Section: Research Paper

Input Output Simulator for Omron Programmable Logic Controller (PLC): a Model for Instruction

Johnny Q. Tagupa
Bohol Island State University Calape Campus
E-mail: johnnytagupa@gmail.com

Abstract

The discovery of electricity was viewed as a stepping stone of the industrial revolution in the modern era. This paved the path to the manufacture of numerous machinery and equipment that change the working speed of industries. It reveals that 7 out of 30 or 23.33% of the student's pre skill test performance was described as "Satisfactory". While 23 or 76.67% of the respondents was described as "Needs Improvement". Likewise, none as described "Very Good" and "Excellent". The average rating of this group is 1.57 which is described as "Needs Improvement". Meanwhile, the post skill test got higher results compared to pre skill test, 26 out of 30 or 86.67%of their performance rated "Excellent" and were ranked first in the group. 4 or 13.33% of the respondents was described "Very Good". The students got a total average rating of 3.60 interpreted as "Excellent". The computed t-value of -28.3428, is beyond the tabular t-value of ± 2.045 at 0.05 level of significance. Hence, the null hypothesis is rejected. Thus there is a significant difference in the pre skill test and post skill test, performance of the student. The use of the device as a tool for instruction proves that it has greatly enhanced the student's retention of knowledge and facilitates effective learning acquisition in electrical technology. the researcher concludes that the Input Output Simulator for Omron Programmable Logic Controller (PLC) was effective in imparting knowledge and skill and also the model was able to performed simulation without any error occur. Inputting, debugging, and simulating the program were done to test the programmability of the instructional Model. All tests were functional and corresponded to the command of the researcher.

Keywords: Programmable Logic Controller, Simulator, Instructional,

Introduction

The discovery of electricity was viewed as a stepping stone of the industrial revolution in the modern era. This paved the path to the manufacture of numerous machinery and equipment that change the working speed of industries. The production rate of goods and materials is on a faster rate leading to a competitive economy in many countries. Thus, making inventions pushed them to their utmost to achieve much efficient equipment for the larger advantage of the society.

The first three phases of the industrial revolution were distinguished by technological improvements but not at the rate of present times. Technology has advanced, been used, and been implemented quickly in recent years for a variety of reasons. Technology has become a big element of human beings' life. Technology is giving civilizations new talents and powers and is

changing life. Society is consequently currently going towards the fourth industrial revolution. The fourth industrial revolution entails a society whereby humans are able to move and communicate with one another between digital realms with the use of technology to aid and manage life.(Kayembe 2019)

On the other hand, Bohol Island State University plays a vital role in advancing the frontiers of science and technology. In recent years, a key concern for policy-makers has been in transferring and translating the knowledge, scientific and technological expertise in the university for the benefit of industries and business in the greater society (Nacorda, 2003). As a technology-based institution that employs theoretical and actual hands-on exercises. BISU provides the technical environment necessary for students in the Digital Age.

The institution focused on adapting technology to ensure that the knowledge generated within was geared towards industry practices. With this goal, course offerings are organized to give attention and training to future human resources of the country to propel economic development. In addition, the Technical Education and Skills Development Authority (TESDA) under Republic Act No. 7796 enabled technology education further. Thus, full participation of all sectors is encouraged to mobilize the industry, labor, local government units and technical vocational institutions in the skills development of the country's human resources.

This study, is a response to provide knowledge-based solutions to societal and economic problems, particularly of Bohol and of the region. It is in this premise that the researcher pursued this study and constructed an Input Output Simulator for Omron Programmable Logic Controller (PLC) as a tool for instruction and to further enhance enhanced the learners' effective competence in their major field of specialization.

Methods

The study used the descriptive and experimental method employing questionnaire and interview techniques and observation guides to secure sufficient data.

