

The effect of distance learning via the Internet on electric motor control

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ABSTRACT: The purposes of this study were to develop a distance-learning module via the Internet in an electric motor control course and to determine the results of student learning by means of the asynchronous approach, whereby the teacher and students are separated from each other in remote locations and at different times. The two sample groups were comprised of second year students in vocational technology who were studying in different fields of farm machinery technology and industrial techniques at Rajamangala Institute of Technology, Lampang, Thailand. The course was divided into 12 modules; each module used a variety of different types of learner interaction. The result was that both sample groups achieved significantly higher scores. There was no statistically significant difference between the two sample groups of students. However, they were satisfied with their courses and felt comfortable using the tools provided. In utilising this approach, the teacher had to introduce students to some basic skills in using the Internet. Those who mastered the new computer skills were able to learn faster and more effectively. It can be concluded that such Internet facilities should be made available to all students in order to enhance the educational experience.

INTRODUCTION

Distance learning is a new technology that has been promoted under the National Act in Thailand in order to educate all Thai people effectively. Interest in distance learning and utilising the Internet has been growing at universities, especially in the field of technology and learning strategies. Universities and colleges have tried to utilise the benefits of technological advancements. For example, they use the Internet with the widespread use of computers as an electronic source of information.

The management of this learning process involved several key factors, such as the Internet system, hardware, software and support platforms from which to learn an online course. Accessing the Internet via a Web site is one factor of concern. Within the virtual classroom of the Web, there are many different technologies that can be used.

The Web provides an opportunity to develop new learning experiences for students that were not possible previously. As a result, students from around the globe can enjoy equal access to the many learning resources available on the Web. The Web, as a medium of learning and instruction, has the potential to support the creation of well-designed resources. Furthermore, it has generated new educational paradigms [1].

Open and distance learning has been promoted in relation to vocational education, higher education and continuing education at the post-secondary level. These resolutions called for the use of new technologies by such open universities. It should be noted that the primary task of an open learning university is the transfer and application of knowledge [2].

Web-Based Instruction (WBI) is a hypermedia-based instructional program that utilises the attributes and resources of the World Wide Web (WWW) in order to create a

meaningful learning environment whereby learning is fostered and supported. WBI is an innovative approach to deliver instruction to a remote audience, utilising the Web as the medium. Instruction is the delivery of information and activities that facilitate learners' attainment of intended, specific learning goals, and the medium is the physical means by which the instructional message is communicated.

OBJECTIVES

The main purposes of this study were as follows:

- To develop the modules of distance learning via the Internet on the course of electric motor control;
- To determine the effects on student learning.

HYPOTHESES

From the review of literature on WBI and psychological theories about interaction effects, the hypotheses were set as follows:

- Students from both groups achieved significantly higher scores in the post-test than the pre-test at the 0.01 level.
- Students were satisfied with these modules at higher than average levels.

METHODOLOGY

This research was experimental in nature. There were two procedures: first, to develop WBI modules on electric motor control, and second, to trial these module on the Internet connected to the Web server at King Mongkut's University of Technology Thonburi (KMUTT), Bangkok, Thailand. Students at Rajamangala Institute of Technology, Lampang campus, who enrolled in this course in the 2nd semester 2001, would then

study at home or anywhere that the equipment were available. The effects of distance learning, such as achievement, satisfaction and management system, were also investigated.

Tools

The tools used in this research were WBI modules in electric motor control, an achievement test and a questionnaire. The delivery model of distance learning via the Internet is shown in Figure 1, while the model of distance learning is shown in Figure 2. The various modules in electric motor control course are listed in Figure 3, while the learning activities in each module are demonstrated in Figure 4.

