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

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ABSTRACT

The objective of this research is to analyze the ability of electrical engineering students to build robots based on Contextual Teaching and Learning (CTL) which is analyzed by Structural Equation Modeling (SEM) through IBM SPSS and IBM SPSS Amos software. CTL is able to aid teachers to explain teaching materials with real situations and also able to motivate students by connecting the knowledge with the real application. This research applied the development research design with the product in the form of the robotics lesson plan as a supporting or measuring tool to assess the ability to make a robot for electrical engineering students. The developed of the robotic module is the research results and monitoring results of the researchers from the year 2009 to 2015. Afterward, seven (7) validators validated the final module. The validators consist of instructional experts, educational experts, engineering experts, and grammarians. In addition, 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

1. INTRODUCTION

Robotics research is a topic that continues to grow recently. As can be shown that the robotics development in Indonesia is also very encouraging. One of the robotics development in Indonesia is the Indonesian Robot Contest that being held for almost two-decade. The participants of the Indonesian Robot Contest is about 40 major universities in Indonesia took part.

The use of the CTL learning model has been widely used in learning a subject matter. The CTL learning model not only contributes positively to learning in social sciences such as Cognitive Psychology (Hazhira et al., 2017), Grammarly in English (Ahmad et al., 2017), English as Foreign Language (Chen et al., 2019), Civics (Amir et al., 2017), Geography (Surdin, 2018) but also in exact sciences such as Natural Science (Suryawati et al., 2018), Biology (Riska et al., 2018) and IT disciplines (Banerjee et al., 2019). Based on the above, this study uses the CTL learning model in robot learning.

SEM is a research method that has advantages in multivariate analysis in research. SEM has been widely used to model a system to find out the relationship between the construct with the construct and also the relationship between the constructs with the indicators. In the education field, SEM has been widely used to analyze the relationship between variables with other variables in an educational system.

According to Paus, et al., (2012) that SEM can be used to model the relationship between central discourse activities and individual learning outcomes at the level of constructs during the online discourse. At the construct level, SEM results showed a robust effect of dyadic conceptual elaboration on individual understanding. Merchant, et al., (2012) used SEM in studying the relationship between the 3D virtual reality features and the chemistry learning test which were linked to variable spatial orientation and usability with self-efficacy and presence. The results of his study indicate that SEM can provide hypothesized answers to the relationship between these variables. Chuang, et al., (2015) stated that SEM is also able to investigate the relationship between the latent

structure of teachers' technology integration practice and its relation to their technological pedagogical content knowledge

This aim of this research is to analyze the ability of electrical engineering students to build robots that have been learning with CTL learning model and be analyzed with SEM method. The research result will be implemented in the Indonesian Robot Contest. Generally, a robot is built using high technology that is because the control of the robot is fully controlled by the microprocessor. Therefore in this research, it will develop a robot with low-cost technology.

The first phase of this research 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 (Brown S.,1999). 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 line with the characteristics of the learning objectives, namely the achievement of workplace competencies as well as the competencies achievement of life skills that successfully applied after using modules and learning media as the teaching materials.

2. MATERIALS AND METHODS

2.1 Contextual Teaching and Learning

According to Berns et al., (2001) 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". Meanwhile according to Hudson et al., (2008) CTL is defined as "a way to introduce content using a variety of active learning techniques designed to help students connect what they already know to what they are expected to learn and to construct new knowledge from the analysis and synthesis of this learning process".

CTL learning model has an advantage in developing students' abilities. Students 'abilities that can be developed such as computational thinking ability (Banerjee et al., 2019), the students' scientific attitude (Suryawati et al., 2018), critical thinking and problem solving (Riska et al., 2018), and self -efficacy, proactive learning (Chen et al., 2019).

Beside that the CTL learning model also has advantages in effectiveness in use in learning. Suryawati et al., (2018) states that CRT is effectively used in learning natural science in junior high school students. Ahmad et al., (2017) states CTL is effective to improve students' achievement at a basic level of English grammar. CTL makes it easier for students to understand and memorize the material and immediately apply them in their daily activities.

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 (Joseph et al., 2013).

