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by Jurnal Internasional Ijstr

Submission date: 13-Dec-2020 10:31PM (UTC+0700)
Submission ID: 1473710051
File name: ing-rbl-Model-In-Subject-Of-Electric-Power-System-Protection.pdf (171.92K)
Word count: 2663
Character count: 14604

Application Of Research Based Learning (RBL) Model In Subject Of Electric Power System Protection

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Abstract: This study aims to assess the effectiveness of student learning in the Electric Power System Protection subject after the use of the Research Based Learning model in learning. The learning model should be adapted to current and future learning needs. Achieving student competencies in learning in each subject, one of which is influenced by the learning model used. Among the learning models that are developing at this time which bring students to develop their abilities in mastering learning material is the Research Based Learning model. This model is a model that focuses on students as a learning resource (SCL) that integrates research into learning. This research in its implementation uses a Research Based Learning model developed by Sota and Karl.P, (2017). This model carries a nine step model that is applied in learning in the subject of Electric Power System Protection. After using the Research Based Learning model in learning, an increase in student learning outcomes is measured in the assessment of effectiveness through formative evaluation and summative evaluation.

Keywords: Subject of Electric Power System Protection, Research Based Learning Model, Effectiveness.

1 Introduction

The learning model today is sufficiently developed in providing solutions to problems that are obstacles in the learning process.[1] In the context of learning, the model is a way to simplify things that feel complicated into something simpler that can be in the form of physical or conceptual presentation of the learning system, and try to explain the linkages to the various components of the learning system into a comprehensible pattern or framework.[2][3][4] A learning model includes the entire learning system that includes the objective component, learning conditions, teaching and learning processes and evaluation of learning outcomes. According to Slavin (2010), the learning model is a reference to a learning approach including goals, syntax, environment, and management system.[5] A good learning model is used as a reference for planning in classroom learning or tutorials to determine learning tools that are appropriate to the teaching materials taught (Trianto, 2011).[6][7] The new model and currently being developed is the Research Based Learning (RBL) Model.[8] This model is a model of advancement in educational technology based on constructivism theory that offers a democratic, student-based learning environment, carried out with an inquiry process, oriented to obtaining a perfect understanding of theory and technology, authentic tasks, and scientific research implemented collaboratively (Gesa, S., 2012).[9] In its development, some researchers have implemented and developed this RBL model in learning in order to find solutions to learning problems, namely in the hope of increasing student competence by implementing the steps of the RBL model developed by the researcher. Some of them have succeeded in developing the model and applying it to learning with efforts to increase learning outcomes. Some studies that have also developed the RBL model in this study include research conducted by Sota & Karl. P., (2017); Christie, D., et al. (2015) outlined the increase in student competence with the RBL learning model. The development RBL model of inquiry-based learning (IBL) model has also been proven to be suitable for use in learning on computer courses in engineering students (Khaled, B.S., Mahmoud, A., 2012). Integrating collaborative learning models (CRBL) and RBL by making several step models for learners and facilitators successfully developed (Wang, H., et al 2008).[10] Seeing the development of this model and its application that can improve student learning outcomes, this model can be said to be feasible as a reference for teachers in the learning process. This model in its application is not limited to being implemented only in classrooms but can also be carried out outside the classroom, when viewed from the characteristics of the model integrated with research, the application of this model also proved to be suitable for training programs and research activities such as the final project. The right subject to be applied is this model, one of which is the Electric Power System Protection course.[11] Why is that, because in this course there are still various obstacles that occur in the implementation, thus, the impact on the achievement of competence is not optimal. Based on the literature review, there are several obstacles that lead to lack of achievement of competencies from the subject of Protection in Electric Power Systems is the lack of infrastructure such as laboratories. Protection laboratory equipment that is quite expensive is a problem in the procurement of equipment (Shahnia F, et al. 2014), even though the industry demands on graduates who have practical experience tend to increase (Ferris J. Bass R. 2013), besides the lack of learning media in the teaching and learning process it is also an obstacle in learning this subject (Brian. K, Robert. E. 2017; Ren. J, Kezunovic. M. 2010) and the model that has been used by teachers in the learning process is still limited. Shahnia F, et al. (2014) stated that the learning process in the Electric Power System Protection course is still limited to the lecture method with little practical experience. The approach taken by previous researchers in answering the above problems to improve student competence in the Electric Power System Protection course has been carried out. Regarding the lack of laboratory facilities and infrastructure, Ferris J. Bass R. (2013) designed the development of educational laboratories tailored to the needs of the industry which aimed to provide students with hands-on experience with industrial protection equipment and software through classroom-based courses. The second obstacle faced in the lecture of the Protection of Electric Power Systems is the lack of learning media, then Brian. K, Robert. E. (2017) develops computer simulation methods in facilitating learning of power system protection by using EMTP software while Ren. J, Kezunovic. M. (2010) performs modeling and simulation in applying protection relay on Smart Grid. Looking

