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DEVELOPMENT OF COLLABORATIVE LEARNING MODEL BASED ON VIRTUAL LABORATORY IN HIGHER EDUCATION

*Rudi Mulya[1], Diki Atmarizon[2]

[1] Department of Informatic Technic, Nahdlatul Ulama Sumatera Barat, Indonesia
[2]Department of English Language Education, Nahdlatul Ulama Sumatera Barat, Indonesia
*E-mail: rudimuly4@gmail.com

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ABSTRACT

In this study, collaborative learning based on a virtual laboratory was developed because the existing model did not integrate collaborative learning with a virtual laboratory. The research step begins with designing a virtual laboratory portal with Moodle software to provide practical management services. The trial was carried out by running an online collaborative practice by implementing the Breadboard Simulator and the TeamViewer application. The research subjects were 30 students of the DIII Electrical Engineering study program. The data collection instrument used a student perception questionnaire on student perceptions about instructional aspects. Descriptive analysis was carried out using the criteria for the level of perception. The results showed that the virtual laboratory-based collaborative learning model had a positive perception of the instructional aspect and increased student motivation in carrying out practical activities.

Keywords: Collaborative learning, Virtual laboratory, Practicuum Digital Electronics

INTRODUCTION

21st-century skills require someone to master various skills including (critical thinking and problem-solving), (collaboration), (communication), and (creativity, and innovation) (Bialik & Fadel, 2015). Implicitly the development of 21st-century skills includes digital literacy skills needed in the era of the industrial revolution 4.0 (Ozer *et al*., 2015); (Vista *et al*., 2018); (Khasanova & Sanger, 2018). The challenges and opportunities of industrial revolution 4.0 encourage innovation in universities.

However, the results of the study show that high school and college graduates in the vocational sphere are not yet optimal in basic and applied skills including 1) communication; 2) critical thinking; 3) solving the problem; 4) professionalism and work ethic; 5) work as a team; 6) build work collaboration; 7) apply technology; 8) leadership; 9) self-discipline; and 10) project management (Sudira, 2018). This problem is reinforced by data on the number of unemployment in terms of education as of February 2019, where more and more diploma and university graduates are not working (BPS, 2019).

Universities need to innovate learning systems that target the shift from conventional learning to digital learning to face the existing challenges. Virtual classes and online resources (e-learning and virtual laboratories) can serve more effectively to learn from home (Ray & Srivastava, 2020).

However, its utilization so far has not been optimal because the material provided is still limited to face-to-face lectures, has not integrated the material in which it can be used as a reference for practical learning activities. Acquiring practical skills is a very important part of learning (Glassey & Magalhães, 2020). Along with the development of science and technology, especially information and communication technology, the concept of electronic laboratory (e-lab) has been developed. In its application, e-lab can be built in the form of a virtual laboratory (v-lab) and remote laboratory (r-lab). Virtual laboratories as an alternative solution to real laboratories are getting more attention in e-learning (Ahmed & Hasegawa, 2014).

Several reference studies have proven that virtual laboratories have advantages including (1) influencing students' knowledge, skills, attitudes, and achievements (Alneyadi, 2019); (2) accommodating larger groups (Coleman *et al*., 2019); (3) scores are more significant than real practice laboratories, (Domínguez *et al*., 2018); (4) effectively improve student laboratory experience (De La Torre *et al*., 2016); (5) reduce costs (equipment, space, and practical laboratory maintenance staff) (Ahmed & Hasegawa, 2019); (6) standing in balance with practical laboratories (Hawkins & Phelps, 2013); (7) offers flexibility during the teaching and learning process (Mikhaylov & Chernov, 2012).

Based on the results of the reference study above, the virtual laboratory-based learning model produced is still not optimal and there are still weaknesses, including the ability to work in groups that are less effective (Altalbe, 2018). The solution offered is to develop a virtual laboratory-based collaborative learning model. The reason for using collaborative learning is because it has advantages in four main categories, namely: social, psychological, academic, and assessment (Laal & Ghodsi, 2012).

COLLABORATIVE LEARNING MODEL

Collaborative learning is learning that includes a small group of students working together to develop the maximum educational experience possible. Then collaborative learning is the work of individuals as members of a group related to mental, emotional, and behavioral functions to achieve community goals and assist students in decision making and increase a sense of community (Johnson *et al*., 1998).

