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# The Effectiveness of the Electro-Pneumatic Trainer Embedded with PIC and Visual Basic Platform for Educational Purposes

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**Abstract:** This study is to identify the effectiveness of the Electro-Pneumatic Trainer Embedded with PIC and Visual Basic Platform for educational purposes as a teaching aid in the implementation of teaching and learning at the Department of Electrical Engineering, Polytechnic Sultan Salahuddin Abdul Aziz Shah. This is a preliminary study and data was collected through questionnaires which contain three main sections. A total of 65 respondents from the semester 3 (Three) of Diploma in Electronics Engineering (Control) participated in this study. The results of the study found that the use of this trainer can improve students' understanding by 95.38% while levels of practical skills showed that respondents' interest has increased by 96.92% after using the Electro-Pneumatic Trainer. This shows that the use of an Electro-Pneumatic Trainer as teaching aids is very high.

**Keywords:** *Effectiveness, Pneumatic Trainer, Teaching aids.*

## 1. Introduction

Visual Basic (VB) has become one of the potential tools in teaching and learning process especially in engineering discipline, for better understanding of complexity in engineering processes. The students have the opportunity engaging an active learning by conducting simulated experiments, gathering results, collecting data, draw the conclusions and troubleshooting (Hamid et al., 2019). Furthermore, VB or computer simulation can enhance student's active involvement in teaching and learning process (Ngabonziza & Delcham, 2014). Computer simulation such as Electronics Workbench, LegoCAD, and Car Builder also helping trainees about event, processes, and activities that can replicate the realworld problems. Burhan et al (2015) also further added the important to engage with activities that equally and effectively as real-life hands-on laboratory experiences and contributing towards greater understanding compared to typical teaching and learning process (chalk and talk).

The development of the Electro-Pneumatic Trainer embedded with PIC and visual basic platform for educational purposes is designed to enhance the process of teaching and learning as a teaching aid for certain courses such as Instrumentation (DEJ 3143). This involves a student from Diploma in Electronic Engineering (Control) at the Department of Electrical Engineering, Polytechnic Sultan Salahuddin Abdul Aziz Shah. Before this innovation, the students simply relate the theory learned in class through educational trainers only. Therefore, students have difficulty correlating between programming and circuitry. The pneumatic trainer prototype has a combination of elements hardware and software.

A Typical method in conducting the practical session only applied a very minimum level of hand-on wiring skill and was assessed at a low level of student's competency. However, there is a great need to reform teaching methods and evaluation tools, laboratory equipment and experiments, in enhancing students' practical skills and practical ability, laying a good foundation for the job and improving their social competitiveness and the quality of personnel training. In the light of this deficiency, the main objectives in the development of this Electro-Pneumatic Trainer are to:

- i) Identify students' interest in the use of Electro-Pneumatic Trainer embedded with PIC and visual basic platform.
- ii) Identify practical skills improvement among students.

Through this study, researchers tried to find answers to the following questions:

- i) what is the level of student interest towards the use of Electro-Pneumatic Trainer embedded with PIC and visual basic platform?
- ii) what level of practical skills improvement among students?

## 2. Literature Review

Hornby (1989) mentions that the word impact meaning changes caused by any act or acts as a result of an action. Meanwhile, effectiveness means the ability or the ability to lead and create the desired result. In accordance with Kamus Dewan (1991), the effectiveness of the means concerning the effectiveness, effectiveness of an action, change and so on.

In addition, the effectiveness of delivery by the lecturer to the students is supported by teaching aids that have a variety of senses in which the materials used have interesting shapes and colors. Students' understanding is much easier with the use of teaching aids. In the process of teaching and learning, teaching aids are an important element in the education world.

The use of teaching aids can help to distribute information to students related to the subjects taught more clearly. Therefore, the use of teaching aids in the process of learning could be a way to improve students' achievement in a classroom. Based on the previous study, the use of teaching aids in the classroom can contribute a positive impact on the learning process (Suparta, 2014; Nor & Sharif, 2014).

According to Farrant (1977), a misinterpretation that occurs in defining the function of the teaching aids caused by the lack of practicing and using the teaching aids during the process of teaching and learning takes place. Thus, the teaching aids that are being produced must bring good effects to the teaching and learning process. According to Kamarul (2010), teaching aids must clarify the vague idea and elusive part. It could be large and clear, attractive colors, the right size, durable, bring impact and cheap.

Some students are weak and are not interested in learning subjects that contain complex circuits because of their elusive. They could not imagine intuitively the relationship between skills learned with the real situation. The use of real tools in teaching will make students more clearly understand what is being presented. Teaching aids are all the equipment used by teachers to help them in delivering lessons in the classroom (Hussin, 1986).