for a solution to the limitations of the learning model in the course of Protection of Electric Power Systems, Farhad Shahnia F, et al. (2014) strive to improve student learning experiences through computer based simulations and practical experiments, where the previous tendency in learning this subject still often uses conventional models such as lecture models with little practical experience. They stated that to further deepen the understanding of students, so that the learning of the subject of Electric Power System Protection needed the right learning model. Shahnia F, et al. (2014) emphasize the suitability of the learning model that greatly determines the achievement of learning objectives.[12] Looking at the constraints, the RBL model is expected to be able to answer the shortcomings in the implementation of the subject of Protection of Electric Power Systems, namely in the form of minimum laboratory infrastructure facilities so that students do not / lack practical experience and the limited learning model applied. In this study, researchers used the RBL model developed by Sota & Karl. P which functions as a model that has been proven to be able to improve the student learning outcomes through the model steps that carry research in learning. This model consists of nine steps implemented in learning.[13]

2. METHODOLOGY

This research was carried out at Islamic State University of Suska of Riau in the Study Program of Electrical Engineering of Energy Concentration in the course of the Electric Power System Protection course by carrying out the RBL model developed by Sota et al. (2017) including: 1) identifying research topics, 2) formulating objectives and research questions, 3) determining search instruments, data collection instruments and intervention instruments, 4) formulating applied theories, 5) making research methodologies and designs, 6) analyzing data, 7) results and discussions, 8) recommendations, and 9) strengthening research. Implementation the steps of the RBL model are presented in classroom learning. In complete, the researcher can describe as follows:

Table 1. *Application of the RBL Model in the Power System Protection class.*

Weeks	Goals	Activities
1	Introduction	The distribution of lecture material is in accordance with the syllabus
1	Students are expected to learn the material related to the lecture and prepare a topic presentation according to each group's assignments	Assign students to study all topics in each group to prepare material according to the topic to be presented
1	Students search for research journals	Assign students to search for research journals
1	Students prepare presentations in the form of PPT for assigned topics and present them according to the steps of the RBL model	Assign students to study and focus on their research and also present it to each group to discuss their assignments on material topics and research by looking for sources from the journal.
2-7-9-14	Students prepare the material according to the assigned lecture topic and present it, then discuss it	Each group prepares material according to the topic of the lecture and presents it in the form of PPT in class
8	Ujian Tengah Semester	
2-7-9-14	Students search for journals related to research topics. Each group prepares a presentation to discuss and shares ideas	Each group looks for a research journal. Each group of students was asked to read, analyze, synthesize, and prepare PPT to be presented in class.
14	Question of Answers	Distributing questions
15	Final Semester Exam	

3. RESULT AND DISCUSSION

The application of the steps of the RBL model during the lecture by following the Sota steps has been carried out in learning in the course of Electric Power System Protection, the method used in assessing the effectiveness of student learning outcomes is carried out in the form of formative evaluation and summative evaluation.

a. Formative Evaluation

Formative evaluation is an assessment of student learning in the subject of the Electric Power System Protection by using the RBL model implemented in each step of learning. The researcher saw the development of learning in the classroom by evaluating the activities carried out in each step of the learning model. The following are the results of student activity assessment reports in each syntax / step model that has been implemented.

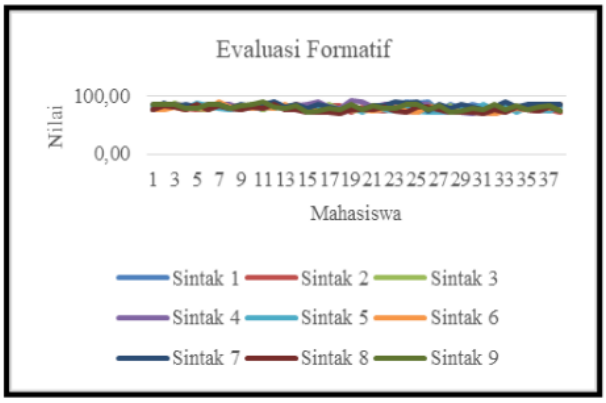

Figure 1. *Formative Evaluation Results.*

The results obtained by students in formative evaluation for each syntax have a value above 70, which has a good to very good category.

b. Summative Evaluation

Summative evaluation is done to test the effectiveness of the Electric Power System Protection course by providing multiple choice questions that have been tested for validity and reliability. The purpose of this evaluation is to test the level of student understanding of the material in the course. After the assessment was carried out on the test questions that were carried out, the results obtained by students after answering the given tests were re-analyzed by homogeneity test, normality test, and independent test sample T-test. The question was given to measure the cognitive abilities of students before learning the subject of Electric Power System

Protection (pretest) and at the time after the RBL (posttest) model was applied. The following are the results of the effectiveness test of summative evaluation.