In constructing the model, it utilized the input-throughput-output approach. Inputs were the things put together to form a desired model. These include ideas concept and views from different related studies. It also includes the supplies, materials, tools, equipment and the cost of constructing the device. The through put of the study includes processes such as planning, laying-out of components, installing and assembling of parts and finally testing and revising the device. The output of the study was Input Output Simulator for Omron Programmable Logic Controller (PLC)

After the assembly of the device, observation guide was used as an instructional replica. A pre-skill test was conducted to the students before any discussion to evaluate the baseline skills requirement of the study. The test was composed of a set of instructions for creating a program through cx programmer software, uploading, downloading, debugging and simulating the program. Students were not expected to perform well in the given scenario. However, they were expected to utilize previous knowledge and competencies to perform safely.

A demonstration lesson on the Input Output Simulator for Omron Programmable Logic Controller (PLC)was conducted after the pre-skill test. Participants were allowed to experience

hands-on application by creating the program, uploading, downloading and basic wiring of the program uploaded. The manner of conducting the post-skill test were similar to that of the pre-skill test. Students were expected to demonstrate advanced competencies based from their knowledge and experience.

The students' ratings in the post-skill test were the basis for determining the degree of effectiveness of the device as an instructional model. It evaluates the efficacy and the amount of learning competencies of the learners has acquired by creating the program and installation at their own pace.

Result and Discussion

Table 1 Input Output Simulator for Omron Programmable Logic Controller (PLC) In terms of Program Simulation

Item	Program Simulated	Operation	Trial	Result	Interpretation
1	Stop-Start Control	Designed and upload a stop-start control program to the PLC and hardwired the electrical devices for stop-start operation	1	Pressing the start button 00, the motor will turn on and green light indicator 00 energized while pressing the stop button 01, the motor will stop and red-light indicator energized	functional
			2	Pressing the start button 01, the motor will turn on and green light indicator energized while pressing the stop button, the motor will stop and red-light indicator energized	functional
			3	Pressing the start button 01, the motor will turn on and green light indicator energized while pressing the stop button, the motor will stop and red-light indicator energized	functional
2	Forward - Reverse Control	Designed and upload a forward-reverse control program to the PLC and hardwired the electrical devices for forward-reverse operation	1	Pressing forward button 02, the motor will rotate clockwise and green light indicator energized while pressing reverse button 03 the motor will rotate counterclockwise and blue light indicator energize, pressing stop button 04 the operation will stop and red-light indicator will energize	functional
			2	Pressing forward button 02, the motor will rotate clockwise and green light indicator energized while pressing reverse button 03 the motor will rotate counterclockwise and blue light indicator energize, pressing stop button 04 the operation will stop and red-light indicator will energize	functional
			3	Pressing forward button 02, the motor will rotate clockwise and green light indicator energized while pressing reverse button 03 the motor will rotate counterclockwise and blue light indicator energize, pressing stop button 04 the operation will stop and red-light indicator will energize	functional
3	Manual Wye-Delta Control	Designed and upload a wye - delta control program to the PLC and hardwired the electrical devices for	1	Pressing start button 01, the motor will run through wye configuration and green light indicator will be energized and pressing push button 02 the operation will change to delta configuration, and pressing stop button 03, the operation will stop	functional

		wye-delta operation	2	Pressing start button 01, the motor will run through wye configuration and green light indicator will be energized and pressing push button 02 the operation will change to delta configuration, and pressing stop button 03, the operation will stop	functional
			3	Pressing start button 01, the motor will run through wye configuration and green light indicator will be energized and pressing push button 02 the operation will change to delta configuration, and pressing stop button 03, the operation will stop	functional
4	Sequential Control	Designed and upload a sequential control program to the PLC and hardwired the electrical devices for sequential operation	1	Pressing start button, the motor 1, motor 2 and motor 3 will turn on with an interval of 10 seconds respectively	functional
			2	Pressing start button, the motor 1, motor 2 and motor 3 will turn on with an interval of 10 seconds respectively	functional
			3	Pressing start button, the motor 1, motor 2 and motor 3 will turn on with an interval of 10 seconds respectively	functional

All outputs were found to be functional since, in digital programming, the logic programmed to the PLC can only be functional or not, as shown in Table 1 of the Input Output Simulator for Omron PLC's functionality. Through the CX Programmer software for Omron PLC, the researcher uploaded a set of instructions, and the program executed without any errors. The researcher was able to modify the addresses as well. The simulation showed that the program was working because the input and output statuses changed.

