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A Study of Virtual Learning Methods for Series and Parallel Electronic Circuit Using DCACLAB

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Abstract

This study aims to compare the effects of two methods of teaching (virtual versus traditional) on student learning of series parallel circuit. Virtual learning is a learning experience that is enhanced through utilizing computers and/or the internet both outside and inside the facilities of the educational organization. The instruction most commonly takes place in an online environment. The teaching activities are carried out online whereby the teacher and learners are physically separated (in terms of place, time, or both). This kind of learning method has been applied for teaching series and parallel circuit for Electrical Technology Course in Politeknik Ibrahim Sultan. Practice in the laboratory is important to produce highly skilled engineering graduates. Electrical Technology Course is a course that needs to be learned by Mechanical Engineering students where students need to understand the basic concepts of electricity used in mechanical which is the most important topic in this course is Series and Parallel Circuit. However, it always causes problems for Mechanical Engineering students due to weaknesses in mastering the concept, this causes students to not be able to make effective circuit connections and subsequently unable to analyze the circuit to obtain current and voltage value readings. Finally, it affects the level of motivation of students in carrying out practical work for this course in particular and courses related to electrical and electronic circuits in general. To overcome this problem a teaching and learning method for parallel series circuits has been developed through a virtual approach using DCACLAB applications. This method of approach can increase the level of understanding of students in turn can improve the number of marks obtained. In addition, the amount of time in performing the lab practice can also be reduced and in turn give students the opportunity to try the task repeatedly. This teaching and learning innovation can also make it easier for lecturers to make demonstrations and in turn trigger students' interest to perform practical in the laboratory.

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Key-word: - series parallel circuit, virtual learning

1. Introduction

Connection of series, parallel and series circuits is a basic technique that students need to master. However, students often have problems with the connection method other than not being able to make an analysis for the measurement of voltage and current values flowing in the circuit. According to Andrew 2000, traditional or conventional teaching methods that practice in teaching and learning today will not be able to meet the demands of the 21st century education. Learning is no longer focused on the classroom alone, but teaching methods are also evolving as technology develops in Malaysia. For example, traditional textbooks cannot cope with the ups and downs of information that are in line with the era of circulation. The use of technology in the field of education should not be subject to limitations or constraints that may impede the teaching and learning process.

Virtual learning methods for series and parallel electronic circuit using DCACLAB is used to help lecturers make demonstrations and in turn can make it easier for students to understand the practicalities they want to carry out. This virtual lab is used in conjunction with the practical lab sheet for this course. This virtual learning method is applied based on observations made on students and lecturers. The results of the observation found that the students did not understand the basic concepts of circuit connection. Students are unable to identify how to make connections in series, parallel or in parallel. The use of a project board (breadboard) is also seen to be one of the causes of the problem because most students cannot understand the concept of connection and subsequently cannot describe the actual state of the circuit.

The use of small components is also a factor in students not being able to make circuit modifications more effectively. Measuring the value of voltage and current in the circuit is the main thing that students need to know. As a result of lack of understanding of the basics of circuit connection makes students unable to make further circuit modifications do not know on which side the current and voltage can be measured. Thus, to overcome this problem, this virtual method has been identified as potential in assisting students in conducting practical's in the laboratory and further facilitating lecturers to make demonstrations

1.1 Objective Research

As a result of the problems presented, the objectives of the study identified are:

- i. To study the effectiveness of DCACLAB application on teaching and learning series parallel circuit concept.
- ii. Apply DCACLAB simulation as an interactive learning method to increase students' understanding of the concept of series and parallel electronic circuits.

2. Literature Review

Abu Bakar Ibrahim, Faridah Hanim Yahya and Hafizul Fahri Hanafi³(2019) say that education and technology are mutually dependent and inseparable. The use of media and technology is an interactive learning. Students do not just use paper and stationery to present their understanding of modules or subjects learned even more when technology is applied in education.

Mok (2000) says that teaching has two functions, namely stimulating learning and creating effective learning situations. One of the ways that educators can use to deliver teaching content is by using teaching aids. DCACLAB are one example of teaching aids which can develop students creativity and critical thinking also spark their interes in learning electronic circuit connection.

Vick, Matthew E (2010) in his research say that, building circuits often entails the use of breadboards (a construction base for an electronic circuit). Although breadboards present a tactile opportunity for physics students, their use is not always well understood. This is often because the physical layout of resistors (see photo, p. 30) does not look much like the diagrams students draw in class. Also, students who fail to measure current in series often blow the multimeter's fuses. This adds stress for both students and the teacher, who must continually replace these devices.

