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THE EFFECTIVENESS OF WEB-BASED TRAINING APPLICATIONS IN AUTOMOTIVE ELECTRONIC SYSTEMS

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ABSTRACT
The roles of automotive technology are developing essentially used in the modern automobile. Training in automotive technology education requires inventive instructional strategies to motivate learners for learning experience. This research has been carried out in order to find out the effectiveness of web-based training applications in automotive electronic systems on the students' achievements and attitudes. An experimental research pre-test and post-test control group was employed in this study. A total of 30 volunteer participants in the second semester 2007 academic year in this study who were freshman undergraduate students' of Mechanical Technology Education program at King Mongkut's University of Technology Thonburi for a period of forty hours. The results revealed that a significance difference in favor of experiment group between the achievement scores obtained from experiment group used web-based training, but no significant difference was found in their attitudes. According to the results, it can be said that usage of web-based training applications in automotive electronic systems is more effective than conventional training.

KEY WORDS
Automotive Electronic Systems, Automotive Technology Education, Web-based Training

1. Introduction

The automotive industry is experiencing an "electronic revolution." Electrical and electronic devices are now being used in almost every major system of the car. Computers are commonplace and are being used to monitors and control almost all critical assemblies. The computer can be tied to the engine, fuel system, ignition system, emission systems, brakes, suspension, transmission, and many other systems. This can make electrical diagnosis and repair very challenging [1]. Perry [2] described "effective education is active and interactive rather than passive and isolating". Dorson, Foster, & Reid [3] said its reasonable application can make teaching more diversified, flexible, and effective.

Technology Education can be built as intended and permanent competency changing. Several cases have demonstrated our effective learning to improve the student's thinking level [4], facilitate problem-solving [5], and offer learning tools which can develop student's competencies. Web-based training, also referred to as Internet-based training is the tools of performance-based training support systems provide learners with practical knowledge and problem-solving skills in a just-in-time format [6]. Despite all the attention focused on Web-based training, there is still much to be learned concerning utilizing the web to design and delivery in higher education.

Therefore, a widespread belief that Web-base training is a powerful instructional device, it is still an open question to under what conditions can multimedia technology promote students' conceptual understanding [7] [8]. Hence, it is important to study on automotive technology area. The automotive electronic systems increases have involved from simple mechanical repairs to high-level technology-related work. The increasing sophistication of automotive subject area requires students who can repair and diagnosis with high performance while servicing their skills common problem-solving skills.

The main purpose of this study was conducted to compare web-based training and conventional training groups' used in automotive electronic systems courses on the students' achievements and attitudes. Based on this purpose, the present study attempted to answer the research questions following:

1. Is there a significance difference between students' achievement scores in the experiment group, in which web-based training applications were applied and the students in the control group, in which conventional training were applied, in favor of the experiment group?
2. Is there a significance difference between students' attitudes in the experimental group, in which web-based training applications were applied and the

students in the control group, in which conventional training were applied, in favor of the experiment group?

2. Research Methods

In this study, researchers provides to find out the efficiency and effectiveness of web-based training used in automotive electronic systems courses on the students' achievements and attitudes towards the training process, was carried out by the controlled pre-test and post-test research design [9].

2.1 Participants

A total of 30 volunteer participants in the second semester 2007 academic year in this study who were freshman undergraduate students' of Mechanical Technology Education program at King Mongkut's University of Technology Thonburi Bangkok, Thailand. This study was conducted in November 2007 to February 2008. All participants had not learned on automotive electronic systems course and related.

2.2 Research Design

The present study is an experimental research pre-test and post-test control group design. One group is administered a treatment while the other is not; all groups are observed before and after the treatment is administered. 30 freshman students are randomly selected to participate in a web-based training study. Half are randomly assigned to an experimental and half or not. All students are given a pre-test at the beginning of the experimental and a posttest at the end of the experimental.

