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Demonstration kit for industrial automation with PLC and HMI

S. Singlar, K. Tunlasakul, S. Arunrungrusmi, W. Poonthong, N.Mungkung

Faculty of Industrial Education and Technology, King Mongkut's University of Technology Thonburi, Thailand, 10140

Abstract

This research aimed to create and find efficiency demonstration set of industrial automation production systems with PLC and HMI, higher Vocational Certificate Program 2014, Office of the Vocational Education Commission. The sample group consisted of 20 students at the Higher Vocational Diploma in Electrical Work, Chaiyaphum Technical College, Semester 1, Academic Year 2020, which were obtained by selecting Purposive Sampling. The research tool was a working demonstration kit. Industrial automation production system with PLC and HMI. Worksheet and post-study. Data is collected from expert assessments, and obtained from the scores during the practice worksheet skills and the scores from the post-study test of the sample group And then brought to the industrial automation demonstration kit with PLC and HMI. The research results were found that the industrial automation demonstration Kit with PLC and HMI was created by the researcher. Effective 82.80 / 81.25, meeting the criteria 80/80, can be used in the teaching of control systems in industrial applications, and the expert satisfaction of industrial automation demonstration with PLC and HMI was very good (4.77

Keywords:Demonstration kit, PLC, HMI, Industrial automation

1. Introduction

The Office of the Vocational Education Commission is the main organization for the management of vocational education and professional training for the people throughout their lives to have quality, meet standards and manage knowledge by the needs of the labor market and the independent profession. Which corresponds to the economic and social development of the country and suits the labor needs of the industrial sector as much as possible. Therefore, the management of teaching and learning according to the Diploma of Vocational

Year 2557 in the field of electrical power. Office of the Vocational Education Commission focus on teachers to organize the teaching process by adhering to activities for learners to learn from real experiences. Practice doing and doing consistent with the content and interests of the learners. Instructional management must be practiced for students to acquire skills and expertise.

In practice, to acquire skills, it is necessary to practice often until the learners have the expertise to perform their work. Today, technology has changed and developed rapidly. Especially the program control technology (Programmable Logic Control System; PLC) to support the development of industrial systems in the future. Therefore, a group of people has been created and developed to play a role in the use and control of this PLC system to comply and support the use of modern technology as required by the establishment. Nowadays, modern media has been used to develop a wide variety of manpower. Especially the way that personnel will work directly. Alternatively, they may also try out a practical work package that matches those used in the facility. Most of the teaching materials are simulated for classroom demonstrations, not industrial machines used in the workshop direct establishment. Therefore, if there is a simulation of the experimental set that is closest to the real industry. It will allow the students to use the virtual equipment and become familiar with the use of PLC control systems, which will give the students the knowledge and skills that best meet the needs of the establishment or industry.

In most cases, the teaching material is displayed as an indicator light and as a digital input-output, such as a conveyance indication. Sensor and motor activity is indicated by a lamp instead. Because training kits are expensive, which is the meat in this part that students have to use their imagination.

In understanding the content, which may make the learners understand the principle of operation of the system is not as good as they should. From such importance and problems, the maker therefore developed a demonstration kit for industrial automation production systems with PLC and HMI

showing the operation through real equipment. With the aim of students to reduce their imagination to understand the content and to help learners understand the principles of programming and receiving analog signals from sensors, which will be used as teaching materials in the course of Industrial Control System, course code 3104-2006.

2. Research Methodology

Population and Sample, the population is a higher vocational certificate student in electrical power, who are enrolled in industrial control systems. The sample group was the second year of Diploma students in Power Electrician, Chaiyaphum Technical College, Chaiyaphum Province, who enrolled in the Industrial Control System Course Code 3104-2006, Semester 1, Academic Year 2020, amount 20 people by selecting a specific (Purposive Sampling) because of the location limitations time to experiment and is a group of students taught by the researcher.

3. Design a demonstration kit for industrial automation with PLC and HMI

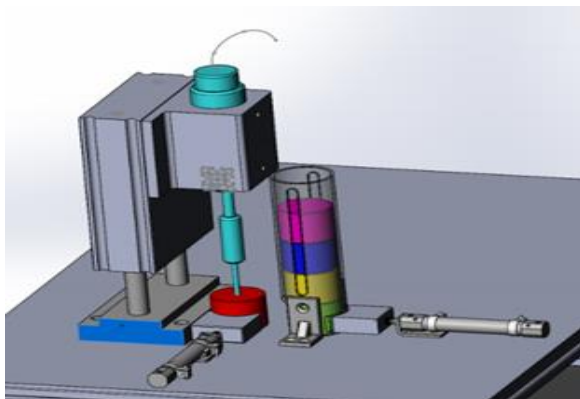


Fig.1 Model of demonstration kit in industrial automation

The industrial automation production system model consists of:

