Development of PLC Festo Module to Support Mechatronics Course in Department of Mechanical Engineering Unesa

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ABSTRACT

Equipment assistance in the form of a Festo PLC trainer obtained from Islamic Development Bank (IsDB) has not been optimized to support Mechatronics lectures because there is no module in the operation of the trainer. To answer these problems, the specific purpose of this research is to develop the Festo PLC module to support Mechatronics lectures at the Department of Mechanical Engineering, Faculty of Engineering, Universitas Negeri Surabaya (Unesa). The long-term goal to be achieved in this research is the realization of learning tools that can bridge the competencies possessed by students with the demands of the rapidly growing needs of the industrial world as an optimal debriefing effort for students who will later work as professionals in industry world. To achieve the above objectives, this research method uses the ADDIE model development (analysis, design, development, implementation, evaluation). The expected result of this research is that the Festo PLC module is declared suitable for use in mechatronics courses and gets a positive response from students so that it can improve their learning outcomes.

Keywords: *Module, Learning, Mechatronics, PLC Festo*

1. INTRODUCTION

The technological development of various production processes in the industrial world is progressing rapidly, of course this will have a consequence, that the workforce operating plants in the industry must meet adequate qualifications so that production runs optimally. This will be a challenge for institutions or educational/training institutions to continuously develop their learning patterns so that their students can be accepted according to the qualifications of the industrial world. Many advanced companies have implemented automatic control systems to support their production processes. Because this system has many advantages, namely the way it works is simple, easy to operate, easy to maintain, and efficient in supporting the production process.

Referring to the development of process technology in the industrial world, the Department of Mechanical Engineering at Unesa, especially in the Mechatronics course, the subject of PLC requires learning facilities and infrastructure in order to meet the demands of the industrial world. The form of effort that has been carried out by Unesa is cooperation with IsDB (Islamic Development Bank) which is a multilateral financial institution founded in 1975 by the Islamic conference organization. One of the learning support equipment received was in the form of various Programmable Logic Controller (PLC) trainers from PT. Festo.

The main problem is that the Festo PLC trainer has not been used optimally in supporting learning. This is because there is no learning device in the form of a module as a guide for lecturers and students in operating the Festo PLC trainer. To answer these problems, in this study, a learning device in the form of a Festo PLC module will be developed to support Mechatronics lectures at the Department of Mechanical Engineering, FT Unesa. It is hoped that the results of this research will be able to bridge the competence of PLC control materials owned by students with the demands of the rapidly growing needs of the industrial world, especially from graduates of the Unesa Mechanical Engineering department who will later work as professionals in the industry.

Based on a research with the title "Development of a learning module based on festo fluidsim v4.2 as a teaching material for electropneumatic control systems" as a learning material for class XI students of Industrial Automation Engineering at SMKN 2 Depok. The results of the assessment of the feasibility level of the learning module include aspects of material, media and student assessment as users. The results of the evaluation of the material expert component get a "very feasible" category with an average score of 3.23 from a maximum score of 4, then the average total score of the evaluation results of media experts is 3.12 from a maximum score of 4 so that it is included in the category " very feasible", the total score from the results of the initial field trial was 3.39 from a maximum score of 4 so it was included in the "very feasible" category, then the total score from the results of the operational field trial was 3.29 from a maximum score of 4 so that it included in the “very decent” category. [3]

According to research entitled "Development of the Omron CPIE PLC Practicum Module to Support Instrumentation and Control Courses in the Department of Mechanical Engineering Unesa". an average of 3.48 is included in the very feasible category from the aspect of material, design, and language. Then the results of the average student response get a value of 3.72 and the lecturer's response to the practicum module gets a value of 3.36 which is included in the very good category so that the module can be used as teaching materials to support instrumentation and control courses. [10]

According to research entitled "Development of the festo fluidsim software-assisted practicum module in the subject of electric motor installation at SMK Negeri 3 Jombang" shows that the results of his research for aspects of the validity of the Festo Fluidsim software-assisted practicum module are stated to be very good. valid with a rating of 91.01%. Then for the results of the research from the practical aspect of the practicum module, namely: (1) the teacher's response got a very good response with a rating of 97.20%, (2) the student's response got a very good response with a rating of 95.40%. The results of the study for the aspect of the effectiveness of the practicum module, namely the learning outcomes of the affective domain of students, were obtained from the average experimental class 87.10 and the control class 84.84, it can be concluded that the practicum module developed is feasible to use in terms of 3 aspects, namely aspects of validity, aspects of practicality, and aspects of effectiveness.[4]. According to the results of research the physical chemistry practicum guide developed is in the good category (3.2). The existence of the practicum guide can make it easier for students to achieve learning goals because learning becomes more well structured [7]. Referring to some of the results of the research above, the author will conduct research on the development of the Festo PLC module to support the Mechatronics lectures on the subject of PLC in the Mechanical Engineering department, Faculty of Engineering, Unesa.