In addition, the plans made by the lecturer will be able to help them to achieve the best in teaching. The Teacher should deliver the best possible teaching by making early preparations in terms of planning, teaching methods and the use of adequate teaching aids (Lambri & Mahamood, 2019).

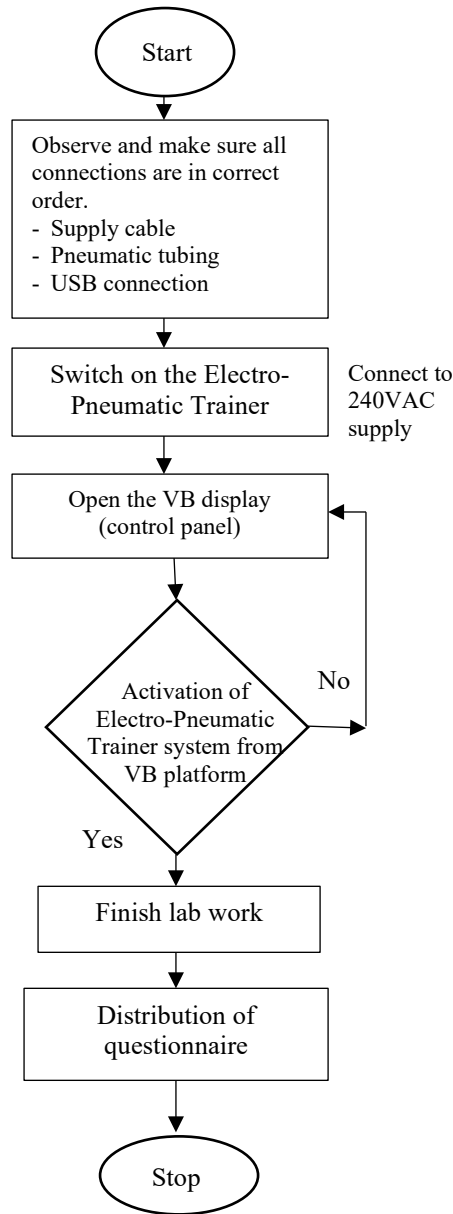
The use of senses will bring more impact to the learning process. According to Long (1978), for that reason, the tools that use a variety of senses will bring more impact in the teaching and learning process. Tools that use color and shape will attract more attention. Likewise, the tools that could be seen, heard and felt would give more impact on the teaching process.

## 3. Methodology

The use of quantitative approaches questionnaire is to obtain information on the facts, beliefs, desires and so on. According to Konting (1990), the questionnaire is more practical and effective to use for a large population. Researchers use this method because this questionnaire method is easily implemented on respondents. Researchers will also get a uniform response from respondents.

According to Fraenkel and Wallen (1996), sample selection is an important aspect of conducting research. With that, the selection of the sample made must meet the characteristics of the study population so that the study findings can be generalized. The sampling method used in this study is simple random sampling.

Population for this research are consist of second years' students (third semester) from Electrical Engineering Department, Polytechnic Sultan Salahuddin Abd. Aziz Shah. The data for this study was collected at the end of the classes once the students finish using the developed Electro-Pneumatic Trainer embedded with PIC. The students need to fill in the questionnaire which consist of three part which are Part A: students background, Part B: Structure of the Electro-Pneumatic Trainer and Part C: student's skill and understanding gained after using the trainers. Figure 1 shows the process flow of how the lab work was implemented and process of distribution of the questionnaire.



**Figure 1.** Theoretical framework for Electro-Pneumatic Trainer embedded with PIC and VB

### 3.1 The sample of study

A sample of semester three students from a program of Diploma in Electronics Engineering (Control) for December 2017 session. A total of 65 respondents participated in this study.

### 3.2 The instrument of study

In this study, the instrument used is a survey method that uses a quantitative approach. The questionnaire is consisting of three parts. Part A is about the respondents' background. Part B is a questionnaire related to the structure of Electro-Pneumatic Trainer. It consists of three (3) questions. Part C related to skills and respondents' understanding of the use of PIC.

The development of this Electro-Pneumatic Trainer is divided into three main stages which are the arrangement of VB platform (input), PIC module (interface) and electro-pneumatic apparatus (output) as in show in figure 2.

