typically require more effort and more money. The application of this logic theory is capable of creating a revolution in technology. The basic configuration of the PID control system can be seen in Figure 1 below

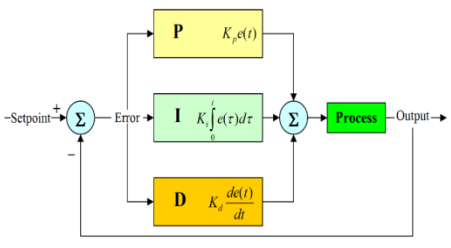

Fig. 1. Basic Configuration of PID Control

To get a price within a certain limit (variables, parameters) a control technique is needed that can control the system itself. The Setup System is also a system in which the components are connected in such a way that it forms a system configuration. The control system regulates its own system or other systems to obtain the desired system response.

The use of a Control system is found in everyday life either in direct or indirect usage. The Control system is generally a system that controls it using an automated manual.

The automatic setting system is a closed-loop control system with the desired input or output reference to be constant or changing slowly over time. The main task of the Control system is to maintain the actual output at the desired price in the presence of interference in the system. For example, the automatic control system is as follows: Control of the process, eg controlling temperature, flow, pressure, fluid surface level, pH, and so on. Power plants, such as voltage regulation, frequency, and so on. Numerical control is the control of operations that require high accuracy in the process repeatedly. For example the manufacture of holes, textiles, welding, and so forth. Transportation, such as elevators, escalators, conveyor belts, trains, airplanes, and so on. Servomechanism and non-technical fields, such as economics, sociology, and biology.

With the approach of inquiry-based learning with the system module provides an opportunity for learners to learn independently on the use of Matrix Laboratory Software. Inquiry based learning method is a method of learning that seeks to instill the basics of scientific thinking in the Student self, so that in this learning process Students learn more by themselves, develop creativity in solving problems. The approach of inquiry-based learning puts the student as the subject of learning. In the learning process, the students not only act as the recipients of the lessons through verbal lecturers' explanations, but they play a role in finding the essence of the subject matter themselves. In addition, all activities undertaken Students are directed to seek and find themselves from something in question, so it is expected to grow self-confidence (self-belief). This means that in the approach of inquiry based learning put the lecturer not as a source of learning, but as a facilitator and student motivator. Learning activity is usually have been done through a question and answer process between lecturers and students, so the ability of lecturers in using the technique of asking is a major condition in doing inquiry. The purpose of using inquiry based learning strategy is to develop intellectual ability as part of mental process, consequently in inquiry-based learning students not only required to master the lesson but how they can use their potential.

The effectiveness of this module is reviewed based on observations of lecturer and student activities, student learning outcomes, and student responses. Lectures become more interesting this is seen from the activities of lecturers and students the most dominant during the trial is to use the module when the lecturer explains the material and demonstrate the use of media and at the time student work on the formative tests of Control techniques. From the results of student, responses will also show a positive response to the Learning Tool Control Techniques Using Matlab Software with Inquiry Based Learning Oriented Industrial Needs.

II. METHOD

Designing Learning Tools Control Techniques with Inquiry-Based Learning Oriented needs this industry requires experts in education, engineering and language, so a multidisciplinary team-based approach is needed. To facilitate the systematic understanding of the flowchart shown in Figure 2.

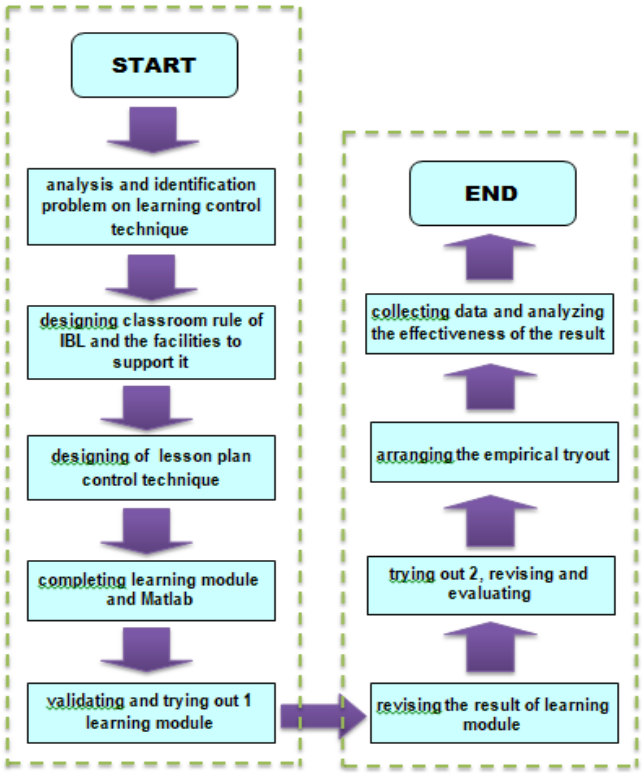

Fig. 2. Flow Chart of Research

Device development refers to the four D models proposed by Thiagarajan [1]. This four-D model consists of four stages:

A. Define Stage (defining)

The purpose of this stage is to define and define the terms of learning. This stage has five main steps, including front-end analysis, student analysis, concept analysis, task analysis, and the formulation of learning objectives.