3. Methodology

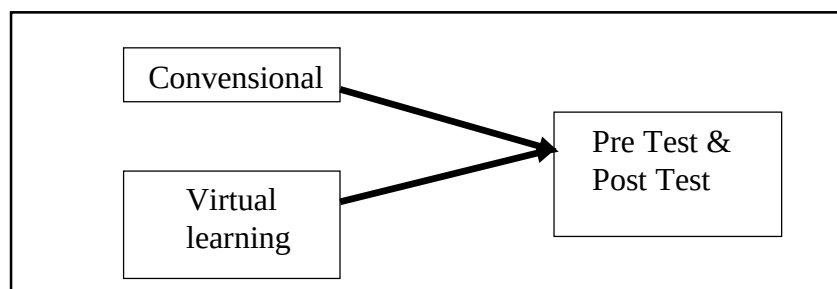


Figure 1: Intrument applied in this study

From **Figure 1** above, pre-test and post- test is used as research instrument based on convensional method for teaching series parallel circuit and virtual learning using DCACLAB application. The conventional method was a lecture-based course that included three, one hour sessions taught by a lecturer. In this course, the sequence of PowerPoint slides and video were shown in the same order as the virtual learning method. **Figure 2** shows an example of learning series parallel concept using basic component and instrument in electronic laboratory such as breadboard , resistor and function genarator.

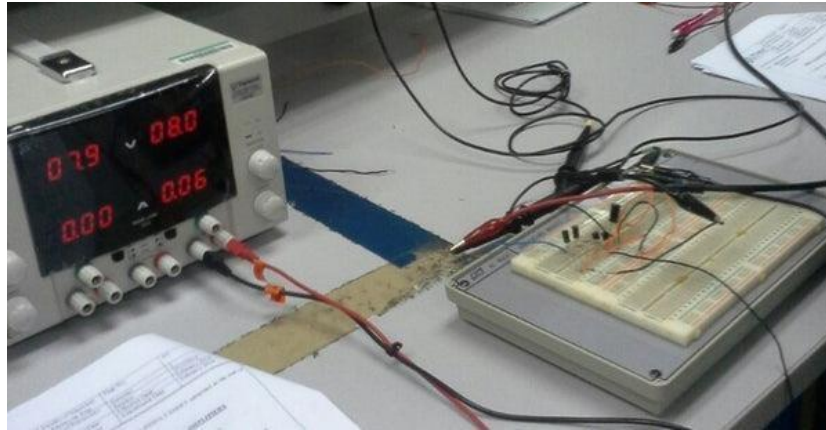


Figure 2 Conventional method of learning series parallel circuit

For virtual learning method, all of the learning objectives were designed the same as the conventional method, with the exception of the teaching method. We designed a virtual learning environment (VLE) that included all corresponding flexibilities and user friendliness enriched with multimedia, as well as interactions among peers and the lecturer. **Figure 3** shows a picture of the DCACLAB work area used for simulate Series, Parallel and Series-Parallel Circuit in this study.