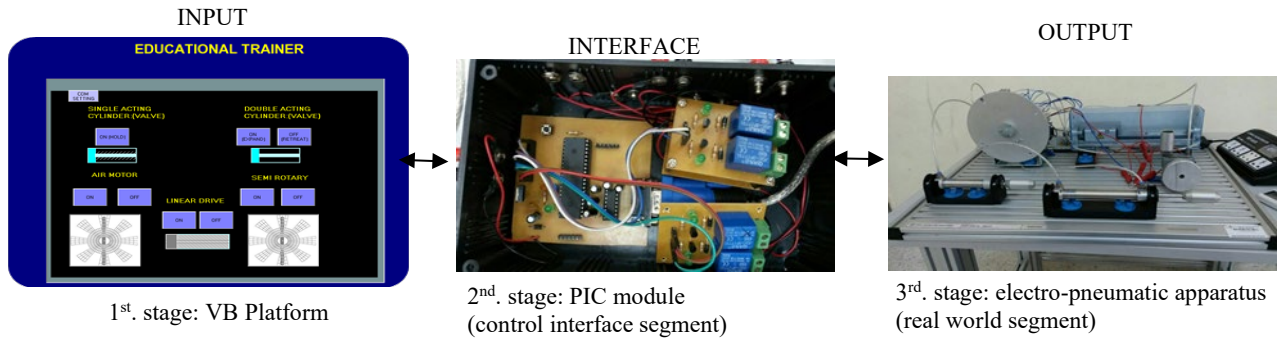


Figure 2. Stages of Electro-Pneumatic Trainer development

Meanwhile, Visual Basic 6.0 was used as the graphical user interface (GUI) input to trigger the output (electro-pneumatic apparatus). If the user clicks 'ON' (HOLD) switch for single acting cylinder, the actual single acting cylinder apparatus will *expand* and when releasing 'ON' (HOLD) switch the actual single acting cylinder will return to its origin position. Same operation goes on when each of 'buttons' acting as switches on VB display is click as shown in figure 3.

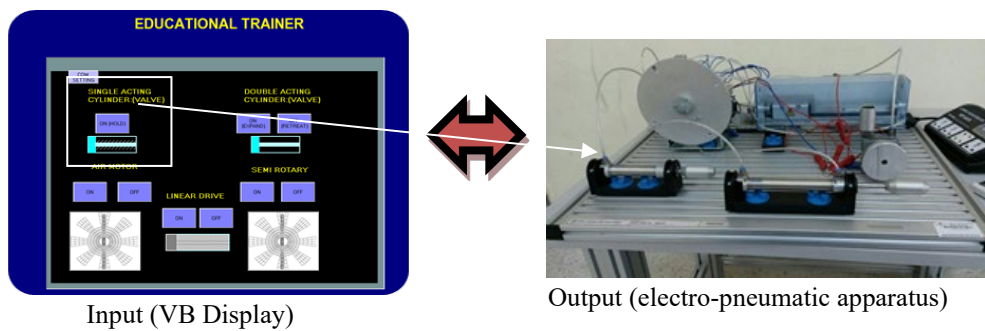


Figure 3. VB (Input) display controlling the electro-pneumatic (Output) apparatus.

Table 1 shows total numbers of classes and students that was involved in the assessment from December 2017 session of student's intake.

Table 1: Total numbers of classes and involved respondents

Course Name	Programme Name	Class	No of Students
Instrumentation (DEJ3143)	Diploma in Electronic Engineering (Control)	DJK 3A	23
		DJK 3B	21
		DJK 3C	21
TOTAL			65

Meanwhile, Table 2 show the numbers and percentage of respondent's genders. From the survey, it shows that 55 male respondents (84.6%) and 10 female respondents (15.4%) involved in these surveys. It shows that majority of the engineering students are male dominant.

Table 2: Respondents gender distributions

Gender	Numbers	Percentage (%)
Male	55	84.6
Female	10	15.4
TOTAL	65	100

Descriptive statistical methods are used in data analysis in the form of the Likert scale. To facilitate the data analysis, the Likert scale is categorizing in Table 3. This table is referred to Shahar's (2006) research.

**Table 3:** Likert scale classification

	Strongly disagree (1)	Disagree (2)	Almost agree (3)	Agree (4)	Strongly agree (5)
<b>Category</b>	Disagree			Agree	

According to Konting (1990), descriptive method is suitable for research that aims to explain a problem or phenomenon. The items from the questionnaire was rearrange based on the previous research instruments developed by others researcher (Burhan et al (2016).

#### 4. Findings

The findings are based on analysis of the data obtained from 65 respondents.

##### 4.1 Data collection

To facilitate the data analysis, data is collected according to the respondents' background, the structure of pneumatic trainer, skills and understanding of the respondents.

**Table 4:** Summary of finding for implementation of Electro-Pneumatic Trainer (hardware development)

No.	Item	Frequency		Percentage	Percentage
		Disagree	Agree	Agree	Disagree
1.	Electro-Pneumatic Trainer is easy to use due to its structure that is user-friendly.	5	60	92.3	7.7
2.	Security features on the Electro-Pneumatic Trainer are concerned.	3	62	95.38	4.62
3.	The layout of the input and output components for Electro-Pneumatic Trainer attracted me to learn.	4	61	93.84	6.16

Table 4 shows the findings of the study that the safety factor is at a high level with a percentage agree of 95.38%. Safety rules and workshop safety laws must be known, learned and adhered to. This is because maintaining safety is the responsibility of every student. By adhering to safety rules in the workshop, any risk of personal or sensory injury or damage to equipment will be avoided (Che Muda & Ramudaram, 1990; Mohd Nor, 2000).