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 (Karl et al., 2016). SEM is able to evaluate the relationship between a construct (variable) with another construct (Inner model). Nor the construct relationship with the indicator (outer model).

Rohatgi et al., (2016) stated that SEM can be used to measure the relationship between the constructs of students' self-efficacy in using ICT to the construct of ICT acceptance, ICT use, and ICT literacy. The results of the analysis using SEM show that there is a positive relationship between each of these constructs.

Research Almerich et al., (2016) examined the relationship model of Teachers' ICT competencies such as technological and pedagogical to the teaching learning process by using SEM. The results showed that how various personal and contextual factors influence these technological and pedagogical.

2.3 Development of 4-D Model

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. This 4-D model consists of four stages, namely:

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

Design Stage

At this stage the prototype-lesson plan is designed. The results of this stage are usually in the form of a preliminary design of the lesson plan 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.

Development 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 lesson plans developed when applied to the teaching and learning process. The effectiveness of lesson plans can be seen through observation, for example teacher and student activities, ability to manage learning, and test student-learning outcomes.

Disseminate Stage

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

3. RESEARCH METHOD

This research was conducted by implementing a development research design with the aim of producing a product in the form of a robotics lesson plan 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 lesson plans (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 lesson plans 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 SEM assisted by IBM SPSS software and IBM SPSS Amos
10. The results of the test data in stage 9 made a structural equation 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 lesson plans are analyzed 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 DISCUSSIONS

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 from 4D model, 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 lesson plans.

4.2 Data from the lesson plan 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 lesson plans for students

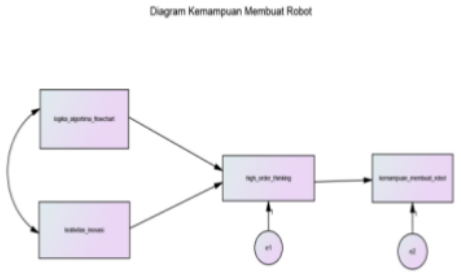
Based on data about the socialization activities of lesson plans carried out on students majoring in electrical engineering above produce data as follows. For questions number 1, 2, and 3 (Q1,Q2,Q3) all respondents consisting of 100 students from representatives of various study programs in electrical engineering (100%) answered that they did not understand about the application of robotics in the industry (Q1), or about robotics equipment (Q2). Respondents also thought that robotics competencies were not taught in their majors, namely electrical engineering (Q3). 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 (Q4) about the contextual learning-based robotics module respondents (Q4) 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 (Q5) and no. 6 (Q6) about the use of computers (Q5) and the help of module respondents (Q6) 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 lesson plan in the form of modules and learning tools developed.

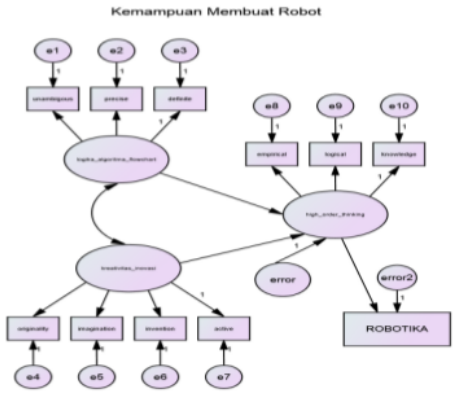
For question no. 7 (Q7) all respondents as many as 100 people (100%) thought that the module developed could facilitate understanding the material (Q7). All respondents (100%) argued that they felt happy and motivated by learning using modules and learning aids. This shows that the existence of modules 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 H_0 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_alchart_flowchart and construct of creativity information)

5. CONCLUSION

Based on the results of data analysis and discussion, the researcher can draw conclusions as follows:

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.

The response from students during the socialization of lesson plans 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 lesson plan 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

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

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.

REFERENCES

Hazhira Qudsyi, Hariz Enggar Wijaya, Nur Widiasmara. (2017). *Effectiveness of Contextual Teaching and Learning (CTL) to Improve Students Achievement and Students' Self-Efficacy in Cognitive Psychology Course*. Advances in Social Science, Education and Humanities Research, volume 164. International Conference on Learning Innovation (ICLI 2017).

