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An Instructional Trainer Innovation for Automotive Lighting, Car Alarm and Central Locking System

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Abstract: The purpose of this study to determine the effectiveness of mock up trainer model in order to improve student's performance in test and repair wiring/lighting system, car alarm system and servicing central locking system. This study adopted one group before and after experimental research design in conducting and gathering information. The training and instruments were administered to 40 third year students in Bukidnon State University, Malaybalay City, Bukidnon. Furthermore, this study used descriptive statistics such as frequency, mean, percentages and standard deviation to describe the respondents. The study utilized the F-test and t-test to establish the difference and regression analysis to measure the extent of effect of input and process variables to output variable. The study found out that the instructional trainer has yielded is positive significance in the program status and highly significant in pre-test result. These are in terms of its effects in output variable and written post-test evaluation. The effect is negative and significant in parent's monthly income, significant in pre-test practical and input process variable's effect in post-test practical evaluation. The following conclusions and implications were drawn. The mock up trainer has been instrumental in improving student's score in test and repair wiring/lighting system, servicing car alarm system and a servicing central locking system. This is because the trainer serves as the medium of instruction to help develop the learning of the students for the automotive electrical system, car alarm with central locking system and other automotive vehicle accessories such as ignition system. Understanding such basic principles will enable the students to be self-reliant, more confident of themselves and they will be able to perform auto electrical and car alarm with central locking system installation and trouble-shooting circuits.

Key words: Instructional trainer automotive lighting, car alarm, central locking system and innovation trainer, servicing, central locking system, post-test evaluation

INTRODUCTION

Many teaching tools are used to teach automotive servicing. This ranges from traditional academic lectures, textbooks, hands on shop work and computer based resources. In the educational area of industrial technology, specifically in the study of automobile (gasoline and diesel) and associated components, it is necessary to use instructional materials that are able to simulate, test and obtain specific data of the operation. There are still theories in the field of automotive which many students find difficult to conceptualize in the real world of modern automobile technology. Despite the efforts of highly capable instructors to explain such theories, there is really a need to use instructional mock-ups or trainers to enhance better understanding and apply the principles presented.

The Input-Process-Output (IPO) Model will provide the general structure and guide for the direction of the study. It has many interdisciplinary applications and is used to convey systems fundamentals in Information Technology (IT), overview on education and as a brainstorming, preliminary investigation tool in systems development processes. It consists of at least three and sometimes four, distinct components.

The theoretical framework that will be used in this study is the input-process-output model. In the IPO Model, a process is viewed as a series of boxes (processing elements) connected by inputs and outputs. Information or material objects flow through a series of task or activities based on a set of rules or description points (Amey, 1995). Flow charts and process diagrams are often used to represent the process. According to Armstrong (2001), this explains that what goes in is the input; what causes the change is the process what comes out is the output (Anonymous, 2011a, b).

The inputs of the model were the information, ideas, resources used and the basis in creating a project. It

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includes the project objectives, project background and project budget to facilitate the implementation of the project. In this study, the following variables are considered as input, these are the student's profile, academic status, program status, number of unit load, number of major subjects, family size and family income (Anonymous, 2011a, b).

The outputs of the model were the information flowing out in the project as results of the processing system. These are the results that provide linkages between the input (problem situation) and the intended outcomes. Additionally, outputs of the model are the direct evidence of the project and typically tangible and countable. Outputs are the intended and unintended results and consequences of the activities and tend to be categorized into short, medium and longer-term results. The output considered the simulation of the prototype and the implementation of the post-test.

MATERIALS AND METHODS

The study made use of one group of experimental research design and it was carried out at Bukidnon State University (BukSU), Malaybalay City, Bukidnon. Data analysis and presentation were carried out in University of Science and Technology of Southern Philippines (USTSP), Lapasan, Cagayan de Oro City. It made use of simple random sampling procedure. Of the 150 students, 40 students were randomly selected from the population computation of the sample size. The researcher conducted a pre-test to diagnose the skill level of each participant on test and repair wiring/lighting system, servicing car alarm system, servicing central locking system and profiling of students. Classroom instruction integrated with the innovation was conducted for four weeks with a total of 45 h. A post-test written and practical hand on were conducted to evaluate the effectiveness of the innovation by external evaluators, one from industry, one a TESDA assessor with National Certificate levels 2-3 and from the academe (Fernandez, 2006).

Descriptive statistics such as frequency, percentage and weighted mean were used to describe the respondent's scores and responses, inferential statistics, t-test to test the difference between pretest and posttest and regression analysis to test the effects of input and process variable to output variable.