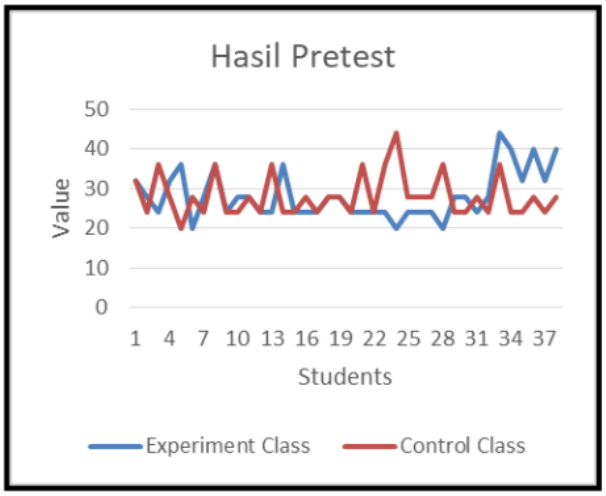

Figure 2. *Results of Pretest Summative Evaluation.*

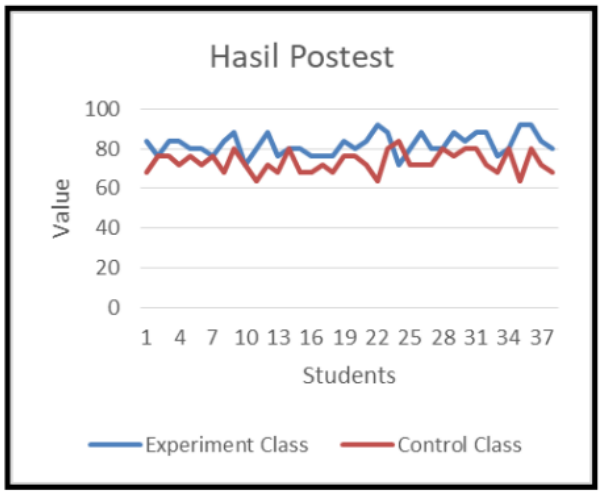

Figure 3. *Results of Posttest Summative Evaluation.*

An increase in student learning outcomes can be seen in Figure 2 and Figure 3. Measurement of learning outcomes is obtained by conducting statistical tests through homogeneity test, normality test, and test independent sample T-test (effectiveness test).

Table 2. *Results of homogeneity, normality test, and independent test of sample T-test.*

Test	Significance
Homogeneity	0,851
Normality	pretest = 0,07 posttest= 0,06
Independent of sample T-test	0,911

Based on the output of the homogeneity test results with the above SPSS, the value of Signification (Sig) Based on Mean is 0.851> 0.05, so it can be concluded that the variants of the posttest control class and the posttest of the experimental class are equal or homogenous. The results of the normality test were obtained from the significance value of the variant of the control class p = 0.07 so that p> α and for the experimental class variant significant value p = 0.06 so that p> α. Thus the sample comes from a population that is normally distributed. Based on the T-test output above, the sig value is obtained. (2-tailed) of 0.911> 0.05, then according to the basis of decision making in the independent samples T-test, it can be concluded that Ho is rejected Ha accepted which means that there are differences in the average posttest results in the control class and experiment class students. The results of the effectiveness test of this study state that there is a significant difference in the learning outcomes of the experimental class towards the control class. The learning outcomes of the experimental class show that learning outcomes increase when compared to the control class. So that it can be stated that learning with the RBL model developed has succeeded in increasing student learning effectiveness in the course of Electric Power System Protection.

4. CONCLUSION

After carrying out learning with the Research Based Learning Model in the course of Electrical System Protection, the results of the study prove that this model has succeeded in increasing student learning effectiveness through formative evaluation and summative evaluation by presenting the results of statistical tests (homogeneity test, normality test, and T-test) in this study. The test results state that the RBL model has significantly improved student learning outcomes.

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