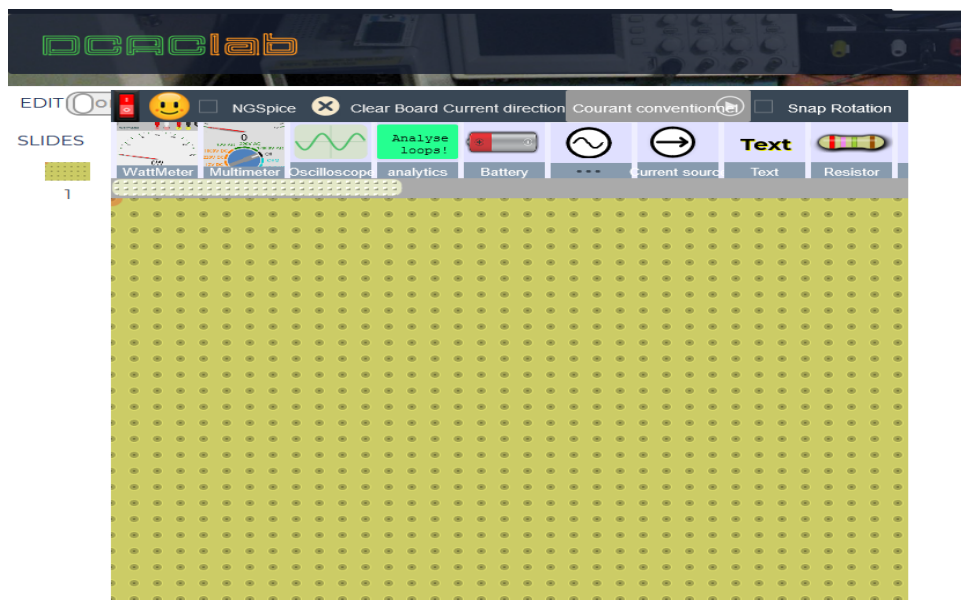


Figure 3 Virtual lab simulation interface using DCACLAB

4. Result And Analysis

This virtual learning method uses DCACLAB to launch the practical process carried out in the laboratory. It aims to facilitate the students of the basic concept of electrical circuit connection. This method is used in conjunction with the practical sheets for the DJJ 2022 ‘Electrical Technology’ Course for Mechanical Engineering students of Ibrahim Sultan Polytechnic.

Figure 4 shows the Series and Parallel Circuit constructed using DCACLAB simulation. Also shown are measuring equipment used to measure current and voltage. From this method, student can construct series parallel circuit with easily change value of supply voltage and resistor. Various kind of desired measurement such as voltage drop across resistor, total current or total resistance value can be done by applying multimeter provided in this application as shown in **Figure 5**. Current flow animation and its value appeared automatically when complete close circuit is made. As an additional output, students can apply output component such as, led, fan or switches to see more effect of current flow in the circuit.

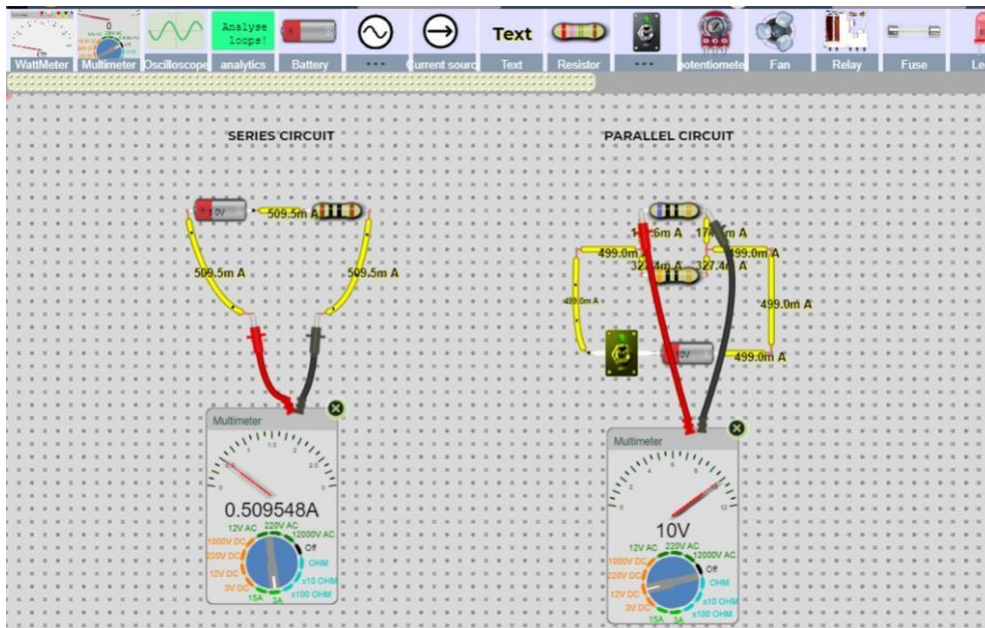


Figure 4 Constructed series and parallel circuit with measuring equipment applied

