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DESIGN OF THE LINEAR CIRCUITS PRACTICUM MODULE FOR THE ELECTROMEDICAL STUDY PROGRAM

Hendra Marwazi [13*], Vita Nurdinawati [1], Mulyatno [2]

[1]Jurusan Teknik Elektromedik, Poltekkes Kemenkes Jakarta II , Hang Jebat III/F3, Kebayoran Baru , Jakarta Selatan, 12120
[2]Universitas M. Husni Thamrin, Jakarta
[3] PUI-P2KAL

*E-mail: hendramarwazi@poltekkesjkt2.ac.id

ABSTRACT

The design of the Linear Circuit practicum module which is the basis for the acquisition signals of Electromedical equipment provides a student's mastery learning experience. Learning experiences aspects should be practiced to the student are motoric and cognitive operations based on Algo-Heuristic learning method. The learning algorithm starting from strengthening the motoric aspect as well as practical learning by using a bread-board for using of the op-amp and testing its circuit assembly. When competences of motoric has been achieved, it is continued with learning to strengthen cognitive aspects through practical learning experiences using practicum modules so that the number and types of linear circuits to be tested are more than using bread-board practice. Components and circuits for learning experiences of motoric practices have been tested and show as goal of planned. The modules for the practice of strengthening cognitive aspects consit of various detector circuits and various inverting, non-inverting, differential and instrumentation amplifier circuits have been tested for their performance in accordance with the underlying theory. Simple observations of learning experiences with the algo-heuristic method by the practicum module have fulfilled the goal of strengthening motoric and cognitive aspects for electromedical students.

Keywords: *Practicum module, Linear circuit, Motor and cognitive operation*.

INTRODUCTION

The signal acquisition circuit is an important part of the electromedical instrumentation system (1). The acquisition signal circuit is the part of the system that the body's physiological signals to be conditioned so that they can be processed further. In the Electrical-medical Technology education curriculum, as well as Electro-medical Engineering Technology, this topic is implemented in the Integrated Electronics Theory and Practice course (2,3). One of the reference books that usually facilitates the learning of this course uses by Coughlin, Robert F., Frederick F. Driscoll. (4), there are various kinds of linear circuits with op-amps and accompanied by detailed analytical techniques and practical circuit design procedures that can be implemented in practical lectures. This books provides many detailed, practical design and analysis examples intended to relate theory to the workplace and be the basis of this module practicum. This shows the importance of the practicum module which allows students to experiment with linear circuits.

Edgar Cone of learning experiences that shows the success of strengthening learning with doing activities by students (5). This shows the importance of the trainer module which allows students to experiment or doing with linear circuits. Lev. N. Landa developed an Algo-heuristic learning theory includes understanding knowledges, motor operations and cognitive operations, on the aspect of the importance of images, concepts and proportions (6).

Often Breadboard is used for liner circuit experiments. Students will assemble a linear circuit that will be tested each component and wire to be connected will visible. This activity has the advantage of strengthening motor learning by assembling, to test each step practice can

be fulfilled or obtained by student, but it takes a long times and many obstacle. However, the number of topics to be tested in the course practice of linear circuit are not quit a lot.

Therefore, it is necessary to arrange an algorithm according to the learning, the motor aspects have to be mastered before continuing to the cognitive learning aspect experiences through linier circuit testing on the module practicum. The difficulties of assembling a circuit on a breadboard need to be experienced by students at an early stage. This initial mastery needs to be fulfilled by designing the motor practice, from the aspect of the image of the component supplying the op-amp, assembling the linier circuit on the important bread-board. When the motoric abilities are completed, the practical design and tested of linier circuits can be developed for cognitive practices using on the designed module practicum board.

