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Analysis of Robotic Building Skill for Electrical Engineering Student Based on Contextual Teaching & Learning With Structural Equation Modelling

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Abstract. The focus of this research is the ability to build robots for electrical engineering students based on contextual teaching and learning which will be analyzed by structural equation modeling through IBM SPSS and IBM SPSS Amos software. Contextual Teaching and Learning (CTL) is a conception that helps teachers to connect teaching materials with real situations and motivate students to make connections between knowledge and application. This research was conducted by applying the development research design with the aim to produce the product in the form of robotics learning device as a supporting / measuring tool to assess the ability to make robot for students majoring in electrical engineering. This developed module is the results of the research and monitoring of the researcher and the team leader for 6 years. The completed module was then validated to 7 validators consisting of lecturers of instructional experts, educational experts, engineering experts and grammarians. And the average validator assessment result is 3.34, which fall into either category. Value probability level is above 0.5 (value = 0,522) then it is concluded there is improvement between constructs.

Keywords: robotic building skill, contextual teaching and learning, electrical engineering students, structural equation modeling, teaching module and robot kit.

1. Introduction

In Indonesia, the object of this research is a topic that continues to grow. Actually the development of robotics in the country is very encouraging. As a barometer, the success of the Indonesian Robot Contest and in the contest no less than 40 major universities in Indonesia took part. However, the development of the robot in Indonesia is only limited to the contest and has not been developed to address problems that are more real, especially in the industrial world.

The focus of this research is the ability to make robots for students majoring in electrical engineering based on contextual teaching and learning which will be analyzed with the latest structural equation modeling method and will be implemented in the Indonesian Robot Contest and the industrial world. Developed countries such as America, Japan, and the UK with very expensive selling prices only develop this type of robot. Currently this robot actually uses high technology, because the control is fully controlled by the microprocessor and we are trying to develop it with the low cost technology.

The focus of the research in the first phase was the research focused on determining constructs related to the ability to make robots and their definitions, making teaching modules and robot kits, determining teaching module validation and robot kits, making assessment instruments, testing teaching modules and robot kits with assessment instruments to respondents (Electrical engineering students), and assessment results (research data) were analyzed through the theory of structural equation modeling to be processed with the help of IBM SPSS software and IBM SPSS Amos.

The main problem is how the ability to build robots for electrical engineering students based on contextual teaching and learning which will be analyzed by structural equation modeling is implemented in learning using approaches according to industrial needs [4]. In order to support the competency-based curriculum of industrial needs, modules have also been developed both manually and interactive mode, which are oriented towards achieving work competencies while also accommodating life skills. In this interest, the problem that will arise is what learning modules are in accordance with the characteristics of the learning objectives, namely the achievement of workplace competencies as well as the achievement of competencies in the field of life skills using the main teaching materials in the form of modules and learning media.

To solve these problems, in this study we will develop the ability to build robots for electrical engineering students based on contextual teaching and learning which will be analyzed by structural equation modeling assisted by IBM SPSS and IBM SPSS Amos software. It is expected that the results of this study will be able to bridge the needs of the workforce, especially from the UNESA Electrical Engineering graduates who will later work as vocational teachers or as a worker in the industrial world.

2. Literature Review

2.1 Contextual Teaching and Learning

According to Agus (2005: 10) Contextual Teaching and Learning is a learning concept that helps teachers connect the content of subject matter to real situations and motivates students to make connections between their knowledge and their application around their lives as family members and communities.

U.S. The Department of Education and the National School-to-Work Office (Blanchard in Maesuri, 2002: 3) states that Contextual Teaching and Learning (CTL) is a conception that helps teachers to connect teaching material to real-world situations and motivate students to make the connection between knowledge and its application into their lives as family members, citizens, labor.

2.2 Structural Equation Modeling (SEM)

Structural equation modelling (SEM) includes a set of mathematical models, computer algorithms, and statistical methods that are compatible with the construction network of data. SEM includes confirmatory factor analysis, path analysis, partial least squares path modelling, and latent growth modelling. Structural equation models are often used to assess unobserved 'latent' constructs. They often call a measurement model that defines latent variables using one or more observed variables, and structural models that show the relationship between latent variables.

