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The Effect of Blended Learning Model to Improve the Conceptual Understanding of Computer and Network Engineering Students

The Effect of Blended Learning Model to Improve the Conceptual Understanding of Computer and Network Engineering Students

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Abstract. Grounded by students' lack of conceptual understanding in identifying and comprehending basic concepts of computer network, this quasi-experimental study aims to identify the effect of applying blended learning model toward the improvement of students' conceptual understanding. It was designed using non-equivalent control group design in which the experimental group and the control group were differently treated using, respectively, blended learning and conventional learning model. There were 58 students selected as the sample of the research; 30 students in experimental class and 28 students in control class. Essay test was chosen to collect the data of the conceptual understanding of the students in both groups. Using MANOVA, the data analysis revealed the significant effect of applying blended learning model toward students' conceptual understanding with $P = 0.000 < 0.05$ of significance level. In conclusion, the result of study identified that 1) the students who taught using blended learning model performed better mastery of basic concepts of computer network with the average score was 74.86, valued in high category; 2) there was a significant difference of conceptual understanding improvement between the group taught by applying blended learning and those by conventional learning model in learning basic computer network.

1. Introduction

The exponential growth of information and communication technology (ICT) in this 21st century has beneficially contributed to many areas. In educational field, an attempt to utilize ICT within instructional methods and strategies has been increasingly developed for the purpose of improving the quality of instruction and expanding students' learning experience. Those who endorse the use of ICT in educational context have grounded their ideas on that ICT has a profound impact which offers new ways of producing, distributing and receiving a learning content (Wang, et. al, 2019). The use of ICT in teaching learning process has also maximized the stage for learning that occurs not only inside a classroom through face-to-face experience but also through the outside-distance learning.

With respect to the fruitfulness of employing ICT in educational field, many believe that learning is better conducted in between the use of ICT and face-to-face experience due to the fact that each extreme has its own particular weaknesses. Kanuka & Anderson (2007), for instance, affirm that using ICT without direct instruction does not allow direct physical interaction among students and students-teacher interactions. This neglects the importance of direct verbal and non-verbal communication which are more able to perceive and sensitize students' different psychological development like feelings,

emotions, and motivations that highly support and determine students' learning achievement. Additionally, ICT alone lack the devices and abilities to develop complex cognitive and social skills and may not fully comply with faculty and individual needs for learning (Wright, 2017). On the other side, face-to-face in-class instruction also has weaknesses in many aspects. One most obvious weakness of it is related to the limitation of learning access. This instruction tends to posit teacher as the main, if not the only, source of knowledge which in turn may lead to students' lack of autonomy in learning and accessing learning content. In line with this limitation, face-to-face instruction also ignores the potentialities of exploring myriad and abundant learning resources offered by other than the teacher who is standing and lecturing in front of the class. Still, learning is then constricted by the only resource the teacher has given to the students to learn from.

For this reason, the idea to combine and integrate ICT in traditional learning activity, commonly termed as blended learning (Wright, 2017), has been a growingly interested learning model in many disciplines worldwide, as well as in Indonesia. Bhonk dan Graham (in Thorne, 2003) define blended learning as *"the combination of instruction from two historically separated models of teaching and learning traditional learning systems and distributed learning systems which emphasizes the central role of computer-based technologies"*. It is believed to play a significant role to assist and optimize face-to-face teaching and learning process (Wang, et. al, 2019) by providing additional platforms for learning outside the classrooms where students can self-directedly access learning materials they need. More specifically in practice, blended learning combines the benefits of collaborative, independent, and problem-based learning to reach the broadest range of learning types by involving providing physical and virtual environments and a wide variety of media (Lothridge, 2013).

Studies related to applying blended learning in Indonesian context have proved its significance to enhance learning which in turn enhancing students' conceptual understanding. Conducting an R&D study subjecting physics education college students, Suana et.al (2017) confirmed that schoology-based blended learning media is able to improve students' conceptual understanding and problem-solving ability. They argued that the effectiveness of this approach is contributed by its ability to promote students' autonomy to access learning material. Added to this, Isti'anah (2017) reported that not only does blended learning promote students' conceptual understanding but also their interest and motivation to learn. In her study using Moodle, a kind of online learning management system (LMS), she found that students' interest and motivation in blended learning instruction leads positively to the development of students' cognitive behavior. Meanwhile, Ekayati (2018), in her qualitative study of applying Edmodo for blended learning instruction, proposed that blended learning is widely making possible to escalate learning quality and intensity that may result positively to students' conceptual understanding.

Drawing attention by these abundant potentialities, this study is conducted to investigate the effectiveness of applying blended learning to improve conceptual understanding of computer and network engineering vocational school students. The empirical problems have been identified: 1) the students lacked of conceptual understanding of basic computer material that hampers their performance in designing computer network. It was proved by students learning achievement where their scores only ranged from 50 – 65, far below the passing grade standard (70); 2) the use of conventional lecturing model was not be able to stimulate students' motivation and interest to learn. This ironic situation is caused by teachers' ability and opportunity to provide ICT integrated material; and 3) learning supporting devices and tools were not fully optimized to create effective learning activities. In line with this, the research problem of this study is formulated as follows:
How does blended learning model effect to the improvement of students' conceptual understanding?