RESULTS AND DISCUSSION

What is the respondent's profile? The data show that majority of the respondents are first courser, regular students with 23-28 units. Majority of the student's family income is 10,000 pesos and below with 5-9 siblings. Majority of the respondents have one major subject in a typical semester.

Table 1: Characteristics of respondents

Characteristics (Specifications)	F-values	Percentage
Academic status		
Regular	29	72.50
Irregular	11	27.50
Total		100.00
Program status		
First course	37	92.50
Second course	3	7.50
Total		100.00
Number of loads (units)		
23-28	24	60.00
17-22	14	35.00
≤16	2	5.00
Total		100.00
Family income		
Php. 21,000 and above	2	5.00
Php. 16,000-20,000	2	5.00
Php. 11,000-15,000	3	7.50
Php. 6, 000-10,000	18	45.00
Php. ≤5,000	5	37.50
Total		100.00
Family size		
7-9	6	15.00
6	11	27.50
5	7	17.50
4	10	25.00
≤3	6	15.00
Total		100.00
Number of major subjects		
1	35	87.50
2	4	10.00
3	1	2.50
Total		100.00

Table 2: Frequency and percentage distribution of respondents overall pretest

Ranges	Frequency	Distribution (%)	Verbal description
26-30	0	0.00	Very good
21-25	1	2.50	Good
16-20	3	7.50	Fair
11-15	23	57.50	Poor
0-10	13	32.50	Very poor
Total		100.00	

What are the respondent's pre-test score in written and practical examination: Frequency and percentage distribution of respondents overall pretest Table 1 and 2. The data show that majority of the students got 57.50% in the overall pre-test score indicating poor. The over-all rating is poor (mean =11.6). The standard deviation of 3.66 indicates the respondent's overall pretest score varied from each other (Table 3).

The data show that all of the student's pre-test scores in the practical evaluation is very poor. The overall rating is also poor (mean = 2.38). The standard deviation of 4.19 indicates that their scores dispersed from each other. This may be because though all of them scored with <10 in the pretest in the practical exam there were some students with little knowledge in the different areas.

Table 3: Frequency and percentage distribution of respondent's pretest practical exam

Ranges	Frequency	Distribution (%)	Verbal description
26-30	0	0.00	Very good
21-25	0	0.00	Good
16-20	0	0.00	Fair
11-15	0	0.00	Poor
0-10	40	100.00	Very poor
Total		100.00	

Table 4: Frequency and percentage distribution of respondent's overall simulation score in activity 1

Ranges	Frequency	Distribution (%)	Verbal description
26-30	0	0.00	Very good
21-25	16	40.00	Good
16-20	14	35.00	Fair
11-15	8	20.00	Poor
0-10	2	5.00	Very poor
Total		100.00	

Table 5: Frequency and percentage distribution of respondent's overall simulation scores in activity 2

Ranges	Frequency	Distribution (%)	Verbal description
26-30	0	0.00	Very good
21-25	6	15.00	Good
16-20	15	37.50	Fair
11-15	16	40.00	Poor
0-10	3	7.50	Very poor
Total		100.00	

Table 6: Frequency and percentage distribution of respondent's overall post-test

Ranges	Frequency	Distribution (%)	Verbal description
26-30	0	0.00	Very good
21-25	14	35.00	Good
16-20	18	45.00	Fair
11-15	7	17.50	Poor
0-10	1	2.50	Very poor
Total		100.00	

What is the respondent's simulation score?: The data show that majority of the respondents obtained 55.00% in the overall simulation scores in activity 1, described as poor to fair. The over-all rating is fair (mean =18.00). the standard deviation of 4.54 indicates the respondent's simulation score activity 1 were widely dispersed from each other (Table 4).

The data show that majority of the respondents got 77.50% in the over all simulation scores in activity 2, described as poor to fair. The over-all rating is poor (mean = 15.82). The standard deviation of 4.24 indicates the respondent's simulation scores in activity 2 were widely dispersed from each other (Table 5).

The data show that majority of the respondents obtained 80.00% overall post-test scores, described from fair to good. The over-all rating is fair (mean = 18.68). The standard deviation of 3.76 indicates the respondents overall scores are widely dispersed from each other (Table 6).