2. METHOD

The development of learning tools in this study uses the ADDIE model. The ADDIE Model Learning Design is one of the interactive learning processes with the basic stages of effective, dynamic and efficient learning. The ADDIE (Analysis Design Development Implementation Evaluations) model originated from the concept of the Instructional Design Model and Theory for the US Army in 1950. Then in 1975 it was developed again by Florida State University for use in all US Armed Forces. Educational practitioners made several revisions and in the mid-1980s a more interactive and dynamic model emerged than the original. This model can then be used for various forms of product development such as learning strategies and methods, media and teaching materials. The ADDIE model can be used as a guide in building tools and infrastructure for training or learning programs that are effective, dynamic and support the performance of the training itself in several stages.

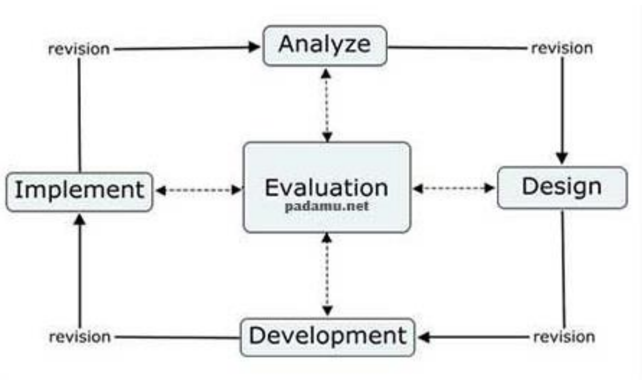

Figure 1 Schematic of ADDIE Model.

The ADDIE model of learning design scheme forms a cycle consisting of 5 stages consisting of: analysis, design, development, implementation and evaluation [8]

1. Analysis The design of the analysis phase focuses on the target audience. At the analysis stage, the definition of instructional problems, instructional objectives, learning objectives is carried out and identification of the learning environment and knowledge possessed by students is carried out.
2. Design The design phase is related to targeting, assessment instruments, exercises, content, and analysis related to learning materials, lesson plans and media selection. The design phase is carried out systematically and specifically.
3. Development During development, the creation and incorporation of content that has been designed at the design stage is carried out. In this phase, storyboards, content writing and graphic design are needed.
4. Implementation In this phase, procedures for training are developed for trainees and their instructors/facilitators. The training for facilitators includes curriculum materials, expected learning

outcomes, delivery methods and testing procedures. Other activities to be carried out in this phase include copying and distributing materials and other supporting materials, as well as preparing in case of technical problems and discussing alternative plans with students.

5. Evaluation Each stage of the ADDIE process involves formative evaluation. It is multidimensional and an important component of the ADDIE process. It assumes a form of formative evaluation in the development stage. Evaluation is carried out during the implementation phase with the help of instructors and students. After the implementation of learning is complete, a summative evaluation is carried out to improve learning. The designer of the entire evaluation stage must ascertain whether the problems relevant to the training program are resolved and whether the desired objectives are met.

3. RESULT AND DISCUSSION

3.1. Analysis

The analysis phase focuses on students. The analysis phase is the first phase that must be done. In this phase, the main concern for the designer is the target learner. There are three segments that must be analyzed, namely learners, learning, and learning media to deliver teaching materials. Student analysis is used to assess the level of cognitive, psychomotor and affective development of students who will use the developed practicum guide. The subjects of this study were undergraduate students of Mechanical Engineering, Department of Mechanical Engineering, FT UNESA class of 2020 who were 20 years old on average. The developmental stage of students is included in the formal operational stage (12 years to adulthood). At this stage, students have the characteristics of being able to think abstractly and purely, able to form concepts that are not dependent on physical reality and can solve problems through the use of systematic experimentation by applying the knowledge learned in everyday life. In studying the Mechatronics subject of PLC, students want an increase in cognitive, affective and psychomotor abilities that can be packaged in the form of practical activities on PLC applications. Therefore, a learning device is needed in the form of a PLC Festo practicum module to support PLC application practicum activities. [9]

3.2. Design

At this design stage, several things were carried out, namely: preparation of tests, selection of media, selection of formats, and initial design of the module.