2.3 Development of 4-D Model Learning Devices

In this research the development model of the device used is a 4-D model (four D models). Thiagarajan, Semmel, and Semmel are suggesting this model (1974). This 4-D model consists of four stages, namely:

2.4 Define Stage

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

2.5 Design Stage

At this stage the prototype-learning device is designed. The results of this stage are usually in the form of a preliminary design of the learning device that depends on the needs. The components of the device used are very diverse, including: student books, modules, teacher books, student activity sheets, lesson plans, student learning outcomes tests, and learning media.

2.6 Develop Stage

This stage aims to produce a revised learning tool based on expert input. The next step is to test with the number of students who fit in the class (unlimited). This activity was carried out to find out how far the effectiveness of learning devices developed when applied to the teaching and learning process. The effectiveness of learning devices can be seen through observation, for example teacher and student activities, ability to manage learning, and test student-learning outcomes.

2.7 Disseminate Stage

At this stage is the stage of dissemination and use of learning devices. Learning devices that have been tested and revised earlier are duplicated and distributed used in learning on a larger scale.

3. Research Methods

This research was conducted by implementing a development research design with the aim of producing a product in the form of a robotics learning device as a support / measure to assess the ability to make robots for electrical engineering students based on contextual teaching and learning which will be analysed by structural equation modelling.

3.1 Research Procedure

The development procedure in the research is carried out through the following stages: 1) Identify various problems around Robotics used in robot contests through literature studies and data mining that will be used as a reference for developing theories, simulations and applications that approach them; 2) Analyse and formulate the results of identification of various problems surrounding Robotics that are relevant to be developed for students majoring in Electrical Engineering; 3) Making analysis and compiling the Content and Learning Scenarios and Designing the infrastructure needed for the development of equipment, teaching staff, laboratory staff, and determining the appropriate evaluation system according to the material needs of robotics; 4) Formulate indicators of the success of the teaching and learning process that is oriented towards achieving the demands of professional performance in the world of work; 5) Implementation of the development of learning devices (facilities) based on contextual teaching and learning as a tool to integrate theory, simulation and applications that are compatible with various problems of Robotics for learning and contest needs; 6) Conducting field trials of robotics learning devices for robotics courses based on contextual teaching and learning in the Department of Electrical Engineering, which are oriented to mastering competency in the world of work needs; 7) Analyses the results of field trials and make improvements to validate testing procedures and test results; 8) Conducted the final revision of the robotics-learning tool based on contextual teaching and learning based on the results of field trials and their validation; 9) The results of field trials (on students) were analysed using analysed with the theory of structural equation modelling assisted by IBM SPSS software and IBM SPSS Amos; 10) The results of the test data in section 9 made a SEM structural model.

3.2 Data Collection and Data Analysis Techniques

Information on the results of field surveys and discussions in order to implement the standard needs of robot contests/competitions so that users of learning devices are analysed using descriptive techniques. Likewise, data on the results of focus group discussions with the aim of identifying and formulating topics of essential topics as teaching materials for mechatronics courses to be integrated in the form of theory, simulation, and application using qualitative descriptive analysis techniques. Qualitative descriptive analysis techniques are making the evaluation and synthesis of the conclusions resulting from the activities. The synthesis and conclusions of the results of this study were formulated through workshop forum forums, and focus group discussions.

4. Results and Discussion

4.1 Data from Indonesia Robot Contest 2009-2015

Data from the Indonesia Robot Contest for the period 2009 - 2015, it can be seen that the modules that have been developed have reached the fourth stage of the development research method, the disseminate method. So that the module is perfect, ready to be duplicated and distributed as a learning tool for robotics courses and robotics courses. In this Indonesia Robot Contest, teaching module materials compiled based on contests are not only for electro majors, but also for multi-disciplines, and the research objects developed do not have to be the latest technology or just appropriate technology, but include the development of learning devices.

4.2 Data from the learning device validation results by the Teaching Staff (Lecturer)

The completed modules are then validated on 7 validators consisting of learning expert lecturers, education experts, engineering experts and grammar experts. And the average result of the validator's assessment is 3.34, which is included in the good category. So that the module can be used in trial 2, which is a trial conducted at the robotics lecture