The data show that majority of the respondent's that post test practical evaluation score is very good with 50% of the total respondents who got that result by the overall

Table 7: Frequency and percentage distribution of respondent's overall post-test practical evaluation

Ranges	Frequency	Distribution (%)	Verbal description
21-25	20	50.00	Very good
16-20	13	32.50	Good
11-15	6	15.00	Fair
6 -10	1	2.50	Poor
0-5	0	0.00	Very poor
Total		100.00	

Table 8: Distribution of statistics (mean, standard deviation, test statistics) on test and repair of wiring/lighting, car alarm and central locking system when grouped according to pre-test and post-tests

	Pre-test		Post-test			
Indicators	Mean	Desc.	Mean	Desc.	t-values	p-values
Test and repair wiring/lighting	4.50	Poor	7.30	Good	6.53**	3×10^{-9}
Car alarm	3.15	Poor	5.93	Fair	7.68**	2×10^{-11}
Servicing central locking	3.97	Poor	5.45	Fair	3.48**	0.00041
Over-all	11.60	Poor	18.68	Poor	8.52**	4.5×10^{-13}

rating is classified as good (mean = 19.88). The standard deviation of 4.78 indicates their post test practical scores were widely dispersed from each other (Table 7).

To further validate the effectiveness of the mock- up trainer design, a one-tailed t-test was conducted to verify that the post test scores of the respondents is significantly greater than the respondent's pretest score.

Is there a significant difference in respondent's pretest and post test scores?: Table 8 shows the distribution of statistics on the respondent's performance in test and repair of wiring/lighting system, car alarm system, central locking system and over-all performance when grouped according to pretest and posttest score. There were two groups being compared: pretest and post-test scores (Table 8).

The null hypothesis that the pretest was greater than the post test in the respondent's scores in repair of wiring/lighting system was rejected. The result indicates that the post test is greater than the pretest in the respondent's test scores in repair of wiring/lighting system (t = 6.53**). The difference is highly significant (Table 9).

The null hypothesis that the pretest was greater than the post-test in the respondent's scores in the car alarm system is rejected. The result indicates that the post test is greater than the pretest in the respondent's test scores in car alarm system (t = 7.68**). The difference is highly significant.

The null hypothesis that the pretest is greater than the post test in the respondent's scores in the servicing central locking system is rejected. The result indicates that the post test is greater than the pretest in the respondent's test scores in servicing central locking (t = 3.48**). The difference is highly significant.

Table 9: Multiple regression analysis of input and process variable and post test scores

Independent variable	Beta coefficient	t-values	p-values	Level of significance
Academic status	0.83	0.55	0.59	Not significant
Program status	8.06	2.56	0.01	Highly significant
No. of units	0.13	0.66	0.51	Not significant
No. of major subjects	-0.33	-0.24	0.81	Not significant
Parents monthly incom	-0.12	-1.96	0.06	Not significant
No. of siblings	-0.39	-0.99	0.33	Not significant
Simulation sources	0.09	0.80	0.43	Not significant
Pre-test practical	13.26	2.97	0.00	Highly significant
Pre-test written	0.05	0.31	0.76	Not significant

The null hypothesis that the pre-test is greater than the post-test in the respondent's scores in the overall scores is rejected. The result indicates that the post test is greater than the pre-test in the respondent's overall scores (t = 3.48**). The difference is highly significant.

To what extent do input (profile) and process (pre-test, activities and simulation) explain output variable (external evaluation score)?: As indicated in the results of the test, the respondent's input and process variables affect the respondent's output variable. The effect is positive as shown in the regression model.

This means for every unit increase in the academic status (irregular to regular), there is an improvement of 0.83 in the respondent's post-test written evaluation. For every unit increase in the program status (first course to second course), there is an improvement of 8.06 in the respondent's post-test written evaluation. For every unit increase in the number of units there is an improvement of 0.13 in the respondent's post-test written evaluation. For every unit increase in the respondent's number of major subject there is a decrease of 0.33 in the respondent's post-test written evaluation. For every unit increase in the respondent's parent's monthly income, there is a decrease of 0.12 in the respondent's post-test written evaluation. For every unit increase in the respondent's number of siblings, there is a decrease of 0.39 in the respondent's post-test written evaluation. For every unit increase in the respondent's simulation score, there is an improvement of 0.09 in the respondent's post-test written evaluation. For every unit increase in the respondent's score in pretest practical exam, there is an improvement of 13.26 in the respondent's post-test written evaluation. For every unit increase in the respondent's score in pretest written evaluation there is an improvement of 0.05 in the respondent's post-test written evaluation.

It can also be seen from table that the regression model is highly significant (F = 2.67*). The null hypothesis is rejected. This signifies that the respondent's input and process variables affect the respondent's output variable.