The researcher designed program consist of a Stop-Start Motor Control, Forward Reverse, Manual Wye Delta and uploaded it to the PLC. Each program was tested 3 trials to ensured the validity of the result. After the 3 trials the researcher found that the program being simulated was all functional, which means there was no error during the simulation and actual operation of the program

In addition, the researcher designed and uploaded sequential motor control. This program involves timer instruction. Timer instruction makes the simulation operate in continuous cycle. Motor 1 first turned on, followed by motor 2, then motor 3. All the electric motor designs functioned adequately from the first up to the last design which means that the program uploaded to the Omron PLC was functional.

Level of the Effectiveness of Input Output Simulator for Omron Programmable Logic Controller (PLC)

To determine the degree of the effectiveness of the Input Output Simulator for Omron Programmable Logic Controller (PLC) as a model for instruction, a pre skill test and post skill test was administered to thirty (30) students.

Rubric was employed as a means in determining student's skill assessment. It has an explicit set of criteria used for assessing a particular type of work or performance and provides more details than a single grade or mark**.**

Table 2 shows the frequency and percentage of the performance of the students before and after the handling of the model.

Table 2
Pre-skill Test and Post Skill Test Result the Input Output Simulator for Omron Programmable Logic Controller (PLC)
N = 30

Score	Description	Pre skill Test			Post Skill Test		
		f	%	Rank	f	%	Rank
3.25 – 4.00	Excellent	0	00.00%		26	86.67%	1
2.50 – 3.24	Very Good	0	00.00%		4	13.33%	2
1.75 – 2.49	Satisfactory	7	23.33%	1	0	00.00%	
1.00 – 1.74	Need Improvement	23	76.67%	2	0	00.00%	
Average Rating		**1.57** Needs Improvement			**3.60**Excellent		

It reveals that 7 out of 30 or 23.33% of the student's pre skill test performance was described as "Satisfactory". While 23 or 76.67% of the respondents were described as "Needs Improvement". Likewise, no one was described "Very Good" and "Excellent". The average rating of this group is 1.57 described as "fair".

Meanwhile, the post skill test got higher results compared to pre skill test, 26 out of 30 or 86.67%of their performance was rated "Excellent" and were ranked first. 4 or 13.33% of the respondents described "Very Good". The students got an average rating of 3.60 which was interpreted as "Excellent". Noticeably, it was found out that the post skill test results of the students was higher and the device was found effective for the improvement of learning competencies through actual and hands-on demonstration.

Table 3 Difference between the Performance of the students under Pre skill test and Post skill test

N = 30

Difference	computed t-value	tabular t-value	Description	Interpretation
	at 0.05 level of significance, df 29			
Pretest and Posttest	-28.3428	±2.045	Significant	Reject Null Hypothesis

Table 3 presents the difference between the pre skill test and post skill test of the students. The computed t-value of -28.3428, is beyond the tabular t-value of ± 2.045 at 0.05 level of significance. Hence, the null hypothesis is rejected. Thus, there is a significant difference in the pre skill test and post skill test, performance of the student. The use of the Input Output Simulator for Omron Programmable Logic Controller (PLC) as a model for instruction proves that it has greatly enhanced the student's retention of knowledge and facilitates effective learning acquisition in PLC programming specifically using Omron PLC.

Conclusion

Therefore, the researcher concludes that the Input Output Simulator for Omron Programmable Logic Controller (PLC) was effective in imparting knowledge and skill and also the model was able to performed simulation without any error occur. Inputting, debugging, and simulating the program were done to test the programmability of the instructional Model. All tests were functional and corresponded to the command of the researcher.

References

Kayembe, C., & Nel, D. (2019). Challenges and opportunities for education in the Fourth Industrial Revolution. African Journal of Public Affairs, 11(3), 79-94.

Nacorda, R. (2003). Learning element package in electrical technology using three phase motor control simulators.

Technical education and skills development act of 1994. http://www.slideshare.net/jaredram55/republic-act-no-7796.