Edgar Cone and Landa's theory about motor operations and cognitive operations, The importance of images, concepts and proportions. Developing a lecture giving algorithm, testing model with bread board takes a lot of time, but the motor aspect, assembling to test each practice can be fulfilled. However, the number of topics tested in practice quizzes is small. Because the use of bread-board requires a longer assembly time, compared to the conventional modules that are already available. Therefore, it is necessary to arrange an algorithm according to the learning, the motor aspect is mastered then to the cognitive aspect through circuit testing on the board that is made to allow more circuit testing. The difficulties of assembling a circuit on a breadboard need to be experienced by students at an early stage. This initial mastery needs to be fulfilled by designing the motor practice, from the aspect of the image of the component supplying the op-amp, assembling the circuit on the important bread-board. When the motor abilities are completed, the practical design can be developed for motor operation skills through the practice of testing the circuit on the designed board.

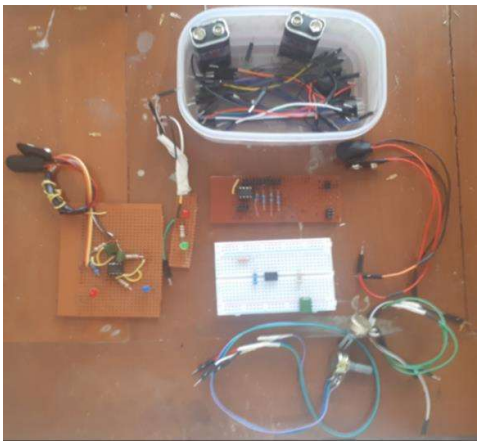

Figure 1 Part of module to be used for motor operation or learning aspect

The design of the practicum module that is made facilitates students to gain learning experience following the Algo-Heuristic method in the form of demonstration or practice. The experience is applied through learning experiences that develop aspects of motor and cognitive operations. These criteria are the basis for making the practicum module. Algorithmically, the practice of testing linear circuits begins with knowing the principle of using an op-amp and the ability to assemble a circuit with an op-amp. This initial topic will be implemented in the emphasis of motor operations, students are expected to be able to use the linear circuit practicum module. Students will physically see the op-amp and the components that make up the astable multivibrator or wein oscillator using op-amp circuit, explore the LED indicator circuit, the variable DC signal source which is also on the installed in practicum board. This

learning experience on the motor aspect is expected to be an initial learning experience before students get the learning experience of testing the performance of linear circuits with a practicum module / board. Meanwhile, the student learning experience related to aspects of cognitive operation development is carried out through learning the performance testing of various types of detector and amplifier circuits, which are available in the practicum module made.

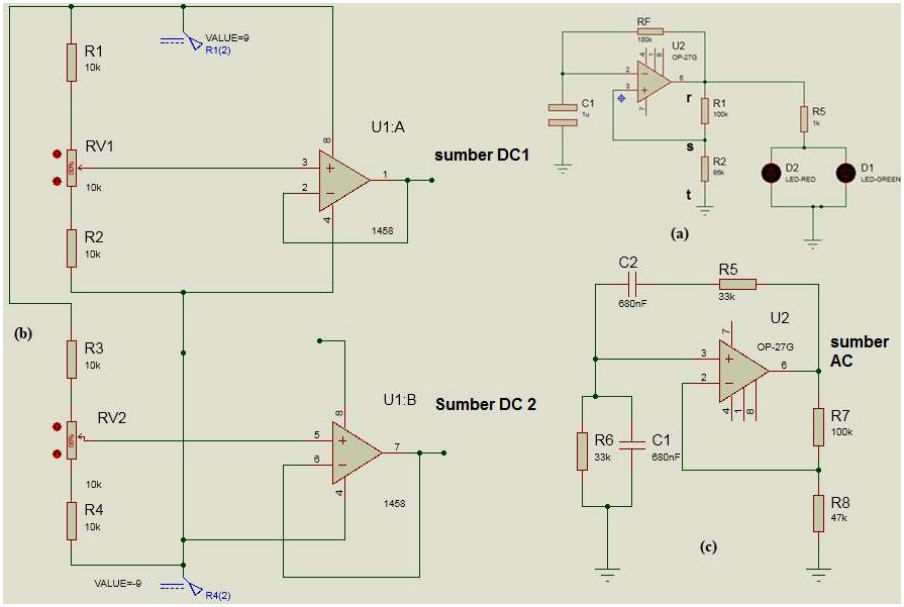

Figure 2. motor learning experiences, assembling (a); testing available circuit (b)