Table 10: Multiple regression analysis of input and process variable and post test practical evaluation

Independent variables	Beta coefficient	t-values	p-values	Level of significance
Academic status	2.54	1.31	0.19	Not significant
Program status	6.41	1.59	0.12	Not significant
No. of units	0.23	0.93	0.36	Not significant
No. of major subjects	1.09	0.63	0.53	Not significant
Parents monthly income	-0.16	-2.06	0.04	Significant
Number of siblings	0.73	1.44	0.16	Not significant
Simulation sources	0.05	1.00	0.72	Not significant
Pre-test practical	13.55	2.38	0.02	Significant
Pre-test written	0.21	1.00	0.32	Not significant

The value of adjusted coefficient of multiple determination is 0.44 which explains that 44% of the total variation of the respondent's output variable is explained by the variation of the respondent's input and process variables. The remaining 56% is due to unexplained variables (Table 10).

As indicated in the results, of the test the respondent's input and process variables affect the respondent's output variable. The effect is positive as shown in the regression model.

This means for every unit increase in the academic status (irregular to regular), there was an improvement of 2.54 in the respondent's post-test practical evaluation. For every unit increase in the program status (first course to second course) there is an improvement of 6.41 in the respondent's post-test practical evaluation. For every unit increase in the number of units there is an improvement of 0.23 in the respondent's post-test practical evaluation. For every unit increase in the respondent's number of major subject, there is an increase of 1.09 in the respondent's post-test practical evaluation. For every unit increase in the respondent's parent's monthly income there is a decrease of 0.16 in the respondent's post-test practical evaluation. For every unit increase in the respondent's number of siblings, there is an improvement of 0.73 in the respondent's post-test practical evaluation. For every unit increase in the respondent's simulation score there is an improvement of 0.05 in the respondent's post-test practical evaluation. For every unit increase in the respondent's scores in pretest practical exam there is an improvement of 13.55 in the respondent's post-test practical evaluation. For every unit increase in the respondent's score in pretest written, there is an improvement of 0.21 in the respondent's post-test practical evaluation.

It can also be seen from table that the regression model is highly significant (F = 2.62*). The null hypothesis is rejected. This signifies that the respondent's input and process variables affect the respondent's output variable.

The value of adjusted coefficient of multiple determination is 0.27 which explains that 27% of the total

variation of the respondent's output variable, post test practical evaluation is explained by the variation of the respondent's input and process variables. The remaining 73% is due to unexplained variables.

CONCLUSION

On the basis of the findings of the study, the following conclusions and implications were drawn. The mock up trainer has been instrumental in improving student's scores in test and repair of wiring/lighting system, servicing car alarm system and servicing central locking system. This is because the trainer serves as the medium of instruction to help develop the learning of the students for the automotive electrical system, car alarm with central locking system and other automotive vehicle accessories such as ignition system. Understanding such basic principles will enable the students to be self-reliant, more confident of themselves and they will be able to perform auto electrical and car alarm with central locking system installation and trouble-shooting circuits (Harris and Taylor, 1997; Mendoza, 2011).

Learning to become an effective technician for automotive electrical lighting system will be challenging because many automotive students will feel that electrical troubles are very complicated and beyond their knowledge. With this an instructional trainer model that may help to develop and improve the knowledge, skills and attitudes of the students in automotive electrical system with car alarm and central locking system, they will be able to experience hands-on learning environment that can quite often stimulate student leaning as much as possible (Hooser, 2010).

RECOMMENDATIONS

Based on the findings and conclusion of the study, the writer arrived at the following recommendations to the following entities:

Administrators: Replicate or purchase this innovation since the mock-up trainer can help the administrators to increase their student's and school's performance with the increase of NC2 passers in their institution. This innovation will also help the school to be accredited for having innovative learning materials in their institution. This is a good practice to the institution that they have enough mock-up trainer models to enhance the learning skills of the students.

Technicians/teacher: They may innovate or create innovation that can also be useful for automotive technicians to visualize the different functions, operations and controls in automotive electrical system and car alarm with central locking system for classroom instruction and laboratory hands-on activity.

Students: One of the basic importance of the proposed study is that it can be a big help to the students to relate the theory learned into the trainer model in automotive electrical system, car alarm with central locking system and how it operates. Drawings found in books are not enough to explain to the students the theory and principles behind the automotive electrical system and car alarm with central locking system in an automotive vehicle. Moreover, the mock-up trainer model will be used for classroom instruction to enhance their knowledge, skills and attitudes towards industrial work.

Industry: Students with effective skills and competence will contribute to the industry by providing quality and globally competitive services in the automotive industry.

Future researchers: Future researchers can make use of the results of this study and will serve as benchmark for other innovation.

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