1. X-axis cylinder
2. Y-axis cylinder
3. Z-axis cylinder
4. DC motor
5. Packing magazine
6. Equipment holder

4. Results

4.1 Results of creating research tools

Table 1: Correspond with lesson plan

No	Items	X	S.D.	Meaning
1.	The behavioral objectives of the curriculum are clearly defined.	5.00	0.00	The most
2.	The pattern of teaching is clear.	4.33	0.58	The most
3.	The lesson plan format is easy to understand.	4.67	0.58	The most
4.	Detailed content suitable for teaching	4.67	0.58	The most
5.	Teaching and learning activities appropriate	4.67	0.58	The most
6.	Suitable for teaching	5.00	0.00	The most
Average		4.72	-	The most

Table 2: Correspond with content

No	Items	X	S.D.	Meaning
1.	Properly prioritize behavioral objectives	4.67	0.58	The most
2.	Content covers behavioral purposes.	4.67	0.58	The most
3.	A description of the content is appropriate.	4.33	0.58	Very much
4.	The content is accurate and clear.	4.67	0.58	The most
5.	The image is related to the content.	5.00	0.00	The most
6.	The content is appropriate for the level of the learners.	4.33	0.58	Very much
Average		4.67	-	The most

Table 3: Correspond with the field of testing

No	Items	X	S.D.	Meaning
1.	The exam meets the behavioral objectives.	5.00	0.00	The most
2.	Suitability and consistency with content	4.67	0.58	The most
3.	The number of tests appropriate for the content	5.00	0.00	The most
4.	Questions and answers are clear.	4.33	0.58	Very much
5.	The difficulty of the exam is suitable for learners.	4.67	0.58	The most
6.	Able to measure their knowledge and understanding clearly	4.67	0.58	The most
Average		4.67	-	The most

Table 4: Correspond with laboratory sheet

No	Items	X	S.D.	Meaning
1.	Experiments are appropriate and consistent with the content.	5.00	0.00	The most
2.	The demo worksheet covers the behavioral objectives.	5.00	0.00	The most
3.	The pictures in the demonstration worksheet enhance the understanding of learning.	4.67	0.58	The most
4.	The sequence of the experimental steps is appropriate.	4.33	0.00	Very much
5.	The demonstration worksheet is suitable for the age of the learner.	4.67	0.00	The most
6.	There is an explanation that is accurate and easy to understand.	5.00	0.58	The most
7.	Ease of use	5.00	0.58	The most
8.	There are some tips and precautions.	4.33	0.58	Very much
9.	There is a clear question-answer.	5.00	0.00	The most
10.	Able to measure their knowledge and understanding clearly	4.67	0.58	The most
Average		4.67	-	The most

4.2 Performance Demonstration Kit for Industrial Automation with PLC and HMI

Table 5: Correspond with demonstration

No	Items	X	S.D.	Meaning
1.	Creating a demo kit is for the purpose.	5.00	0.00	The most
2.	Encourage learners to learn about control systems in industrial work.	5.00	0.00	The most
3.	The size and shape are appropriate.	4.67	0.58	The most
4.	The positioning of the equipment is reasonable.	4.33	0.58	Very much
5.	The quality of the equipment and the structure is strong.	5.00	0.58	The most
6.	Maintenance and easy cleaning	4.33	0.58	Very much
7.	It is convenient and safe to use.	4.67	0.58	The most
8.	Tools and equipment are suitable for learners.	5.00	0.00	The most
9.	The explanation is accurate and easy to understand.	4.67	0.00	The most
10	There are clear and accurate pictures explaining the steps.	5.00	0.58	The most
Average		4.67	-	The most

Table 6: Performance analysis of the demonstration unit

Items	No of Student	Full Score	Total Score	Score average	Percentage
Formative test 2 Topics	20	25	414	20.70	82.80
Summative Test	20	20	325	16.25	81.25

Table 7: Results from comparing learners' learning achievement

Items	No of Student	Full Score	Total Score	Score average
Application of basic commands to Mitsubishi PLC with GX Work3 program	20	10	95	47.5
On the application of PLC in various industrial systems	20	10	101	50.5
Sum	20	20	196	49

Table 8: Analysis of post-study test scores

Items	No of Student	Full Score	Total Score	Score average
Application of basic commands to Mitsubishi PLC with GX Work3 program	20	10	161	80.5
On the application of PLC in various industrial systems	20	10	164	82.00
Sum	20	20	325	81.25

Table 9: Analysis of academic achievement scores

Items	No of Student	Full Score	Total Score	Score average
Academic achievement test	20	30	487	81.17

Table 10: Comparison of pre-test and post-study scores with industrial automation production systems using PLC and HMI.

	No of Student	Average	t_{cal}	t_{tab}
Pre-Test Score	20	6.05	5.68**	1.7291
Post-Test Score	20	16.03		

5. Conclusion

A demonstration of industrial automation products, PLC, and HMI that were built, the experts were satisfied at the highest level of satisfaction (4.77). After the learner has tried to use the water pump working demonstration with built-in PLC and HMI and figured out the demonstration performance. The demonstration set had an efficiency of 82.80 / 81.25, meeting the criteria 80/80 when tested with E1 / E2 values, indicating that the generated demonstration unit was effective and could be used in teaching and learning activities.

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