

Comparison Study Between Lecture, Discussion and Collaboration Methods in Learning of the Concept of Basic Electric Circuits

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ABSTRACT--Electricity contributes to technological development so that there is an industrial revolution 4.0 in the 21st century era. Basic electric circuits (BEC) is a subject matter that must be mastered by students who pursue Electrical engineering technical competence in the Vocational Technical School (VTS). The teaching method plays an important role in the learning activities of BEC in the classroom. The use of appropriate teaching methods can help students understand the concepts of BEC subject matter. In Indonesia, there are still many teachers using the lecture method in learning activities so students often have difficulty learning the BEC concept. This study aims to conduct a study to compare lecture, discussion and collaboration methods in BEC learning activities. Participants in this study consisted of 79 students and 3 teachers. The research method is an experiment to compare the effectiveness of lecture, discussion, and collaboration methods. Data analysis uses Covariance Analysis (Ancova) to compare teaching methods and N-Gain Score testing to study the effectiveness of teaching methods in learning BEC concept.

Keywords--Lecture method, discussion, collaboration, concept understanding, basic electric circuit.

I. INTRODUCTION

Vocational Technical School VTS students were required to study the basic subject matter and to apply in work place or industry in order to face the challenge of industrial revolution 4.0 in 21st century. Electrical engineering students were obliged to study and to comprehend the BEC concept. Electricity was a part of basic concept of science subject; physics [1]. There were so many student having difficulties in learning the BEC concept for electricity was considered abstract phenomenon [2] that caused students experienced misconception [3–7]. What meant by misconception was students had different knowledge and concept from natural phenomenon and scientists' concept [8]. Misconception tool place because in the material there were so many formulas that linked to one another [9]. Therefore, students experienced misconception for they learned the Ohm concept in which there were numbers of formulas to comprehend and were related to each other. Reference [9] stated that students' perception caused the misconception extended for they were used to integrate with the physical environment. For instance, students had the access to directly interact with the electrical devices (electric installation, cooking equipment, washing machine, etc.) and electronic devices (computer, cellphone, and others) in their surroundings.

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Numerous academics from all countries over the globe had undertaken research on the misunderstanding and misconception regarding the electric subject matter [10–17]. Researchers in Indonesia recently reported their research finding that students' misconception with regard to electrical series was up to 83% while 17% did have the concept understanding [18]. Based on the observation in some provinces in Indonesia, one of the factors that contributed to this misconception was teacher still using the lecture method. This was relevant to what stated by the reference [19] that teacher was one of the casual factors to students' misconception for they did not use the appropriate teaching method. teaching method must be in accordance with the material and students' need [20]. The usage of lecture method was used in conventional teaching, there was only one-direction communication taking place for it put teacher as the center of attention while students who did not actively interact only taking down notes, listening to the material presented by teachers and passively receive [21, 22]. In discussion method, communication was built in a group consisted of several students who put forward their ideas [23]. The disadvantage of discussion method was teacher only supervised and did not actively took part in the discussion. Teacher who had pedagogical competency, had the skill and was able to apply the appropriate teaching method in line with the material, such as collaboration method. Ones who had collaboration teaching skill were able to communicate the concept of the material as well as to connect current, different potential and resistance put forward by Ohm so that it would bring positive impact to student's learning achievement on electrical direct current subject.

1.1 Statement of the problem

VTS students experienced in applying Ohm law in an electorol series because they less understood the basic concept of electricity such as capacity, current, different potential and resistance. This difficulty was caused by teacher not having the skill to turn the misconception students had while learning process. Students stood with their own concepts that were not in line with the scientists'. In teaching activity, teacher used inappropriate method such as lecture and discussion method. Teachers who had the pedagogical competence would be able to use appropriate method for EDC learning, such as collaboration method. In this method, teacher would be able to communicate the material to students to establish an effective knowledge transformation.

Students' difficulties in implying the concept of Ohm law in BEC series were caused by the fact that they did not own total understanding of it.