In collaborative learning there are five important elements (Gokhale, 1995): 1) positive interdependence; 2) individual and group accountability; 3) supportive interactions; 4) collaborative skills development; and 5) group processing. The characteristics of collaborative learning in the classroom based on (Matthews, 1996) are: 1) communication; 2) social interdependence; 3) student exploration; 4) promote interaction; 5) diversity between groups; 6) an assessment that is not only based on group performance but also individual performance. The advantages of collaborative learning are in four main categories (Horton, 2006) namely: social, psychological, academic, and assessment. Weaknesses: 1) students' opinions and questions can deviate from the subject matter; 2) takes quite a lot of time; 3) the existence of personal traits that want to stand out or vice versa who are weak feel inferior and always depend on others. The following are the steps of the collaborative learning model in previous research as Table 1 below.

Table 1 Collaborative Learning Model Steps

Researcher	Syntax
(Reid, J., Forrestal, P., & Cook, 1989)	1. Engagement 2. Exploration 3. Transformation 4. Presentation 5. Reflection
(Barkley, Elisabeth E,	1. Orienting students

Researcher	Syntax
2012)	2. Forming group 3. Designing the learning task 4. Facilitating student collaboration 5. Grading and evaluating collaborative learning
(Restrepo *et al*., 2014)	1. Establish the collaboration 2. Process of dialogue 3. Process of discovery 4. Applying new knowledge
(Zurweni *et al*., 2017)	1. Apperception 2. Axploration 3. Collaboration 4. Creation 5. Evaluation 6. Feedback
Developed models	1. Orientation 2. Arrange assignments 3. Discovery process 4. *Online Collaborative* 5. Presentation 6. Evaluation

MATERIALS AND METHODS

This study uses development research methods. The research design used the R&D model from Borg & Gall. Product trials are carried out by experts/experts, limited trials, and extended trials. The test subjects are 1) Experts (construct and content validation are experts on media, materials, learning models, language, and evaluation experts). The expert trial was carried out using the Forum Group Discussion (FGD) technique; 2) the limited trial subjects were experts and users (lecturers and digital electronics course participants 6 students), the trial subjects were expanded to 30 students in the DIII Electrical Engineering study program Padang State University. The research method used is a quasi-experiment with the experimental form of One-Group Pretest-Posttest Design.

The data for analysis were collected using a questionnaire on the subject's perception of the product display on the aspects of instructional and ease of operation. The instrument of subject perception in the instructional aspect in the form of a questionnaire adopted (Muchlas, 2014): 1) clarity of basic competencies and goals; 2) clarity of learning instructions; 3) ease of understanding the practical material; 4) the accuracy of the order of presentation; 5) the breadth and depth of the material; 6) flexibility; 7) interactivity; 8) evaluation accuracy. To determine the successful implementation of virtual laboratory-based collaborative learning, the collected data were analyzed descriptively using the eligibility criteria as presented in Table 2 below.

Table 2 Product Eligibility Criteria and Perception

Scoring scale	Level
80% - 100%	Very Good
66% - 79%	Good
56% - 65%	Low
0% - 55%	Very Not Good

RESULTS

3.1 Student Perceptions of the Instructional Aspect

Student perception testing Table 3 contains information about the instructional aspects of the Digital Electronics Practice based on a digital laboratory.

Table 3 Student Perceptions About Instructional Aspects

Component	Student		Maximum Score
	Score	%	
Clarity of basic competencies & objectives	726	69,14	1050
Clarity of learning instructions	339	75,33	450
The breadth and depth of the material	336	74,66	450
Ease of understanding material & running practices	403	67,16	600
The accuracy of the order of presentation	458	76,33	600
Flexibility	212	70,66	300
Interactivity	225	75	300
Evaluation accuracy	582	72,77	750
Total	3281		4500
% average		72,91	

Based on the findings of the perception component analysis on aspects of learning, it is possible to conclude that students have positive perceptions with an average percentage of 72,91%.

Practice Digital Electronics, which is typically done in real-world laboratories, has some limitations. As a result, the research is conducted in a virtual laboratory. The results obtained show that students have positive perceptions of the instructional aspects and the appearance of the virtual laboratory model. These findings are consistent with (Prieto-Blázquez *et al.*, 2008) who state that virtual laboratories are just as effective as real laboratories, can be done anywhere and at any time (Utami *et al.*, 2018), and allow students to learn independently and practice outside of class (Palagin *et al.*, 2007).

The positive relationship between the use of virtual environments and student performance. The JavaBreadboard Simulator, a supporting application included in the virtual laboratory, can be used to simulate and prove concepts related to digital electronics courses. This is consistent with the findings of the research (Kumar & Kumari, 2016), (Abreu *et al.*, 2015) that show simulators can improve students' understanding of learning material. Collaboration in a virtual laboratory can also be done online using a supporting application, such as TeamViewer, which provides a collaborative approach with an online meeting device.

CONCLUSION

The results showed that the developed virtual laboratory-based collaborative learning model could be implemented. This is based on positive perceptions from students both from the instructional aspect. This model can also increase student motivation in carrying out practicum.

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