The learning experiences aspect of motor operation is to train students to use the components and tools available so that students can assemble according to the initial skill and knowledge requirements of linear circuits with op-amps. Installing the op-amp on the project board, provides op-amp supply from two voltage sources, a 9-volt battery or a 9-volt adapter. To train assembling through the activity of installing an op-amp voltage supply and assembling a 1 Hz a stable multivibrator circuit, with an LED indicator. The series of a stable 1 Hz multivibrator is intended to test the correctness of the assembly or test the damaged condition of an op-amp fig 1 and fig 2 (a). Besides that, train to read the circuit of two DC voltage variable signal sources with a low output resistance from the voltage follower circuit. Testing a variable DC signal source that can be set negative, zero or positive. In general, the circuit and tools required are described below fig. 2(b).

Student learning experiences in developing aspects of cognitive operations are implemented in linear circuit performance testing. The trainer module design can be draw in Figure 3. There are two nodes output voltage 9 V and - 9V, and a ground node with 4 terminals. These nodes can be used as supplies to external circuits or can also be used to voltage supply from outside if the internal supply is not functioning.

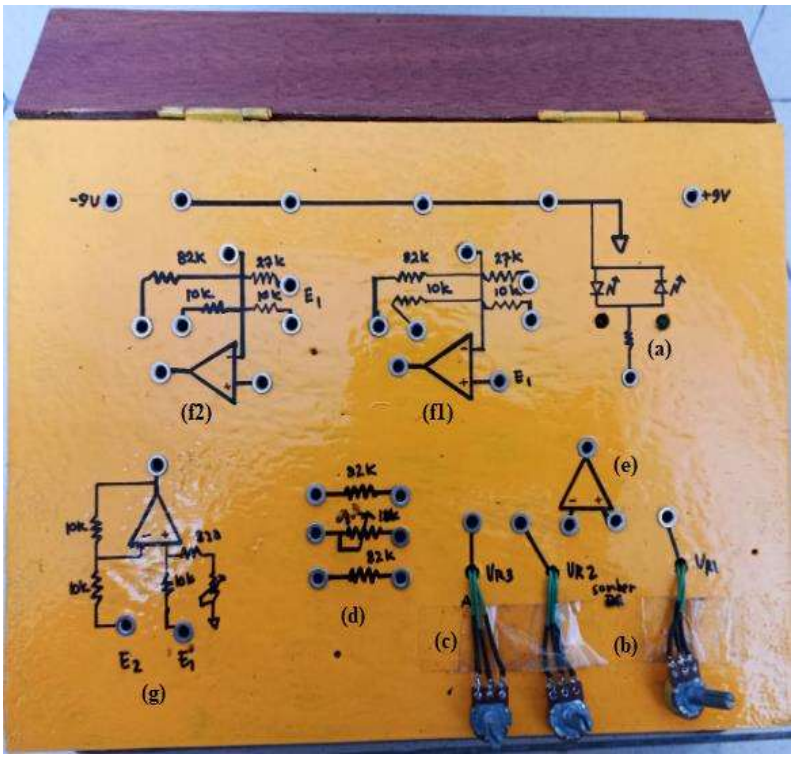

Figure 3. Practicum board of Linier Circuits for cognitive operation

Provided is a series of 2 LED indicators, green and red, which will on according to the polarity of the voltage they are subjected to (fig 3.a). Underneath are two variable DC signal sources, which can produce varying voltages with +, zero or negative polarity and have very small output resistance, according to the op-amp output (fig. 2.b, 3.b). A variable ac signal source with a frequency of 5 Hz (fig 2.c, 3.c). Beside that there are also two 82 k resistances and 1 k variable R to facilitate the arrangement of instrumentation or other circuits, even this resistor can be used for signals with high Ro (3d).