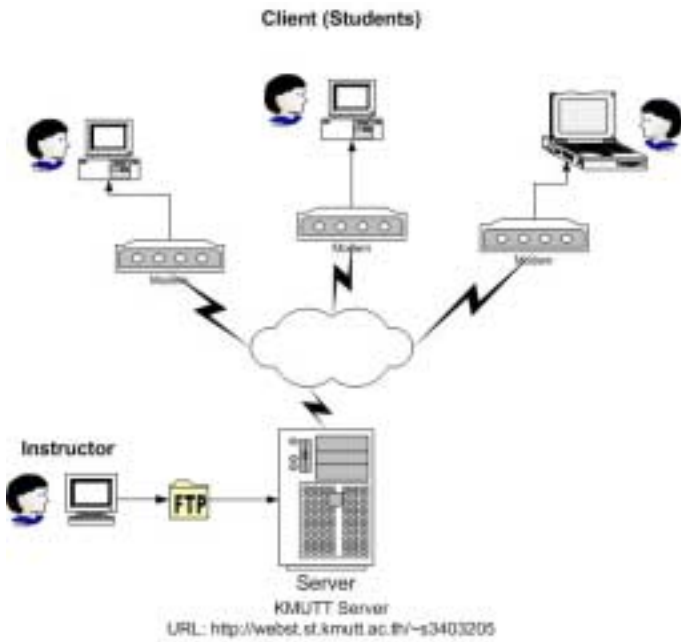


Figure 1: Delivery model of distance learning via the Internet.

Samples

There were two groups of students from Rajamangala Institute of Technology, Lampang campus, used in this study: 32 from

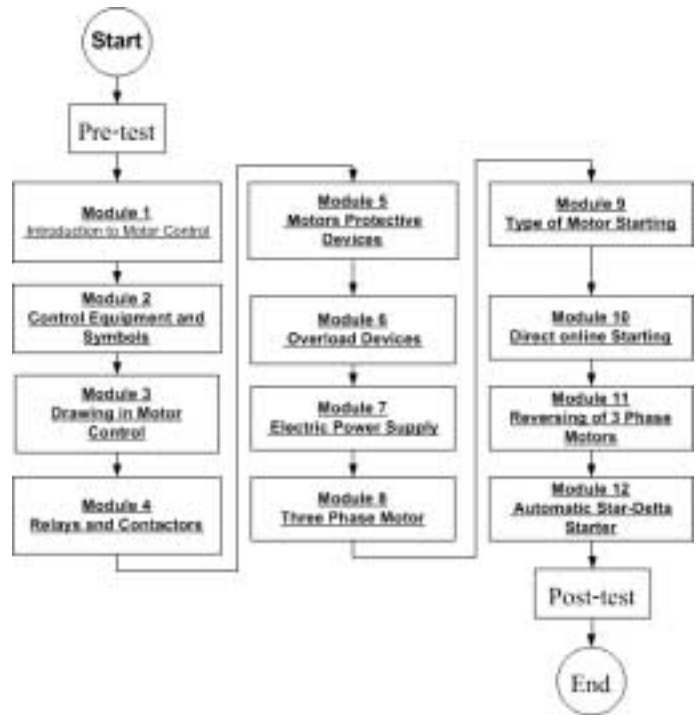


Figure 3: Modules in the electric motor control course.

Industrial Techniques, and 20 from *Farm Machinery Technology*. Both groups were tested before and after the experiments. They also undertook exercises at the end of each module and submitted to the teacher by e-mail. After they learned the entire program, the same test was conducted again.

The data were analysed to compare achievements between pre- and post-test scores, and also between the *t*-test scores of the two groups. Students' levels of satisfaction were analysed using mean and standard deviation, while other results were studied by percentage.

RESULTS

The development of the WBI course on electric motor control incorporated 12 modules. These were: Introduction to Motor Control; Control Equipment and Symbols; Drawing in Motor