2.3 Designing a Web-based Training Program

Researchers were applied the standard systematic design process as presented into 8 categories: 1) Analyzed needs; 2) Identify goals and conduct instructional analysis; 3) Analyzed learners and contexts; 4) Write performance objectives; 5) Develop assessment tools; 6) Develop instructional strategy; 7) Develop and select instructional materials; and 8) Design and conduct the first formative evaluation to be provide the whole content [10]. Consequently, the effective of training program on problem-solving skills, Jonassen [11] suggested the features of training program researchers should be implemented "One frequently-used model of the problem solving process"; a basic sequence of three cognitive activities in problem solving:

1. Representing the problem includes calling up the appropriate context knowledge, and identifying the goal and relevant starting conditions for the problem;
2. Solution search includes refining the goal and developing a plan of action to reach the goal;
3. Implementing the solution includes executing the plan of action and evaluating the results.

This rationale was developing an appropriate web-based training program in this study. Problem-solving skills is setting goal, such as subjective, objective, informative, assessment of program.

2.4 Computer Programming

Researchers were adopting computer programming 'Dream Weaver 8' for constructing main program. In the part of dynamically, researchers applied computer programming 'Macromedia Flash Version 8', and then applied 'Adobe Photoshop Version 7' for improve the high light of the pictures. A program of 'Macromedia Author ware Version 7 used for designing the test items.

2.5 nstruments

As instruments, the web-based training measurement and evaluation achievement test, attitude scale and questionnaire were used in the study. The instruments have involved from 2 experts in the field of automotive technology education, 2 experts in the field of computer multimedia technology, and one expert in measurement and evaluation were consulted during designing instruments. The unit achievement test was developed by the researchers. The test items were composed of 120 multiple-choice. The learning strategy focused on symptoms diagnosis of automotive electronic systems. It can be separated to solve the problems; students' have selected analyze a situation by identifying, testing, inspecting the problem towards well-structured problems or ill-structured problem.

he items provided four training modules are: 1) Fundamental of electronic technology and principles of electronic fuel injection control system composed of resistance, capacitor, transistor, integrated circuit, diode, oscilloscope, principles of gasoline electronic fuel injection control systems; 2) Fuel delivery system composed of fuel pump, injector, fuel pressure regulator, cold start injector; 3) Air induction system composed of throttle valve, auxiliary valve, air flow meter; and 4) Electronic control system composed of intake air sensor, water temperature sensor, manifold air pressure sensor, crankshaft angle sensor, oxygen sensor, vehicle sensor, throttle position sensor, diagnosis function.

irstly, a pilot test with 210 items was prepared consulting the experts and in the first semester 2007 academic year. The pilot test was applied to 40 students who had taken this course before. After that, item analyzes were done by validity and reliability studies. Then, researchers were identified the difficulty of the test items with 120 items was prepared. It was established that the whole items difficulty level (between 0.36 and 0.77) and discrimination index (between 0.29 and 0.48) were within acceptable range of 0.3 – 0.7 and 0.2 – 0.5 respectively [12]. The piloting of these instruments

yielded reliability coefficients of 0.63, 0.71, 0.76 and 0.79 respectively using KR-20 formula. These indicate that all the dependent were validity and reliability coefficients obtained were higher than the recommended level of 0.89 [13].

econdly, a Likert's rating scale with 16 items (4 aspects) was developed by the researchers. The items was rated on a five point rating scale from (5) strongly agree to (1) strongly disagree. The pilot form of the attitude scale with 20 items was applied to 40 students, reliability coefficients of 0.83, 0.86, 0.80 and 0.89 respectively using Cronbach's Alpha Coefficient [14].

hirdly, to find out the students' achievement in the experiment group regarding web-based training application was being covered, a training process questionnaire composed of multiple choices was administered to the students in the experiment group and they were checked lists the following questions in the questionnaire.

2.6 Procedures

In the experimental group, training process would be covered was planned by researchers. Training was done using the web-based training applications. On the other hand, in the control group, the classroom was covered in conventional training method in which lecturer centered, mainly, lecturing method was used. For the experiment group, researchers can be described into 7 procedures as follows:

2.6.1 Students were matched by conducting a pretest;
2.6.2 Academic training modules in automotive electronic system was identified and sequenced;
2.6.3 A pre-test for each module was structured and administered before training;
2.6.4 Each module was taught through a web-based training;
2.6.5 A post-test for each module was structured and administered after;
2.6.6 Students were matched by conducting a posttest;
2.6.7 A criterion test for the whole module was administered after training;
2.6.8 Suitable statistical techniques were employed to analyze the data collected.