4.3 Data on the results of socialization of learning devices for students

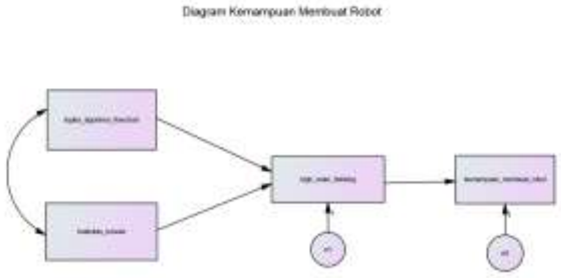
Based on data about the socialization activities of learning devices carried out on students majoring in electrical engineering above produce data as follows. For questions number 1, 2, and 3 all respondents consisting of 100 students from representatives of various study programs in electrical engineering (100%) answered that they did not understand about the application of robotics in the industry, or about robotics equipment. Respondents also thought that robotics competencies were not taught in their majors, namely electrical engineering. This shows that the competency image of the electrical engineering department is currently only limited to industrial automation, not to mention the robotics competencies in the Industry. Even though there are many developments in industrial automation systems that use industrial robots.

For question no. 4 about the contextual learning based robotics module respondents who answered interestingly were as many as 90 students (90%) out of 100 students and those who thought "unattractive" were 10 students (10%). As for question no. 5 and no. 6 about the use of computers and the help of module respondents who think "interesting" as many as 10 students (100%) and those who think "not attractive" as many as none (0%). This shows a positive response to the learning device in the form of modules and learning tools developed.

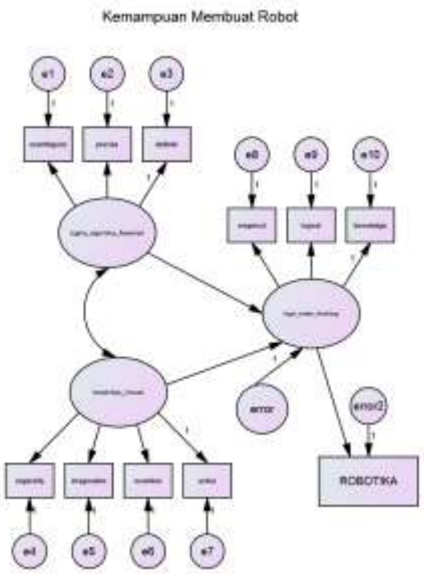
For question no. 7 all respondents as many as 100 people (100%) thought that the module developed could facilitate understanding the material. All respondents (100%) argued that they felt happy and motivated by learning using modules and learning aids. This shows that the existence of modules can motivate students and help students understand the material.

4.4 Data and results of processing with path analysis with the theory of structural equation modelling

The results of data processing research with path analysis through the theoretical structural equation modelling approach assisted by IBM SPSS and IBM SPSS Amos software obtained the structural model path diagram as follows:



So that the SEM structural model is as follows:



After computing with IBM SPSS and IBM SPSS Amos software, the results are as follows:

Notes for Model (Default model)

Computation of degrees of freedom (Default model)

Number of distinct sample moments:	55
Number of distinct parameters to be estimated:	25
Degrees of freedom (55 - 25):	30

Result (Default model)

Minimum was achieved
Chi-square = 28.922
Degrees of freedom = 30
Probability level = .522

Because the probability level is above 0.5 (value = 0.522), it is found that H0 can be accepted (the existence of a correlation between constructs (construct of ability to make robot with construct of high order thinking with construct of logic a chart flowchart and construct of creativity information).

5. Conclusion

Based on the results of data analysis and discussion, the researcher can draw conclusions as follows: 1) This developed module is the result of research and monitoring by the lead researcher and a team that for 6 years continues to develop contest-based robotics research, with the hope that in the future it will be able to produce contextual learning-based robotics learning tools to improve students' skills; 2) The response from students during the socialization of learning devices developed shows that the competency image of the electrical engineering department is currently limited to the electrical engineering department, currently only limited to industrial automation, not to mention industrial robots. Even though there are many developments in machinery in the industry that use industrial robots. Therefore a learning device is needed that can support the learning of robotics competencies in the electrical engineering department. From the results of student responses also showed a positive response to the contextual learning based robotics module developed; 3) The completed module is then validated on 7 validators consisting of learning expert lecturers, education experts, engineering experts and grammar experts. And the average result of the validator's assessment is 3.34, which is included in the good category. So that the module can be used in trial 2, which is a trial conducted at the robotics lecture; 4) The probability level is above 0.5 (value = 0.522). It can be concluded that H0 can be accepted (there is a correlation between constructs (construct ability_make_butter with construct high_order_thinking with construct__flowchart logic_algorithm and innovation_ creativity).

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