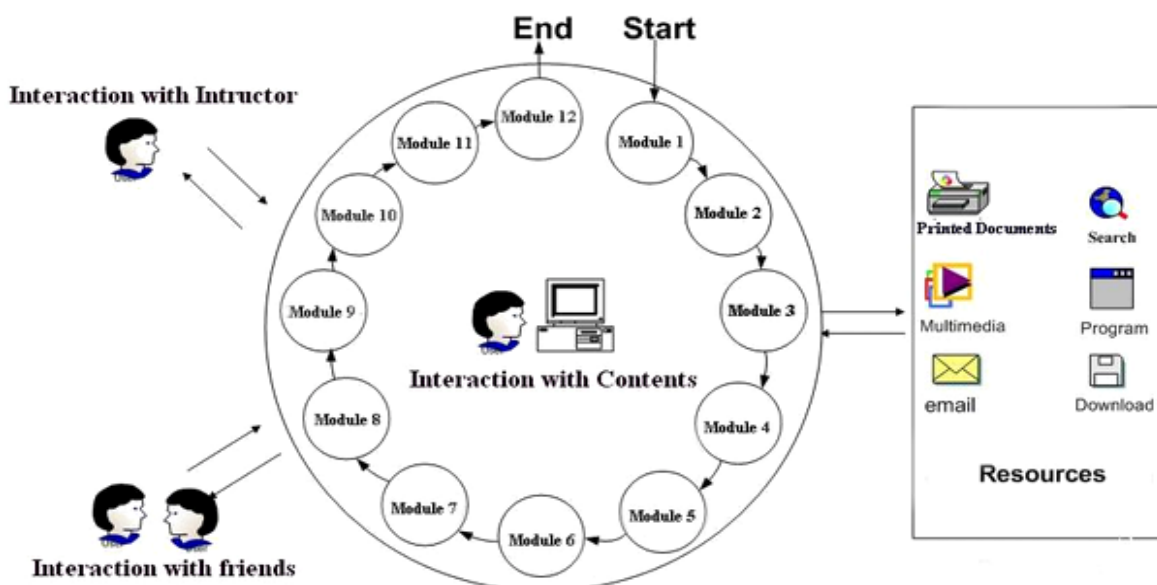


Figure 2: Model of distance learning.

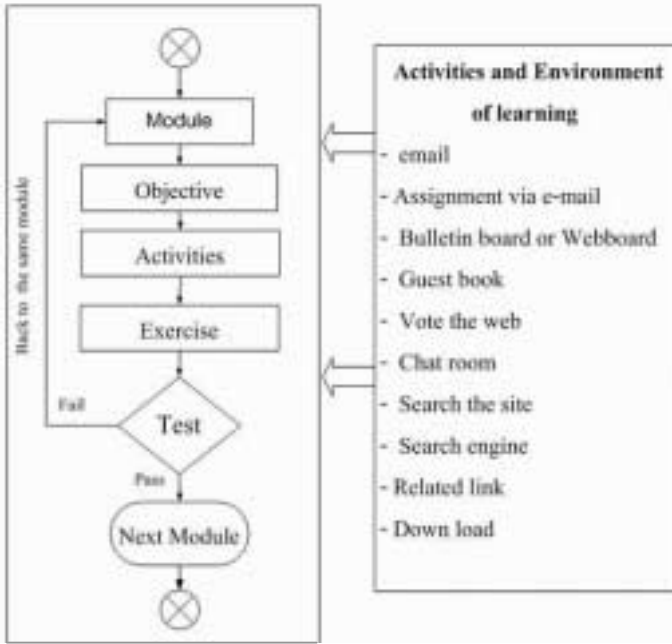


Figure 4: Learning activities in each module.

Control; Relays and Contactors; Motor Protective Devices; Overload Devices; Electric Power Supply; Three phase Motors; Type of Motor; Starting; Direct Online Starting; Reversing of a 3-Phase Motor; and Automatic Star-Delta Starter. Each module was designed with various elements that would promote interaction with learners, such as illustrated working simulations of equipment and circuits. They also provided for self-directed learning so that it was available anywhere and at anytime. Examples of the developed modules are shown in Figures 5 to 8.