For testing linear circuits with op-amps, OP-027 is used. There is an independent op-amp that can be used to test the detector circuit, testing the characteristics of the op-amp (fig 3.e). There are two op-amps around which there are 4 resistances, this is meant to be able to vary the amplifier circuit with one or two input signals (fig 3. f1, f2) can be used for experiment for inverting, non-inverting, summing, differential amplifier. A differential amplifier is also provided which can be tested for performance independently or as part of an instrumentation amplifier (fig.3g). From this circuit it is possible to test the performance of the reinforcement

DISCUSSION

This practicum module has been tested for its performance in the electronics laboratory of the Politeknik Keshatan Jakarta 2. Two DC voltage signal sources VR1 and VR2, both separate on the board and attached to the board, can produce a voltage that varies in magnitude from 3.3 V to -3.3 V, can also produce a voltage of zero volts. This voltage source, as an ac voltage source VR3, which varies in magnitude, produces a voltage with a frequency of 5 Hz and the voltage variation on amplitude. The Ro of the dc signal and ac signal source can be added by resistor in fig 3.3 so that to signal source with high resistance output (Ro). The series of indicators tested are both mounted on the board and separately, the green LED will light up when given

a positive voltage, otherwise the red LED lights up when given a negative voltage. This section shows that it can be used for student practicum.

Performance testing for detector circuits, fig 3.e, that use two DC signal input sources, provided showing the output voltage +Vsat or –Vsat, or can also be shown on the green or red LED indicator that lights up. Likewise testing two op-amp circuits, which are arranged for inverting amplifier circuits, summing, voltage follower, non-inverting amplifiers with various variations of various gains: X1, X3, X8.2, show appropriate with the theoretical analysis. Testing the differential amplifier that is installed on the board, X1 with two signal inputs, namely from signal sources has shown conformity with the X1 gain theory. Besides that, an instrumentation amplifier is also assembled with 3 op-amps and has an X30 gain, testing on the instrumentation circuit.

The application of the use of this trainer module has been tested in practical lectures at the electronics laboratory of the Jakarta Health Polytechnic 2. Because only simple observations were made, the data were qualitative. The topic of motor operation shows that students can properly made source the op-amp supply from either two DC voltage sources, either from the battery or from the adapter. Most students can properly supply the op-amp on the breadboard. Because it is possible that students can determine pin 1 on the op-amp in this practicum. The next stage, students try to assemble based on the astable multivibrator circuit image onto a breadboard whose output will make the LED blink. Most have been able to assemble correctly, indicating a faulty op-amp because the circuit does not work. But there are still students who are wrong in assembling this circuit and even burning the op-amp. Because there are students who have not fully mastered the bread board, read the circuit to be implemented on the bread board. The third stage reads the two variable DC signal source circuits, and assemblies and tested them. This stage shows the difficulty of students assembling and testing it requires a rather long time and assistance. This is probably due to not being accustomed to observing the available circuits and the reality of their assembly.

Figure 4. The trainer modul of linier circuit are used by student

The topic of cognitive operation learning experiences was implemented to test the detector circuit on the board. Most students have been able to assemble a detector circuit with two DC signal sources, attach it to the input of the op-amp and attach the output of the detector circuit to the indicator circuit. Most of the students have been able to properly assemble, test the detector circuit correctly. This stage shows that after students practice motor skills related to assembly the separate component used in practice, assembly circuit in practicum board made easier and performance testing can be done well.

CONCLUSION

A conclusion should be an answer to a research question, and not expressed in a statistical sentence. The conclusion is a summary of the description of the results and a discussion of the research objectives. Suggestions are given for further development and research. Conclusions and Suggestions must be in the form of a narrative and must not use bullets or numbers. In general, practicum modules and learning implementations that follow Algorithmic-Heuristic procedures can be used and students experience learning according to algorithms so that at the next stage learning achievement is continuous.

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