Ahmad Shodiq, Abdiyana Ihsan. (2017). *The Effectiveness of Contextual Teaching and Learning to Improve Achievement in Basic Grammar Class at Kampung Inggris Language Center Pare Kediri*. UI Proceeding on Social Sciences and Humanities Vol 1. 2017.

Chen, M.-P., Wang, L.-C., Zou, D., Lin, S.-Y., & Xie, H. (2019). *Effects of caption and gender on junior high students' EFL learning from iMap-enhanced contextualized learning. Computers & Education, 140, 103602.*

Amir Danis, Reh Bungana Br. Perangin-Angin, Sri Milfayetty. (2017) *The Effect of Contextual Teaching and Learning (CTL) and Motivation to Students' Achievement in Learning Civics in Grade VII SMP Imelda Medan. IOSR Journal of Research & Method in Education (IOSR-JRME) e-ISSN: 2320–7388,p-ISSN: 2320–737X Volume 7, Issue 6 Ver. I (Nov. – Dec. 2017), PP 24-3.*

Surdin. (2018). *The Effect of Contextual Teaching and Learning (CTL) Models on learning outcomes of Social Sciences of the material of forms the face of the earth on Class VII of Junior High School*. International Journal of Education and Research. Vol. 6 No. 3 March 2018.

Suryawati E., K. Osman, *Contextual Learning: Innovative Approach towards the Development of Students' Scientific Attitude and Natural Science Performance*, *Eurasia Journal of Mathematics Science and Technology Education*, vol. 14, no. 1, pp. 61-76, 2018.

Riska Septia Wahyuningtyas, Wuryadi. (2018). *The Influence of Contextual Teaching And Learning (CTL) towards Chritical Thinking and Problem Solving Ability on Skeletal System Materials* . 5thICRIEMS Proceedings Published by Faculty Of Mathematics And Natural Sciences Yogyakarta State University, ISBN 978-602-74529-3-0

Banerjee, R., Tarazi, J., & Ahli, M. J. A. (2019). *Application of Contextual Teaching and Learning model through Interdisciplinary Student Projects – An approach to enhancing Accounting and IT skills*. 2019 Advances in Science and Engineering Technology International Conferences (ASET).

Paus, E., Werner, C. S., & Jucks, R. (2012). *Learning through online peer discourse: Structural equation modeling points to the role of discourse activities in individual understanding. Computers & Education, 58(4), 1127–1137.*

Merchant, Z., Goetz, E. T., Keeney-Kennicutt, W., Kwok, O., Cifuentes, L., & Davis, T. J. (2012). *The learner characteristics, features of desktop 3D virtual reality environments, and college chemistry instruction: A structural equation modeling analysis. Computers & Education, 59(2), 551–568.*

Chuang, H.-H., Weng, C.-Y., & Huang, F.-C. (2015). *A structure equation model among factors of teachers' technology integration practice and their TPCK. Computers & Education, 86, 182–191.*

Brown S. (1999) Reinventing the university. *Assoc Learning Technol* J; 6: 30-37. Fender B. The e-university project. London: Higher Education Funding Council for England.

Berns R. G., P. M. Erickson, "Contextual Teaching and Learning: Preparing Students for the New Economy", *The Highlight Zone: Research @ Work*, no. 5, 2001.

Hudson C.C., V.R. Whisler, "Contextual Teaching and Learning for Practitioners", *Journal of Systemics Cybernatics and Informatics*, vol. 6, no. 4, pp. 56-58, 2008.

Joseph F. Hair, G. Tomas M. Hult, Christian M. Ringle, Marko Sarstedt - A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM) (2013, SAGE Publications).

Karl G. Jöreskog, Ulf H. Olsson, Fan Y. Wallentin. Multivariate Analysis with LISREL (2016, Springer International Publishing)

Rohatgi, A., Scherer, R., & Hatlevik, O. E. (2016). *The role of ICT self-efficacy for students' ICT use and their achievement in a computer and information literacy test. Computers & Education, 102, 103–116.*

Almerich, G., Orellana, N., Suárez-Rodríguez, J., & Díaz-García, I. (2016). *Teachers' information and communication technology competences: A structural approach. Computers & Education, 100, 110–125.*

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