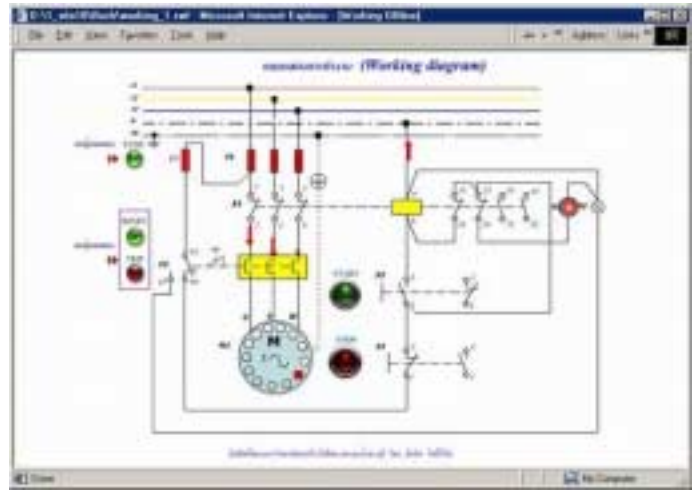


Figure 6: Simulation of a direct online starter.

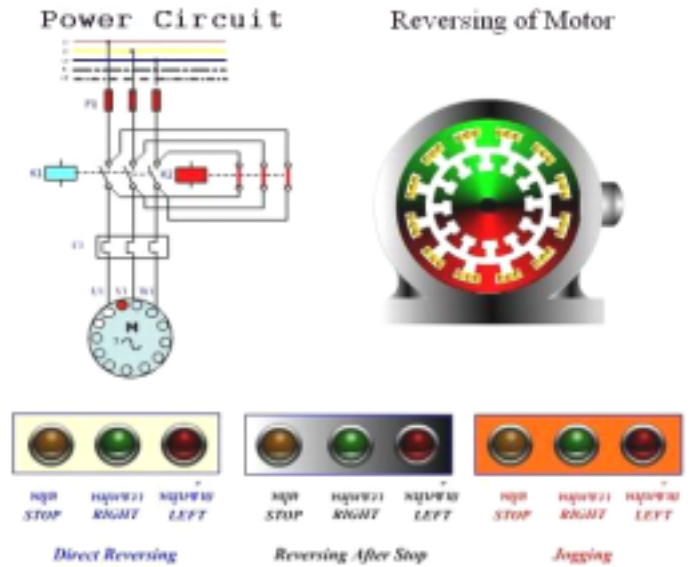


Figure 7: Reversing a three-phase motor.



Figure 5: Homepage of the Internet distance learning course in electric motor control.

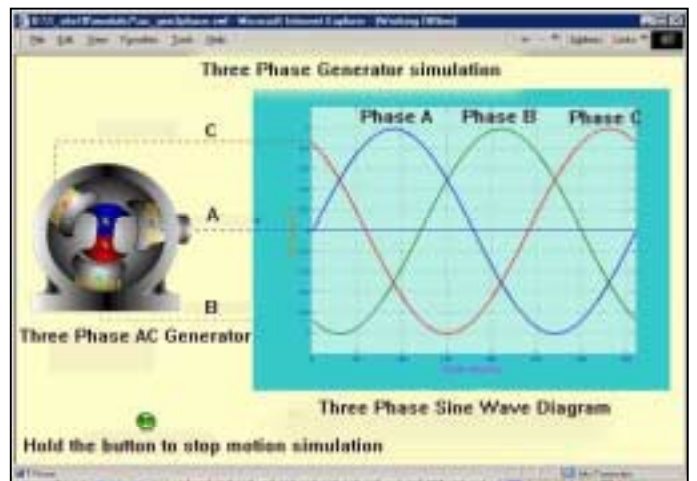


Figure 8: The three-phase generator simulation.

The study on the effects of distance learning via the Internet focused on achievement and other aspects, such as students' satisfaction and facilitation of learning. The researchers studied students' achievements by comparing pre- and post-test score results by *t*-test; these are listed in Table 1.

As shown in Table 1, the *t*-value of both groups had significant difference at alpha 0.01. These showed that the post-test scores differed to the pre-test scores. According to the mean scores, the post-test scores were greater than the pre-test scores, which

implies that students achieved some knowledge or learned from these modules. This finding confirms the efficiency of the modules. Under this research, the achievement of these two groups by comparing students' was scores also studied. There was no significant difference between these two groups, even though there were different characteristics within the field of study, as shown in Table 2.