1.2 Research question

The following questions were addressed for this research:

- a) How was the process of teaching while teacher using the lecture method, discussion method and collaboration method to comprehend the concept of BEC?
- b) Was there any difference in terms of students' achievement as lecture method, discussion method and collaboration method were used?

1.3 Purpose of the study

is study aimed to know:

- a) Difference found in EDC concept learning while in the lecture method, discussion method and collaboration method.

b) The effectiveness of lecture method, discussion method and collaboration method toward student's learning achievement in EDC learning concept.

1.4 Research hypothesis

Research hypothesis was to compare the average score of students' achievements in using lecture method, discussion method and collaboration method in learning BEC concept.

II. LITERATURE REVIEW

Before teachers were assigned to teach, they had already experienced education process and been trained to obtain pedagogical and didactical competence to undertake the guide line of teaching activity to inform and to construct concept of definition, to observe phenomenon and fact, to value the difference each student had and to direct the learning process to a situation that developed students' knowledge [24]. Although teacher had stepped into the education process and pedagogical training, yet, there were still many of them using their own self-method without paying attention to the content that would be presented to the students such as BEC. The following were methods used in teaching activity.

1.5 Lecture method

Lecture method has been known for such a long time and has been used by teacher to transmit cognitive comprehension to groups of students [25]. Generally, lecture was a method in which teachers stood in front of the classroom and were occupied writing down the material [26]. In this method, teacher was seen as an expert [27], using the lecture method to present the material [28–30]. Learning by using lecture method, was less interesting to students. Instead it was boring that caused students did not work the assignment out [31, 32] and did not obtain good result [28–31]. Lecture is monotonous [22] [33] students sometimes played around, became sleepy and fell asleep in classroom [34]. The research finding showed that teaching by using lecture method turned students down and less mastered the material [21]. Empirical study conveyed that active learning was more prominent than lecture method [35]. Although lecture method had sometimes been criticized over, the fact showed that it could still stand in this technological development era [36]. According to the reference [37] lecture method transmitted small amount of knowledge for it was able to discuss many points but it did not always catch students' attention. According to the reference [38] that only students who were well prepared could go through the learning process delivered in lecture method. This perception spilled that lecture method own many disadvantages with it that later had impact to students' achievement.

1.6 Discussion method

Discussion was not a new term in learning activity. Group discussion consisted of some forms namely small group, sitting in circle, panel discussion and debate [39]. Discussion method was a group learning led by one of students in the same group [40]. Discussion could raise self-confidence [41]. On principle discussion method, knowledge and ideas from number of students might lead to answer as a solution to particular issue [42]. Discussion

method was a forum where students' ideas were exchanged [39]. Discussion was a type of activity that turned a class into small groups to effectively speak about certain topics or to address issues. This was a process of thinking together where students had the access to freely speak or interact with the teacher. This process put students in the center because students needed to actively participate [39]. Teacher played the role as moderator. There was stream from teacher to students as well as from students to one another. Teacher should not let an individual dominated the discussion [43]

Discussion learning method was beneficial to students. It brought out advantaged result to the students [39, 40]. In certain situation, discussion method would involve students' spoken or written expression [44], in group discussion, there would be provocative question to trigger their critical thinking in minutes. According to the reference [45], the quality of the group discussion sometimes emerged to some elementary and junior high school students.

This method could lead to students' active participation [46], self-confidence and leadership skill [47]. A researcher [39] concluded that discussion method could increase students' potential.

The perception above showed that discussion method had certain prominence to be applied in learning activity and had positive impact to students

1.7 Collaboration method

In 21st century, collaboration method had become a trend to collaborate in thinking, resolving global issues that had been noticed internationally [48]. Collaboration was teaching model that had been applied in varied field of science [49]. Collaboration method of an intellectual approach hired the collaboration of teacher and students, students as well as the collaboration of students with their classmates to solve the problem, to finish the task and to have ready product [50, 51].