2. Research Methods

This research was to investigate the effectiveness of blended learning model in improving conceptual understanding of computer and network students. It was designed quasi-experimental research of nonequivalent control group design. The research subject was 58 students of class XI of Private Vocational School of Informatics Engineering Santo Petrus Ruteng in 2018/2019 academic year. They were divided into two groups: 30 students were in the experimental group and 28 students were in the

control group. Blended learning, the investigated learning model, was treated to experimental class with the procedures displayed in table 2. Meanwhile for the control class, conventional lecturing model was applied. The learning topic chosen for both groups was basic computer network materials. The instrument of data collection using in this study was essay test of students' conceptual understanding. After collecting, the data was then analyzed using MANOVA assisted by SPSS 25.

Table 1. The Experimental Research Design

Group	Pretest	Treatment	Posttest
Experiment	O_1	X_A	O_2
Control	O_3	X_B	O_4

(Adaptasi Campbell & Stanley, 1963)

E : Experimental Group
K : Control Group
O_1 : Pretest of Experimental Group
O_2 : Posttest of Experimental Group
O_3 : Pretest of Control Group
O_4 : Posttest of Control Group
X_A : Treatment of Experimental Group
X_B : Treatment of Control Group

Table 2. Design of Blended Learning

Activity	Phases of Blended Learning Model	Steps for Learning the Blended Learning Model	Times	Platform
Introduction	First phase, *seeking of information*	The teacher asks students to download the materials previously uploaded by the teacher in the used learning platform.	10 minutes	*Google Class Room*
Core activities	Second Phase, *acquisition of information*	The teacher explains the learning competence and objectives to initiate students' readiness and prepare them to explore the relevant materials through face-to-face learning as well as technology-assisted blended learning.	5 Minutes	
		The teacher explains and demonstrates the steps of PAN and LAN network simulation, while students are asked to observe the activity. The teacher confronts students' idea or thought after the observation with the result of their interpretation of various-provided sources in the learning platform.	30 Minutes	*Cisco Packet Tracer*
		The teacher assigns students to do exercises about PAN and LAN computer network simulation and asks them to discuss in groups to accomplish the task.	30 minutes	*Cisco Packet Tracer*

		The teacher asks students to send their works via email.		*Google Mail*
Closing	Third Phase, *synthesizing of knowledge*	The teacher helps students synthesizing knowledge into their cognitive structure. The teacher and students make a conclusion about ways of designing computer network. Students reflect their learning mastery by making a record.	15 minutes	

3. Result and Discussion

3.1. Posttest Data of Students' Understanding of Concept

The posttest is provided to know students' understanding of concept after applying a treatment. The posttest scores of understanding of concept is as shown in Table 3.

Table 3. Posttest Result of Students' Understanding of Concept

Class	Sample	Results		Average
		Maximum Score	Minimum Score	
Experimental group	30	84.00	64.00	74.86
Control group	28	78.00	58.00	67.89

The analysis results of students conceptual understanding after implementing blended learning model showed the average mark of 74.86; the highest mark was 84.00 and the lowest one was 64.00. The students were grouped based on the initial ability by referring to the pretest analysis results. The groups were divided into two categories, namely, a. the group of students with the high initial ability; b. the group of students with the low initial ability. This categorization was resulted from initial calculation interval based on the difference between the highest score with the lowest score. The difference was then divided by the sum of two appropriate categories. After the interval specified, then students were classified according category the intervals. The students in the experiment group, with high and low initial ability were 45.00% and 55.00% respectively. While in the control group they were 35.00% and 65.00% respectively.

3.2. The effect of applying blended learning model toward students conceptual understanding.

Before taking into the statistical computation, the hypothesis of this research problem is formulated as follows:

H_0 : There is no significant difference of students' conceptual understanding between those treated using blended learning model and those treated using conventional learning model.

H_a : There is significant difference of students' conceptual understanding between those treated using blended learning model and those treated using conventional learning model.

Table 4. Hotteling's Trace Testing Result

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.967	799.221[b]	2.000	2.000	.000
	Wilks' Lambda	.033	799.221[b]	2.000	2.000	.000
	Hotelling's Trace	29.063	799.221[b]	2.000	2.000	.000
	Roy's Largest Root	29.063	799.221[b]	2.000	2.000	.000

Class	Pillai's Trace	.351	14.862[b]	2.000	55.000	.000
	Wilks' Lambda	.649	14.862[b]	2.000	55.000	.000
	Hotelling's Trace	.540	14.862[b]	2.000	55.000	.000
	Roy's Largest Root	.540	14.862[b]	2.000	55.000	.000

Based on the table 4, the result of Hotteling's Trace testing was significantly different in which the significance level (P) was 0.000 < 0.05. The result of statistical analysis rejects the null hypothesis (H_0) and confirms the alternative hypothesis (H_a). Therefore, the application of applying Blended Learning model effects positively toward conceptual understanding of class X Private Vocational School of Informatics Engineering St. Petrus Ruteng.