2.7 Quality Assessment

Teeranatanakul et al [14] explained the quality assessment in the online learning that whole of a web-based training which focused on content analysis consisted of 3 aspects as follows: 1) Content; 2) Items; and 3) Programming design (graphics and sounds). The result of 9 experts' was mean at 4.00 which were at a good level. The quality assessment in the whole of a web-based training which focused on computer programming and presentation consisted of 3 aspects as follows: 1) Still images; 2) Pictures; 3) interaction; 4) Texts and colors; and 5) Simulation. The result of 9 experts' was mean at 4.33 that mean at a good level.

2.8 Data Collection

All participants completed a pre-test that assessed their basic knowledge of automotive electronic systems. The experiment group then undertook the automotive electronic systems session of 3 hours per week. They were learning a web-based training including 4 learning modules: This group was allowed access on the computer room (CB 30412) at Department of Mechanical Technology Education, King Mongkut's University of Technology Thonburi. The control group had 3 hours session in- volving a conventional learning in classroom. There was also same content of automotive electronic systems.

2.9 Data Analysis

At the end of February 2008, a posttest was completed by both groups. The present research results were assed by descriptive and inferential statistics. The data analysis was scores, percentages, mean standard deviation. The t-test used for calculate the significance of differences between the groups [15]. The effectiveness of a web-based training presented a p-value of less than 0.05 was considered statistical significance difference. All the analysis was done by using the Statistical Package for Social Sciences (SPSS) computer program.

3. Results and Discussions

In table 1, to find out the efficiency of a web-based training, a total of 30 freshman students are randomly selected to participate in a web-based training study. The formative and summative evaluation was considered in this study for six hours beforehand. The efficiency found that 77.59/81.52 that had the criterion higher than 75/75. Sikhabandit [16] analyzed the efficiency of web-based learning assess too usefully in training. The overall of web-based program was clearly following; texts and colors, content, simulation, interaction, miscellaneous, and self-assessment.

Table 1
The efficiency of a web-based training program (n = 30)

Module	Pretest			Posttest			Efficiency E_1/E_2
	Scores	Mean	E_1	Scores	Mean	E_2	
1	30	23.42	78.16	40	31.58	78.95	78.16/78.95
2	20	15.17	75.85	30	24.07	80.23	75.85/80.23
3	20	15.13	75.65	30	23.13	77.11	75.65/77.11
4	20	16.14	80.71	30	26.93	89.77	80.71/89.77
Total	90	69.86	77.59	120	105.71	81.52	77.59/81.52

Table 2
Comparisons of Pretest Scores of Participants

Group	N	Mean	SD	t	*df*	Sig (2 tailed)
Experiment	15	53.16	4.514	2.927	29	.001*
Control	15	42.27	5.342			

*Note. *p >.05 (Independent t-test)*

Table 3
Comparisons of Posttest Scores of Participants

Group	N	Mean	SD	t	*df*	Sig (2 tailed)
Experiment	15	75.39	2.976	1.834	29	.004*
Control	15	58.82	4.043			

*Note. *p <.05 (Independent t-test)*

Table 4
Comparisons of Pretest & Posttest Scores of Experiment Group

Group	N	Mean	SD	t	*df*	Sig (2 tailed)
Pretest	15	53.16	5.342	21.246	14	.000*
Posttest	15	75.39	4.043			

*Note. *p <.05 (Paired sample t-test)*

Table 5
Comparisons of Pretest & Posttest Scores of Control Group

Group	N	Mean	SD	t	*df*	Sig (2 tailed)
Pretest	15	42.27	5.342	12.534	14	.000*
Posttest	15	58.82	4.043			

*Note. *p <.05 (Paired sample t-test)*

Table 6
Comparisons of Attitude Scores of Web-based Training and Conventional Training Group

Group	N	Mean	SD	t	*df*	Sig (2 tailed)
Experiment	15	4.67	0.449	-1.742	14	.183*
Control	15	3.95	0.593			

*Note. *p >.05 (Independent sample t-test)*

The comparison of the students' achievement of the both conventional training and web-based training was made through using the pre-test and post-test scores. In table 2, there is a difference between the means of pre-test scores in groups. It can be seen the p-value ($p > .05$) so it can be said that there is not any difference between the experiment and control groups. Difference between the scores that obtained from both groups is not significant.