The collaboration teaching of an activity that promoted the most effective teaching [52]. Collaboration teaching would increase students' interest and promote critical thinking [53]. Researcher found that students facing some issues in collaboration learning. These issues occurred because students did not listen or interrupted others' opinion and refuses suggestion [50] the lack of collaboration skill would slow students down in learning the material [54].

Researcher reported the issues in collaboration teaching such as organizing of learning activity, teacher's less supervision towards students' behavior, managing the learning time distribution, preparing relevant material, and developing students' behavior [55]. This issue was caused by teachers who did not have themselves prepared to collaborative work and less productive [56] and organizing collaborative work as facilitating the activity process and teachers' less attention [57]. Based on that point of view, it conveyed that teachers might be able to comprehend and apply the collaborative teaching so that students would comprehend the concept of BEC

III. METHODOLOGY/MATERIALS

3.1 Participant

79 students and 3 teachers of Electrical Engineering subject participated I this research. This research was undertaken in Vocational Technical School in Manado, North Sulawesi, Indonesia

3.2 Design

This research was an experimental research to compare the teaching by using lecture method, discussion method and collaboration one. This research was to study the pros and cons as well as the effectiveness of those three methods in learning the concept of BEC.

3.3Instrument

3.4Data Analysis

To analyze the data, Analysis of Covariance Statistics was used which was an analysis to study the effectiveness of teaching with lecture method, discussion method and collaboration one. The analysis result would be the reference to do relating discussion with the writing of this article.

3.5Procedure

Teaching was applied by three teacher who had relevant background in VTS. They had all taught BEC over 10 years. Each of them was assigned to undertake the teaching by using one method which was different from what others would apply. Before the experiment took place, they were directed by the researcher regarding their own further tasks. 27 students attended the class where lecture method was held, 27 students attended the discussion method class, and 28 students went to the collaboration method class. The undertaking of the experiment took place 8 times meeting, each meeting took 90 minutes duration. Test was held in their last meeting as 90 minutes long. During the test researcher involved in observation and did the interview was taken to end the treatment.

IV. RESULTS AND FINDINGS

The result of treatment was described in Table 2.

Table 2: Pretest dan Posttest Data

Method	N	Pretest		Posttest	
		Minimum	Maximum	Minimum	Maximum
Lecture	27	22	41	43	59
Discussion	27	22	39	54	68
Collaboration	27	19	38	65	81
Total	81				

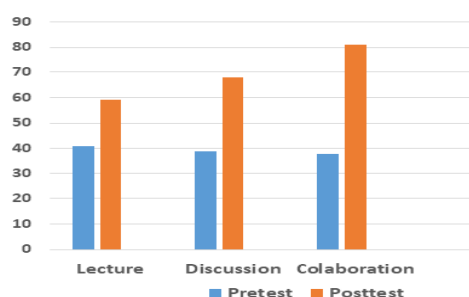


Figure 1: Pre-test and Post-Test Diagram

The requirements of Anova Statistics examination were the research data needed to be normally distributed and the variance of research data group were homogenous.

Table 3: Tests of Normality

Method	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Lecture	0.134	27	0.200	0.961	27	0.386
Discussion	0.158	27	0.083	0.960	27	0.373
Collaboration	0.095	27	0.200	0.970	27	0.648

The criteria of data normality test were if sig. Score was above $\alpha = 0.05$, it can be concluded that the research data distribution was normal. Table 3 showed Sig. > 0.05 . It explained that the research data of those 3-teaching method was normally distributing.

Table 4: Test of homogeneity of variances

Levene Statistic	df1	df2	Sig
0.889	2	78	0.416

Sig. Score showed in table 4 was $0.416 > 0.05$. The result showed that all these teaching methods were categorized homogenous and had same variances.

