

Development and Finding Performance of Experimental Set for Automatic Car Washing Systems

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Abstract

This paper reports the development and performance on the experimental set for Automatic Car Washing Systems, and achievement comparison by the mean of the pre- and post-tests. These were teaching topics in the course on Fluid Power Technology in the Automotive Technology Program at Siam Technology College in 2016. The researchers created an experimental set comprising (1) the testing tool, (2) instruction manuals, (3) an evaluation sheet by specialist suggestions, (4) an achievement test, and (5) an evaluation sheet index of item objective congruence. The subjects were 15 fourth-year undergraduate students in the Automotive Technology Program in the second semester of 2016. The testing results showed that the percentile of an average score was 83.21, during the course and 81.50 after the course completion, which was higher than the criteria set at 80/80. The t-test results pointed to the students' gain in learning achievements at a significant level 0.01.

Keywords: *Automatic car washing systems, measurement of testing set performance, t- test*

1. Introduction

Pratumsuwan (1997) highlighted the economic growth of the country as causing more expansion of various industries. It is therefore necessary to develop *the process technology* to adjust production rates in response to market demands, particularly for effective PLC control systems. This is because PLC is required to control the sequence of a device. In addition, the system control of the electrical circuit with PLC can reduce quantity of wires. It will change control to be programmable on the keyboard, and modify operation of a circuit easily (Jenkawkum, 1992).

As known, workmanship skills development to keep up with the change of technology is very important, especially in learning and teaching for technicians to help facilitate communication between learners and instructors effectively. The course instructors in Fluid Power Technology have been well aware of the high cost of PLC and thus would like to develop an experimental set for PLC.

In so doing, the researchers constructed an experimental set to help students to learn on the hand-on experience basis. The researchers as course instructors also expected the students to react with enthusiasm and motivation in learning Fluid Power Technology they are to encounter at work in the industrial sector.

2. Research Objectives

In the study, the researchers aimed to (1) develop and find the students' performance on the experimental set of the automatic car wash system, and (2) compare the students' achievements on the pre- and post-tests.

3. Research Methodology

The researchers were to find the students' performance in using the test kit for the automatic car wash system. The subjects and the instruments are described in this section.

3.1 Participants

3.1.1 Three course instructors Fluid Power Technology who have knowledge, expertise and teaching experience or in mechanical vibration work for at least 5 Years. The course instructors were to use the test kit with the students under study.

3.1.2 Fifteen fourth-year undergraduate students who were enrolled in the course Fluid Power Technology in Semester 2-2016.

3.2 Research Instrument

The main research instrument was an experimental set comprising (1) *the testing tool*, (2) *instruction manuals*, (3) an evaluation sheet by specialist suggestions, (4) *an achievement test*, and (5) an evaluation sheet index of item objective congruence.

In constructing the experimental set for Automatic Car Washing Systems, the researchers did a course content analysis of teaching documents and textbooks in Course 220-202 Fluid Power Technology by using PLC programming with a ladder diagram. The researchers selected three levels of Knowledge, namely *Recalled Knowledge*, *Applied Knowledge* and *Transferred Knowledge*. Then the researchers identified specific behavioral objectives in the framework of target ability, knowledge and skills to achieve by learners, learning activities for the behavioral objectives, 3.2.1.4 Determine the behavioral objectives by defining according to ability, knowledge and skills to achieve the behavior of the desired learner after teaching, followed by design and construction of the experimental set of the automatic car wash systems.

Figure 1: Experimental Set of Automatic Car Wash System.



The researchers constructed manuals for course instructors and learners. The Instructor's Manual consists of (1) guideline for using the experimental set and (2) evaluation criteria of practice, (3) content sheet, (4) laboratory sheet, (5) laboratory answer sheet, (6) exercise sheet, (7) pre-test sheet, post- test answer sheets, and (8) practice evaluation sheet. The Learner's Manual consists of (1) content sheet, (2) laboratory sheet, and (3) exercise sheet.

The constructed instruments were evaluated by three experts regarding the quality of (1) content, (2) laboratory sheet, (3) experimental set, and (4) test sheet. The questionnaire for quality evaluation was in 2 parts: Part 1: the question items on a rating scale of 1 Low-5 High levels, and Part 2: open-ended questions with additional suggestions. Then the researchers constructed a multiple-choice pre-test and a post-test with four answer-options to measure learning achievements. All these instruments were evaluated by the three experts' evaluation for Index of Incongruence (IOC).

The researchers revised the instruments on the basis of evaluation and feedback from the three experts and used all the instruments with the students under study. The pre- and post-tests were administered to the students under study and compare their obtained scores for significance by the t-test.