1. Test Compilation, Learning outcomes tests are arranged based on indicators and learning objectives that are used to measure student success in teaching and learning using a direct learning model combined with a problem-based learning model. Measurement of learning outcomes here is more emphasized on student self-assessment, an assessment that compares student competency achievements with previous ones, as recommended [11].

2. Media Selection, this activity was conducted to determine the appropriate computer-assisted media and trainer kits for conveying sensor material. The media used are as follows: a) Computer learning based The computer media used is a minimal set of computers/laptops/notebooks with a Corei3 processor with the Cx.Programmer application installed. b) Assisted learning based The learning aid used is an PLC trainer.

3. Preliminary Design of the module,

4. Format Selection: 1) The paper size used in compiling the module is A4 vertically. 2) Column (single or multi) proportional. The use of single or multi columns is adjusted to the shape and size of the paper used. 3) The sign or symbol used is easy to catch which aims to emphasize things that are considered important or special. The signs or symbols are pictures, tables, bold print, italics, etc.

5. Module Draft, The initial design activity of the module resulted in a draft of a practicum guide covering several aspects as follows. 1) The title of the module that describes the material to be included in the module; 2) Learning outcomes that will be achieved after completing studying the module; 3) The final ability that will be achieved after students study the module; 4) Learning indicators that will be achieved after students study the module; 5) Learning objectives to be achieved after students study the module; 6) Module material that contains knowledge, skills, and attitudes that must be learned and mastered by students; 7) Procedures or activities that must be followed by students to study the module; 8) Contextual-based tasks.

3.3. Development

At this stage of development, validation of the feasibility of the Festo PLC module is carried out. Based on the validation results, it shows that the average score of the 3 validators (technical, learning, and Indonesian language experts) is 3.65 which is included in the good category. Overall, it can be concluded that the sensor practicum guide developed is feasible to use.

3.4. Implementation

Trial implementation of the Festo PLC module in mechatronics lectures held in the odd semester 2022/2023 at the Department of Mechanical Engineering, State University of Surabaya. There were

10 students who were the subjects of the limited trial who programmed the mechatronics course in the study program bachelor of mechanical engineering education.

3.5. Evaluation

Student learning outcomes in the limited trial were measured using a performance appraisal sheet. Mastery of student learning is based on the minimum standard of completeness set by the Department of Mechanical Engineering, FT Unesa. The criteria for mastery learning individually is if it reaches a mastery value of at least 70 or 70%. Meanwhile, to determine student learning completeness classically, it is said to be complete if the percentage of students who get a minimum score of 70 is 85%. [12]

A test is conducted to determine the extent to which students can achieve the learning objectives. In this assessment, two tests were conducted, namely pretest (initial test) and post-test (final test) at each meeting. From the results of the initial and final tests, it can be seen that student learning outcomes have increased. In addition, the average test results from learning activities 1 to learning activities 3 showed that all students did not complete the pretest while at the posttest all students completed. For classical completeness in the pretest learning activities 1 to learning activities 3 is 0% while in the posttest it is 100%. Learning devices that are arranged in the form of modules are one of the factors that determine whether or not the learning objectives are achieved. Good learning tools will determine the quality of learning. The development of learning tools carried out by researchers is in accordance with social learning theory and Vygotsky's constructivism learning theory. Social learning theory suggests that most humans learn through observing and remembering the behavior of others. Meanwhile, Vygotsky stated that learning occurs through social interaction, through the help of teachers or peers who are more capable, specifically providing direction or scaffolding, namely providing support for learning and problem solving. This support can be in the form of instructions, warnings, encouragement, detailing the problem into steps, giving examples, or other actions that allow students to grow independently as learners.[1]

Data collection on the results of student responses to the use of the module is carried out after implementation of the developed module. Based on the results of student responses obtained through student response questionnaires. In the questionnaire, there are several questions based on the assessment of the response to the use of the module which consists of 3 aspects, namely, the display aspect, the material presentation aspect and the benefits. Based on the table above, it is known that the students gave a very good response. This can be seen from the average response value in each aspect. In the aspect of appearance obtained an average of 3.65; the aspect of material presentation is 3.62 and the aspect of benefit is 3.62. If the results of the three aspects are averaged, it will get a value of 3.63 which is included in the very good category. It can be concluded that the developed module received a positive response from students.[2]

4. CONCLUSION

Based on the research that has been done, it can be concluded that: (1) based on the validation results from 3 validators, it shows that the average validation score is in the good category (3.65). It can be said that the developed module is feasible to be used to support mechatronics learning, (2) based on the test results, it can be said that learning is more effective with indicators that the positive response from students is enthusiastic in participating in learning, and (3) student learning outcomes have reached individual and classical completeness.

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