Table 5: Students' average achievement

	Sum of Squares	df	Mean Squares	F	Sig.
Between Groups	7656.469	2	3828.235	229.354	0.000
Within Groups	1301.926	78	16.691		
Total	8958.395	80			

The result of analysis in table 5 showed sig. score as $= 0.000 > 0.05$. This result proved that students' average achievement on these three teaching methods were significantly different.

Later on, effectiveness analysis was taken from three teaching method in learning the BEC concept.

Table 6: The categorization of effectiveness N-Gain Score [60]

Percentage (%)	Interpretation
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< 40	Not effective
40 – 55	Less effective
56 – 75	Effective enough
> 76	Effective

Tablee 7: N-Gain score

Method	N	Mean N-Gain Percent	SD
Lecture	27	28.30	3.53
Discussion	27	40.26	2.77
Collaboration	27	63.63	3.56

A good teaching depends on an appropriate method. Students' low learning achievement taught by using lecture method [26] because the learning process was a teacher-oriented one. students became passive and only memorize the material [58], this type of teaching made students tired and felt bored easily for students only listened to what a one-way instruction teacher had to say [59].

This research finding was relevant to the reference [60] which showed the effect of discussion method was more prominent than a conventional method one, because the use of lecturing method only caused less of critical and creative thinking as well as collaboration problem solving [61].

The learning result by using group discussion was above the lecture method because discussion session was more effective than lecture method [37] has an opinion that discussion session was more effective than lecture session in stimulating students' interest and in viewing their understanding about the material. As stated by Bloom quoted by reference [62], the use of lecture method was determined by the certain objective by the teacher, which was able to communicate the information in an efficient way, but discussion method has certain prominent in developing students' critical thinking skill, problem solving and in transforming students' behavior. Teacher who applied discussion method would motivate students [41] [62] and behavior [63]. Therefore, the overviews on some references addressed the teaching of discussion method that could stimulate interest, behavior and motivation. This was an aspect in affective field that actively support students' cognitive skill [64].

Other than that, there was an increase in terms of interest in academic community to investigate the students' conceptual comprehension.

Besides, there was an increase in the academic community to investigate vocational students' conceptual comprehension about electricity and to find out ways to develop the conceptual comprehension between students [10] [65]. Solution was offered to overcome the conceptual issues regarding electricity, but with limited success [66] and these topics still drew attention [12] [17] [67, 68] that less of communication occurred between teacher and students. In Indonesia, there were still many teachers using the conventional method in delivering the material of BEC subject. Teachers who already had pedagogical competency through the education and training were expected to have varied skills and strategies to apply in teaching activity in the classroom to create an effective communication between teacher and students. Teachers who had the collaboration skill in teaching activity to

communicate the concept of BEC material which was abstract so that students could be motivated to think along with their classmates and eventually they could find the concept taught in line with real life in their surroundings. Apart from the advantages in discussion method, reference [69] had opinion about it that there were limitations in this method such as domination by certain students in a session; other students might not participate at all in the discussion and that the discussion could be taken out of its context [41] wrote that sometimes discussion flowed well but there were times it got slower and lost its effect [44].

The problem found in teaching by using discussion and collaboration method was on students' mental issue such as shy that they were less able in discussion and collaboration with teacher and other students.

Some students were shy but did not find difficulties in following the learning process but their ideas and opinions were not delivered in class but rather they received information from teacher and other students that benefited themselves. In collaboration learning, there would be analogical thinking to provide clarity about the BEC material with its abstraction so that students would be able to comprehend the concept that were being learned [70].

V. CONCLUSION

According to the result and research finding about BEC learning achievement in using these three teaching method, it could be concluded that: (i) there were significant difference between the achievement of these three methods; (ii) the achievement of students who were taught in collaboration method was higher than taught in either discussion or lecture one; (iii) the result obtained by discussion method was higher than lecture one; lecture method was un-effective; (iv) the use of discussion method was less effective; and (v) collaboration method was sufficiently effective.

This research finding could be taken as reference for teacher to apply collaboration method compared to either discussion or lecture method in BEC learning.

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