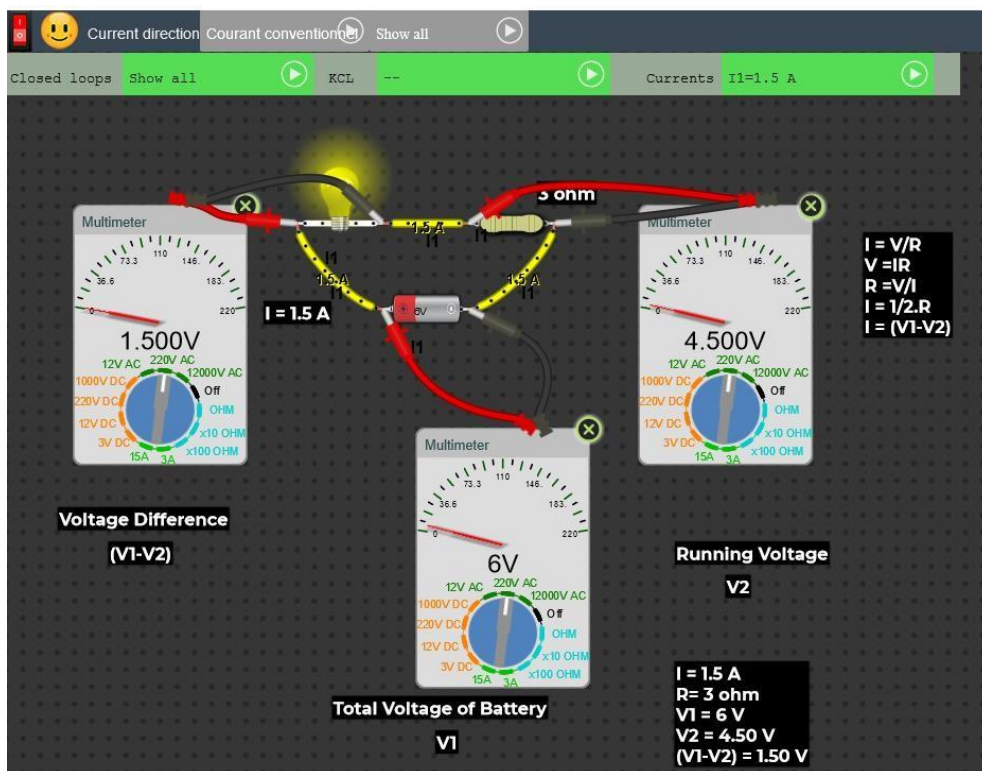


Figure 5 Voltage and current virtual measurement

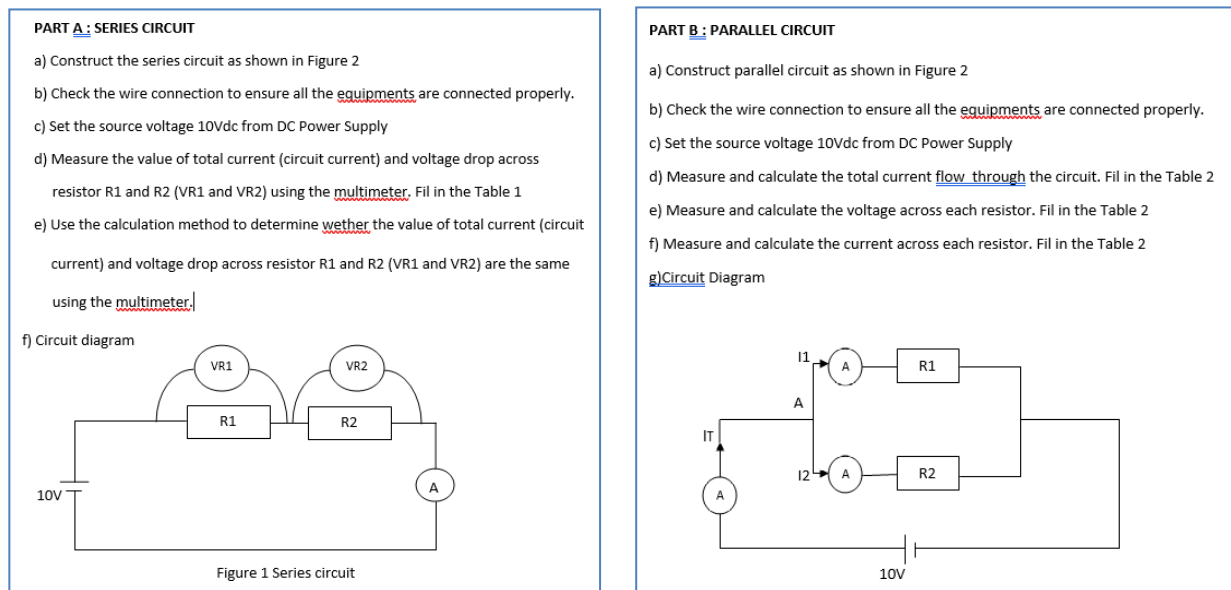
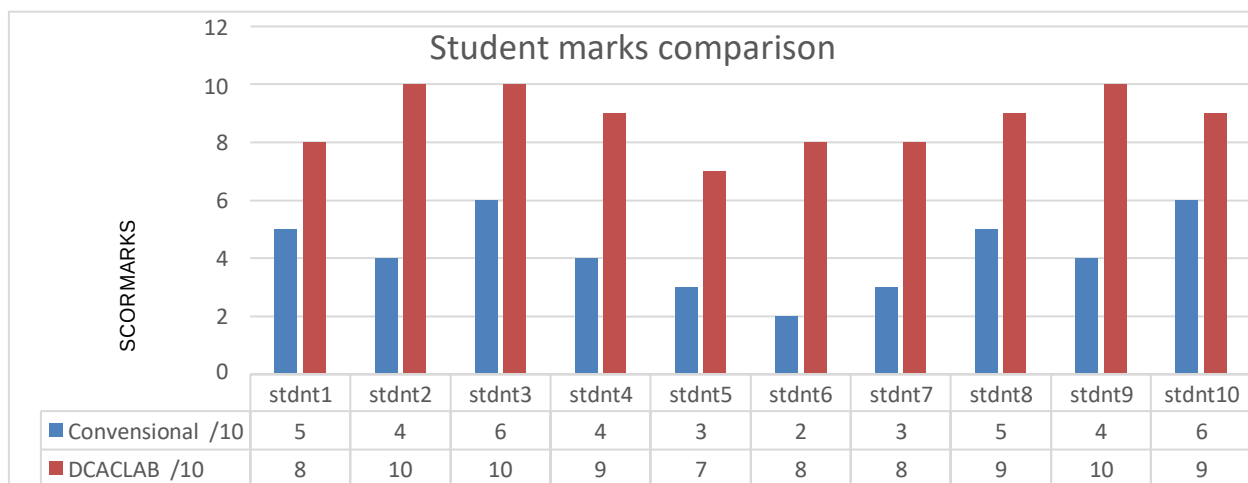