Table 1: Comparison of pre-and post-test scores of students by *t*-test.

Group and Tool	n	\bar{X}	SD	<i>t</i>
Industrial Techniques				
Post-test score	32	76.19	11.84	12.14**
Pre-test score	32	48.06	10.64	
Farm Machinery Tech.				
Post-test score	20	79.20	12.19	7.44**
Pre-test score	20	52.70	12.68	

**P<0.01

Table 2: Student's satisfaction and the needs of the course.

Topics	n	\bar{X}	SD
1. Convenience of Internet access.	52	3.21	0.99
2. Speed of the Internet.	52	3.13	0.84
3. Convenience of sending homework via e-mail.	52	4.13	0.79
4. Lesson objectives clear.	52	3.98	0.75
5. Suitable contents for students.	52	4.17	0.58
6. Interesting multimedia.	52	4.11	0.70
7. Exercises helped students understand lessons.	52	3.88	0.78
8. Students satisfied with the course.	52	3.90	0.60
9. Students' freedom of learning via the Internet.	52	4.23	0.70
10. Chance for self-discovery.	52	4.03	0.81
11. Other courses should be delivered via the Internet.	52	3.96	0.74
12. Met counselling needs with the instructor.	52	4.28	0.72
13. Met the needs of part-time students.	52	3.00	0.77

With regard to behaviour, all students studied these modules in the Internet room at the Rajamangala Institute of Technology, Lamphang campus. They were asked to check how they used the Internet. The data were analysed by percentage. It was found that a few of them studied in an Internet shop or at home. All of them used the Internet for e-mail, pressure and report (100%, 81% and 79%, respectively). Half of them used the Internet for Perch or news. Most of them had some problems with the English language. Half of them encountered problems in using the program, downloading the program and linking to other Web sites. Few of them had any problems with the lessons.

Students were asked to rate the course in a questionnaire that used a 5-point scale, which is concurrent with the hypothesis. It was found that they were satisfied with the management system at an average level (\bar{X} = 3.13 to 4.13). It was also found that they were satisfied and obtained good feelings with the developed modules at a more than average level (\bar{X} = 3.90 to 4.17).

Concerning students' self-confidence, most students felt a degree of freedom and had the chance to discover knowledge

via the Internet for themselves (\bar{X} = 4.03 to 4.23). Regarding the topic of their needs and teacher's services, students wanted other courses to be delivered via the Internet as well, and students still wished to consult with the teacher (\bar{X} = 3.96 and 4.28). On average, students studied these modules when they had free time.

DISCUSSION

This study developed WBI for a distant learning course on electric motor control. The results indicated that the pre- and post-test score of the students in both fields were significantly different at the alpha 0.01 level. The post-test score was higher than the pre-test score. There was no significant difference between these two groups of students, who studied in different fields. Additionally, most students were satisfied with the course and felt comfortable using the tools provided.

Participating students had the opportunity to study individually and at any time that was convenient to them. Moreover, the modules were designed with interactive programs and multimedia techniques, which added greater effects to the program. This can be compared to a previous study on the academic achievements of a course on electronic devices and circuits between individual and group study by using CAI on a Web page; the results showed that, after the experiment, students achieved higher scores than before and that group learners achieved more than the individual learner [3].

The study described in this article ensured that everyone had access to the relevant information. Students needed to practice and were able to freely exchange ideas and knowledge. Thus, it contributed to their learning and encouraged their enjoyment of computer-aided instruction on a Web page. The course was convenient, accessible and user-friendly. The activities and learning components included: homework assignments via e-mail; bulletin boards; guestbooks; voting polls; chatroom; search engines; related Web sites and downloads. These tools also enabled students to collaborate within a learning environment.

It was also found that the teacher had to introduce some basic skills in using the Internet and distance learning methods to the learners involved. Those who mastered the new computer skills were able to learn faster and more effectively. Such Internet facilities should be made available to all students; furthermore, teachers should also be trained in these new methods.

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