The researchers analyzed the obtained data in 4 parts are (1) the quality analysis of the experimental set, (2) the consistency of the pre- and post-tests with behavioral objectives, (3) the students' performance analysis on the experimental set, and (4) the students' performances in comparison, as follows:

(1) The quality analysis of the experimental set:

The evaluation results from the questionnaire on the 5-level rating scale were presented in averages

(2) The consistency of the pre- and post-tests with behavioral objectives:

The consistency of the pre- and post-tests with behavioral objectives evaluated in 3 options, namely +1, 0, -1 for IOC.

(3) The students' performance analysis on the experimental set:

The students' performance analysis on the experimental set was by the criteria set as 80/80 (Boonyaritipong, 2009).

(4) The students' performances in comparison:

The researchers compared the students' performance scores obtained from the pre- and post- tests by the t-test. The statistical significance for the difference was set at .01 (Boonyaritipong, 2009).

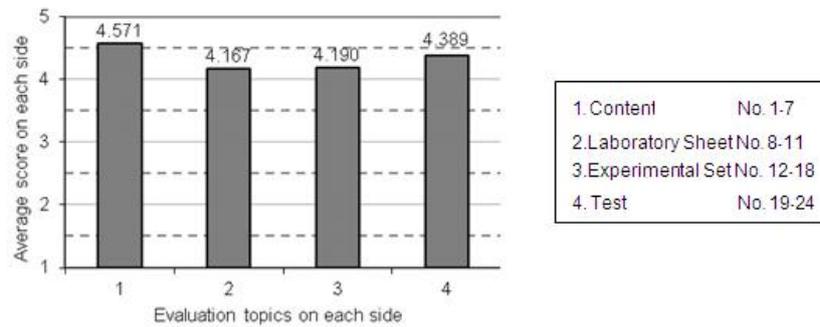
4. Results of the Study

The results were reported in four aspects as given below.

4.1 The results of the quality analysis of the experimental set by the three experts were in 4 aspects, namely content, laboratory sheet, experimental set and the pre- and post-tests. Of 24 items, the mean of the content was at 4.571, of the laboratory sheet at 4.167, of the experimental set at 4.190, and of the pre- and post-test form at 4.389.

The evaluation results on the 4 aspects revealed the mean score ranging from 4.167 to 4.571, indicating a good level according to the defined criteria, as shown in Figure 2.

Figure 2: Results of Quality Evaluation of the Experimental Set



4.2 The consistency of the pre- and post-tests with behavioral objectives in 40 items was between 0.67-1.00, with the mean value of 0.90--higher than the defined criterion at 0.5.

4.3 The students’ performance analysis on the experimental set was at 83.21/81.50-- higher than the defined criteria at 80/80 as shown in Table 1.

Table 1: Performance Results on the Experimental Set

Description	N	ΣX	Full score	\bar{x}	percentage
Exercise scores	15	337	27	22.47	83.21
Test scores	15	489	40	32.60	81.50

As seen in Table 1, the students performed at 83.21% on the exercises and were able to obtain 81.50% on the tests after completing the use of the experimental set.

4.4 The students’ performances on the pre- and post-tests in comparison by the t-test indicated a difference in the students’ learning achievements significant at the.01 level as shown in Table 2.

Table 2: Results of the Analysis of Learning Achievement

Description	N	\bar{x}	Σ	T
Pre-test	15	11.60	315	29.015*
Post-test	15	32.60		

As shown, Table 2 indicates the difference test results by the t-test between the pre-test and post-test significant at the.01 level. The results suggest that the experimental set for Automatic Car Washing Systems worked well with the students under study.

5. Conclusion

In this study, the researchers constructed an experimental set for automatic car wash systems for 15 students in the course on Fluid Power Technology in the Automotive Technology Program at Siam Technology College in 2016. The experimental set consisted of machines and documents for the practice. The findings pointed to good evaluation by three experts at the average value of 4.167-4.571 by the defined criteria. The Index of Congruence (IOC) between the objectives with the tests was at 0.9. The students’ percentage of average scores during study was at 83.21, followed by 81.50 after

study completion—indicating the level higher than the defined criteria at 80/ 80. The final result clearly indicated the statistical significance at the .01 level by the t-test for the students' learning achievements at the pre- and post-stages of the study.

6. The Authors

Jirawat Garluna, Udomsak Chotimongkol, and Ananchai Tiangda are full-time lecturers in the Department of Automotive Technology, Siam Technology College, and Bangkok, Thailand. They have keen interest in research in Fluid Power Technology in the Automotive Technology and related areas.

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