From the questionnaires, it shows that majority of the respondents are satisfied with the hardware fabrication and simulation development for Electro-Pneumatic Trainer. with an average of 94% of the respondents agreed that it was user friendly, attractive and safe during the execution of hands-on practical. The Electro-Pneumatic Trainer is considered as attractive as more students give attention during the teaching and learning process and also during the hands-on session (Item 3: 93.8%). It is also effective because more integration of various output components (i.e.: 5 difference output components) is embedded in this trainer as to uphold the curriculum requisite. Furthermore, it is also user friendly because it is easily installed and operated by the instructor and trainees during the teaching and learning and hands-on session as indicated in the surveys.

##### 4.2 Skills and Understanding

The majority of the participants agreed that the multiple I/O PLC modules help them in enhancing their knowledge understanding (95.38%) and hands-on skill (96.92%) which is good for preparing them to enter the job industries once they are graduated from this institution as shown in Table 5.

**Table 5:** Summary of finding for implementation of Electro-Pneumatic Trainer (knowledge understanding and hands-on skill)

No.	Item	Frequency		Percentage	Percentage
		Disagree	Agree	Agree	Disagree
1.	My knowledge about the input and output of Electro-Pneumatic Trainer can be increased.	4	61	93.84	6.16
2.	I can understand the connection from the input to the output of the Electro-Pneumatic Trainer.	4	61	93.84	6.16

3.	The use of Electro-Pneumatic Trainer is to provide an understanding of the integrated circuit.	3	62	95.38	4.62
4	I can master the Electro-Pneumatic Trainer.	6	59	90.76	9.24
5.	Hands-on experience using the Electro-Pneumatic Trainer can give me an idea for the final year projects.	2	63	96.92	3.08
6	Electro-Pneumatic Trainer will help me in improving practical skills (hands-on).	2	63	96.92	3.08
7	My interest to learn subject related is increasing after using Electro-Pneumatic Trainer.	4	61	93.84	6.16
8	I am more easily understand subject theory taught by lecturers with the help of the Electro-Pneumatic Trainer.	3	62	95.38	4.62

By using an Electro-Pneumatic Trainer, it can help students improve their skills in the installation of pneumatic and electro-pneumatic circuits. Hands-on learning activities through "hands-on" activities are seen as important because this type of learning allows students to remember the lessons taught longer than objectivism learning where the teacher only gives all the information and has no direct involvement by students. Through "hands-on" activities, teachers can also find out the extent of students' understanding of a subject matter (Ismail, 1999). Therefore, student achievement, particularly in the subject of Instrumentation can be improved when students can relate the theory taught with practical implementation in a "hands-on". According to Julie Gantcher through Afifah (2012), hands-on learning is a fun and clear activity and increases curiosity, competence and creativity through activities carried out in practice. Hands-on activities will encourage students to be more interested in the subject being studied. A deep interest in the use of this trainer, can help students in generating ideas for students' final projects (Pratama, 2018).

In addition, using the Electro-Pneumatic Trainer has helped students in improving students' understanding and the relationship between theoretical and practical elements. Based on a study conducted by Darusaram & Johari (2013), a total of 53% of study participants stated that the use of the model he created can provide an understanding to them. According to GEOGRAFIA Online™ Malaysian Journal of Society and Space 12 issue 3 (69 - 78) 72 Themed issue on technological, vocational and educational empowerment of Malaysia's human resource © 2016, ISSN 2180-2491 Kuppusamy (2008), interest influences the academic achievement and learning process of students in school. Students are expected to enhance their understanding of concepts as well as their more active involvement in planned learning activities.

## 5. Conclusion

Through this innovation, it helps the students to achieve the objective and learning outcome by enhancing the teaching and learning (cognitive) and psychomotor skill aspect through circuit installation, testing and trouble shooting. The development of Electro-Pneumatic Trainer also has been designed to expose the students by showing more apparatus related to electro-pneumatic control which five (5) different output apparatus that can be controlled by using VB platform. Furthermore, it is supported by questionnaires distributed to 65 students which show that the use of this trainer can improve students' understanding by 95.38% while levels of practical skills showed that students' interest has increased by 96.92% after using the Electro-Pneumatic Trainer. Furthermore, this innovation can be expanding by considering additional electro-pneumatic apparatus to further enhance the level of understanding and psychomotor skill of the students.

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