B. Stage Design (designing)

At this stage is done prototyping device design learning. The result of this stage is usually the initial design of the learning device that depends on needs.

Components of the devices used are very diverse, including student books, modules, teacher books, student activity sheets, lesson plans, student learning outcomes, and learning media.

C. Stage Develop (development)

This stage aims to produce a revised learning tool based on the input of experts. The next step is a trial with the appropriate number of students in the actual class (unlimited). This activity is carried out to find out how far the effectiveness of learning devices developed when applied to the teaching and learning process. The effectiveness of instructional tools can be seen through observations, such as teacher and student activities, ability to manage learning, and test student-learning outcomes.

D. Disseminate stage (spreading)

At this stage is the stage of dissemination and use of learning tools. The learning tools that have been piloted and revised were duplicated and deployed for use on larger scale learning.

III. RESULT AND DISCUSSION

A. Validation result of learning tools by validators (lecturer)

Learning devices in the form of training modules that have been prepared, before being used validated by 5 validators (lecturers) multidisciplinary of instructional professional, educational professional, engineering expert and grammarians. The validator's assessment of the module is referring to the validation sheet indicators. Module validation technique is to put a check "√" on the validation sheets that has been available. The complete result of the validator assessment of the module is as shown in table I below.

TABLE I. VALIDATOR RATING RESULTS

No	Aspect of Assessment	Average	Category
1	Characteristics	3.92	Very Good
2	Contents	4.00	Very Good
3	Language	3.80	Very Good
4	Illustration	3.85	Very Good
5	Format	3.80	Very Good
6	Cover	3.80	Very Good

The complete result of the module revision of the validator is as shown in table II.

TABLE II. REVISED VALIDATOR RESULTS

Device Type	Before the revision	After the revision
Learning	Cover and title made more interesting, lecturer module does not exist	Cover and title have been made more interesting and lecturers module has been made
Engineering	Problems are made more varied, explanations remarks should be given a reference	Problems have been made more varied, explanations description has been given a reference
Language	Writing bold and italics adjusted, foreign language writing should be italicized, many images and tables are not given the name of the image and table name	Writing bold and italics adjusted, foreign language writing should be italicized, many images and tables are not given the name of the image and table name

Based on table I the mean validator assessment results are 3.86 which fall into the denomination very well. So that the training modules can be used in the experiments conducted on the lectures of Control techniques.

B. Results of socialization of learning tools to students

The result of module socialization data at the students of Electrical Engineering Department-Faculty of Engineering-State University of Surabaya was obtained by using response questionnaire instrument. This socialization was given to 10 students representing several courses in the Department of Electrical Engineering-Faculty of the Engineering-State University of Surabaya. This instrument is used to know the opinions and responses of the students to the competence of Control techniques, learning tools consisting of Teaching Module Engineering Based Inquiry-Based Learning arrangement consists of modules and props.

The data of students' response result of learning tool socialization activity that conducted at Electrical Engineering Department Faculty of the Engineering State University of Surabaya can be explained as follows:

All respondents, consisting ten representatives of students from diverse majors in the Electrical Engineering Department of State University of Surabaya, respond "did not understand" to the questions number 1, 2, 3 which are about the application of industrial setting techniques.

According to the respondents, the control technique competence should not be conducted in the Electrical Engineering Department of State University of Surabaya. This illustrates that the course image in this department is still restricted to the basic materials of Electrical Engineering, such as logic circuit, electronic frames, and microprocessor. However, they respond differently to Control technique Competence applying in industry.

Meanwhile, the expansion of automation has spread in industrial world recently with the use of robots and machines to minimized manpower.

On the fourth question which is focused on the Instruction of Inquiry Based Learning module, there are 9 respondents (90%) of 10 respondents who say that it is "interesting". On the other hand, there is one respondent (10%) who states "not interesting".

The questions number 5 and 6 are about the utilization of computers and module. All respondents (100%) say that they are "interesting" to apply them in learning process. This indicates that students respond positively in the using of module and the developed learning device.

Students' response result on question no. 7 is that all of respondents (100%) say that they find it is easier to understand the material using the developed module. It seems that all respondents felt excited and motivated when they are learning using modules and teaching tools. This signifies that the module is able to increase the students motivation and help them in understanding the material.

IV. CONCLUSION

The developed modules can be used in a broader trial conducted on the lectures of Control techniques. With Inquiry Based Learning and the tool of a trainer, all respondents (100%) in the limited trial are motivated and happy with the learning of control Techniques.

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