Figure 6 Series and Parallel Circuit as in practical sheets for the DJJ 2022 ‘Electrical Technology’ Course

From **Figure 6**, students need to build a circuit based on the instructions in the diagrams. The time spent completing assignments using conventional methods and virtual learning methods was recorded along with the total marks obtained. A comparison of the marks obtained can be seen in Graph 1 while the comparison of time is seen in Graph 4.2.

Graph 1 Student marks comparison based on conventional and virtual learning environment using DCACLAB



Graph 1 shows a comparison of marks obtained by students using the conventional method with the DCACLAB method. Shows that the total marks obtained by students is lower if using conventional methods. The lowest score obtained using the conventional method is 2 marks while the highest score is 6. When using DCACLAB, the marks obtained by students are higher. The lowest score obtained by students is 7 marks which is nearly equivalent to the highest score of the conventional method, and the highest score obtained is 10 marks. From Graph 1, it was also found that all students get a score of 5 and above when using the DCACLAB method compared to the conventional method where only 2 students obtains a score of more than 5 marks.

Table 1 Time comparison based on conventional and DCACLAB method

	stdnt1	stdnt2	stdnt3	stdnt4	stdnt5	stdnt6	stdnt7	stdnt8	stdnt9	stdnt10
Conventional (minit)	40	55	30	45	50	40	50	45	45	50
DCACLAB (minit)	23	25	20	30	30	25	20	18	20	25

Table 1 shows a comparison of the time taken by students to complete a given task using conventional methods and DCACLAB methods. The lowest total time using the conventional method is 30 minutes and the maximum time usage is 55 minutes. Meanwhile, for the use of DCACLAB, it was found that the minimum time usage is 18 minutes and the maximum time usage is 25 minutes. From this result, stated that the use of DCACLAB can save time because during the use of conventional methods all students take more than 45 minutes to complete the given task while when applying the DCACLAB all samples do not need 45 minutes to complete the task.

5. Conclusion

Based on the analysis, it is found that this virtual learning method has had an impact on lecturers and students. Where it can help lecturers to make a demonstration of circuit connection more easily. This in turn can increase understanding to students faster. Once students have understood the basic concepts of circuit connection, students can make connections more effectively. Students can also change the desired resistor value more easily using this virtual learning method. Next, students can measure current and voltage values more effectively because there is already a measurement equipment installed in the DCACLAB. The time taken by students to analyze current changes in voltage and voltage can also be minimized and in turn can make comparisons with the theories that have been learned. Overall this virtual learning method is easy to use and indirectly spark interest and attraction for students to think critically and creatively.

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