According to Table 3, there is a difference between the means of post-test scores obtained in groups. It can be seen the p-value ($p < .05$) so it can be said that there is a difference between the means of experiment and control groups. This significance difference showed that web-based training applications are more effective than conventional training in
simulation on real-time. The students' can be found the alternate solutions with critical thinking. Moreover, they have understood regarding causes and effects in automotive electronic systems with using this approach.

The differences between pre-test and post-test results for both groups using paired sample t-test procedure, there was a significance between pre-test and post-test results for both web-based training (Table 4) and conventional (Table 5). According to the results, it can be said that usage of web-based training applications in automotive electronic systems is more effective than conventional training.

The students' attitude was to assess the course content, delivery, texts, and instructor. On a scale of 1 to 5, the students' rated their course satisfaction according to each of statements given on the survey. The t-test indicated no significant difference in students' attitude (Table 6).

4. Conclusion

This study was conducted to compare web-based training and conventional training groups' used in automotive electronic systems courses on the students' achievements and attitudes. The results of this study indicated that achievements scores of the web-based training and conventional training groups during both the pre-test and post-test examinations. The amount of students' achievement gained from both sections of the course was also significantly different. Therefore, the difference of the quantitative outcomes indicates that students gain web-based training amounts of students' achievement in the automotive electronic systems. Sudsomboon [17] conducted a development of online instructional package on automotive transmission systems subject for mechanical technology education program. He developed online learning course, an available package designed for automotive technology courses. The effectiveness of students' achievement was done by online learning significantly different. In the program, the information is presented in four text-based learning units including preliminary, core and supplementary constructivist items follows by practical exercises. In this result, problem-solving skills were adopted. Six undergraduate students with basic skills in maintenance, repair, and diagnosis were performed on practical exercises. The student who felt understands with the asynchronous and had methodology to learning learned most from online learning.

The findings have demonstrated that the use of a web-based training can be effectively in enhancing student's achievement in automotive electronic systems as well as their perception of the conventional teaching. Those are propose new features are requires for online teaching/training. The difference between the mean gains of students exposed to a web and those denied a web on all the dependent measure is in the affirmative. The important issues found that 'role of the online teacher'; the role of the teacher in online environment can be addressed. The utility tools as interactive online teaching have educators recommend for developing. Roles of online teachers that were designing to 'pioneering' for a new methodology [18]. Three particular functions of both these contexts are discussed. The first function is the design and organization of the learning. The second is the creation of a community of learners through student-to-student discourse. The third is the provision of direct instruction. Researchers were attempted to create an innovative for enhancing undergraduate students on automotive electronic systems. There are several characteristics that lead to the effective design of training.

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References

[1] J.E. Duffy, N. Henke-Konopasek, *Auto electricity and electronics technology (4th edition)* (Tinley Park, Illinois: The Goodheart- Willcox , 2004) 7-13.

[2] B. Perry, Using photographic images as an interactive online teaching strategy, *International Internet and Higher education 9*, 2006, 229.

[3] V. Dorson, P. Foster, & D. Reid, Information communication technology (ICT) integration a science education unit for preservice science teachers; students' perceptions of their ICT skills, knowledge and pedagogy. *International of Science and Mathematics Education, 4*, 2006, 345-363.

[4] C.P. Lim, Effective integration of ICT in Singapore schools: Pedagogical and policy implications. *Educational Technology Research and Development, 55*, 2007, 83- 116.

[5] S. Hennessy, k. Ruthven, & S. brindley, Teacher perspectives on integrating ICT into subject teaching:

Commitment, constraints, caution, and change, *Journal Curriculum Studies, 37*, 155-192.
[6] M. Discoll, Web-based training in the workplace. *Adult Learning, 10*, 21-25.
[7] D. Ardac, & S. Akaygun, Effectiveness of multimedia-based instruction that emphasizes molecular representations on students' understanding of chemical change. *Journal of research in Science Teaching, 41*, 317-337.
[8] J. Van der Meji, & T. De Jong, Supporting students' learning with multiple representations in a dynamic simulation-based learning environment. *Learning and Instruction, 16*, 2006, 199-212.
[9] J.W. Crewell, *Educational research: planning, conducting, and evaluating quatitative and qualitative approach (3rd edition)* (Upper Saddle River, NJ: Pearson/Merrill Prentice Hall, 2008) 191-195.
[10] W. Dick, L. Carey, & J.O. Carey, *The systematic design of instruction* (Boston, MA: Pearson/Allyn & Bacon, 2005).
[11] D.H, Jonassen, *Learning to solve problems: an instructional design guide*. (San Fransico: Pfeiffer, 2004).
[12] C. R. Kothari, *Research Methodology*, (New Delhi: Wishwa Par kasha, 2003).
[13] L. Koul, *Methodology in Educational Research*, (Delhi: Vikas Publishing House, PVT Ltd, 1992).
[14] P. Teeranatanakul, P. Kiattikomol, & S. Yampinij, *Design and Production of Computer Instructional Package for e-Learning*, (Bangkok: D Printing House, 2003) 158-171.
[15] B. Sisa-aat, *Statistical Approach in Research*, (Mahasarakam: Apichat Printing House, 1998) 63-64.
[16] S. Sikhabandit, *Educational Technology*, (Bangkok: King Mongkut's Institute of Technology North Bangkok).
[17] W. Sudsomboon, A development of online instructional package on automotive transmission systems subject for mechanical technology education program: *The 1st International Conference on Educational Reform, Mahasarakham University*, Khon Kaen, 2007, 154-167.
[18] T. Anderson, L. Rourke, D.R.Garrison , W. Archer, Assessing teaching presence in a computer conferencing context, *Journal of Asynchronous Learning Networks, 5(2)*, 2001.

Appendix 1 Sample figures of a web-based training program

The currently available online a web-based training includes:

1) The *main menu* of automotive electronic systems (Figure 1); it is suitable for automotive technology courses like simulation software and computer-aid instruction that used for training into car automobile company.

Figure 1.

An example of the "main menu" type of a web-based training program:

2) The *training module* of automotive electronic systems (Figure 2); it is guideline for students understanding the instructional system (e.g. content, subjective, objective, assessment, etc.) like e-book.

Figure 2.

An example of the "training module" of a web-based training program

3) The *content* of automotive electronic systems (Figure 3); it is describing the content of each module as similarly as workshop manual.

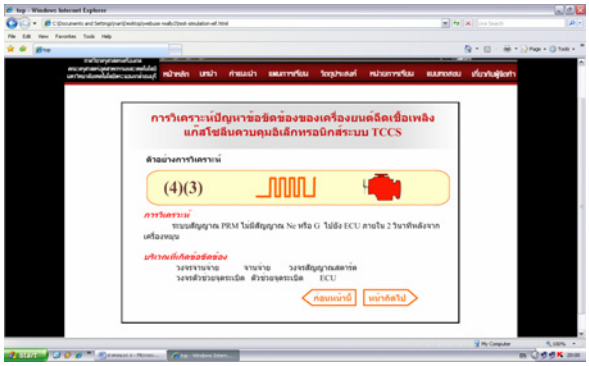

Figure 3.

An example of the “content” of a web-based training program

4) The *simulation program* of automotive electronic systems (Figure 4); it is simulating current situation and diagnosis of each component in automotive electronic systems.

Figure 4.

An example of the “simulation program” of a web-based training program

5) The *pretest-posttest* of automotive electronic systems (Figure 5); it provides students achievement of each module in automotive electronic systems by self-assessment.

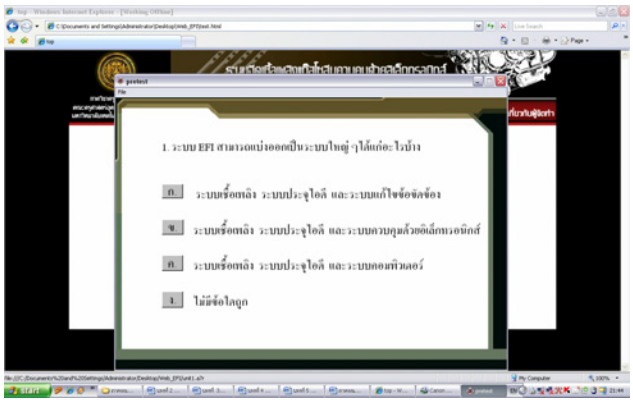

Figure 5.

An example of the “pre-test-post-test” of a web-based training program

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