Blended learning can improve conceptual understanding because this model helps students to more develop in the learning process, in accordance with learning styles, preferences in learning provides realistic and practical opportunities for teachers and students. That makes the learning be more independent, useful, and grow (Prabowo, 2014). Blended learning model is not monotonous but it is always evolving to improve training. Lessons become interactive sessions that teachers and students look forward to and enjoy. Blended learning enables students to stay focused for longer which brings them academic success. Digital learning mechanisms can sustain the interest of students through graphics, videos and other methods. Teachers have the freedom to create instructional videos and give real-time feedback that promotes engagement with students.

The recognizable impact from blended learning that had been conducted are 1. The students are more enthusiastic with blended learning because the learning process becomes more interesting and not monotonous, (2) by implementing blended learning, teachers can observe students' activities out of school hours and (3) the students can explore other learning resources besides in classes. It is in compliance with Dwiyogo's statement (2010), that blended learning is the best choice to improve effectiveness, efficiency and attractiveness in humans' interaction in various learning environment. Blended learning offers opportunities to learn in groups and to learn individually, as well as in the same or in different time.

The consideration to organize the blended learning composition to be 50/50, 75/25 or 25/75 depends on targeted competence analysis, subject's goal, learner characteristic, face-to-face interaction, online or combination learning strategies, learner's location, teacher's competence and characteristic and available resources (Dwiyogo: 2010). Based on cross analysis toward those considerations, teachers will be able to decide the most suitable learning composition (percentage). Nevertheless, the main consideration in planning learning composition is providing the learning resources which is suitable for various learners 'characteristics in order to learn more effective, efficient and interesting.

3.3. Students' response on the application of blended learning model

To identify students' response on the application of blended learning model, the Likert scale questionnaire was analyzed using descriptive statistics, assisted by Microsoft Excel program. The questionnaire was distributed to the students in experimental group to reveal students' response related to blended learning model in two main aspects: 1) students' response related to learning strategies in blended learning model and 2) students' response regarding the efficacy of applying blended learning model to solve problem in the classroom. The result of the analysis of the questionnaire is displayed in figure 1.

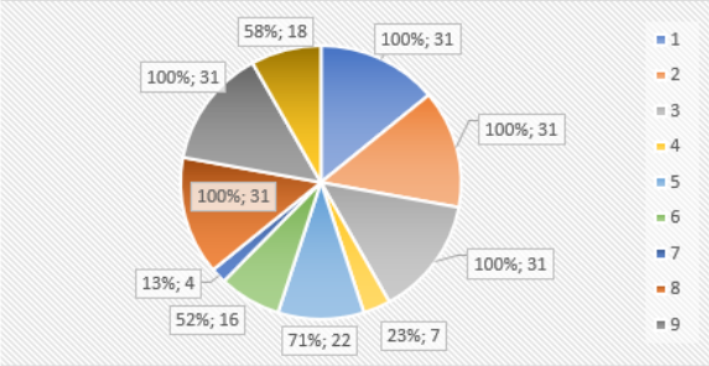

Figure 1. Students' response on the application of blended learning model

The data analysis of the questionnaire shows that most of the students in experimental group have positive response to the application of blended learning model in the classroom. In term of learning strategies of blended learning model, the result of data analysis shows students' high enthusiasm to engage actively in blended learning. This finding endorses the theory saying that blended learning model turns the learning approach in the classroom from teacher-centered to student-centered learning (Park & Ertner, 2007) and results positively to students' active and independent learning (Tarhan & Ayyıldız, 2014; Ramstedt et.al., 2016). Dealing with the efficacy of blended learning to solve students' classroom problem, the data analysis also reveals students' high belief on blended learning model. The students have high belief on blended learning model that can encourage them to be involved in learning real-life problems, enriching problem-solving skills, encouraging multidisciplinary learning, fostering independent learning, facilitating learning to search for information, and enhancing learning of conceptual understanding.

4. Conclusion

In conclusion, as the quality of learning process is characterized by its ability to bridge students' knowledge gap, treating students to involve actively in its process has now become an ideal, yet fruitful learning model. Studies related to applying blended learning in Indonesian context have proved its significance to enhance learning which in turn enhancing students' conceptual understanding. Blended learning is widely making possible to escalate learning quality and intensity that may result positively to students' conceptual understanding. This study confirms that challenging and engaging students' self-directed learning of problem-related concepts is able to accelerate students' conceptual understanding. By its reciprocal relationship, students' conceptual understanding may improve gradually as the result of the precise application and the frequent use of blended learning model in classrooms.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8