The Development of E-learning Course for Theory of Structure I by MIAP Teaching Method

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***Abstract*- This research aimed to develop e-learning course for Theory of Structure I by applying MIAP teaching method. The sampling group was 32 fifth-year students from the Department of Civil Engineering, Technological University (Dawei), 10 students for trial group and 22 students for real group. There were two group of experts, one group checked the IOC value and another group evaluated the quality of e-learning course. The quality assessment of e-learning media evaluated by experts was found at a good level. The results showed that the efficiency of e-learning course E1/E2 was 91.58/96.14, attaining above 80/80 criterion. The posttest scores of the students were higher than the pretest scores at 0.05 statistical significance level. The satisfaction of students on e-learning course was also found good. In conclusion, e-learning course can be used in teaching Theory of Structure I effectively and it helps make learning more enjoyable.**

***Keyword*: E-learning, Theory of Structure, MIAP**

I. INTRODUCTION

Civil engineering curriculum at Technological University (Dawei) includes the subjects in the fields of Civil engineering such as Theory of Structure I, Structural Steel Design, Mechanics of Materials, and so on. Theory of Structure subject is one of the important subject in Civil Engineering since it gives a set of scientific rules to design and calculate the structural models accurately. It is concerned with the understanding of the behavior of the structures such as beams, columns, frames, when they are subjected to applied loads and other actions [1]. When the teacher gives a lecture on the theory of structure to the students, they can understand only theoretical knowledge and cannot imagine about the behavior of the structural members. If the teacher demonstrates them with some physical model that is compared with the real one, they will clearly understand and transfer these knowledge to the real process. The subjects that are taught in Civil Engineering can be interesting or bored for the students depending on the teaching methods and strategies that the teachers use for teaching process in the classroom [2]. Most of the engineering subjects are focused on theoretical knowledge and the teachers use traditional teaching method and learning approach to teach these subjects so the students get less practical knowledge. Thus, the teaching method should be changed to solve these problems.

To improve the teaching process and the learning outcome of the teachers and students at Technological University (Dawei), in this study, e-learning course for Theory of Structure I is developed by applying MIAP teaching method. E-learning course for teaching Theory of Structure I is constructed as virtual classroom which is most similar to traditional classroom or synchronous learning [3] using power-point slides, video materials, documents, demonstrate to the students with experimental units. It can also serve as a supplementary material for learning process in traditional classes. This study aims to develop e-learning course for Theory of Structure I by MIAP teaching method for using in teaching and learning process effectively.

A. Objectives of the research

1) To develop e-learning course for Theory of Structure I by MIAP teaching method.
2) To evaluate the efficiency of e-learning course (E1/E2) for Theory of Structure I by MIAP teaching method.
3) To compare the success of pre-study and post-study of e-learning course for Theory of Structure I by MIAP teaching method.
4) To evaluate the satisfaction of the students on e-learning course for Theory of Structure I by MIAP teaching method.

B. Hypothesis of the research

1) The developed e-learning course has the efficiency (E1/E2) greater than or equal to

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80/80.

2) The success of the post-study is higher than the pre-study at 0.05 statistical significance level.

3) The result of the satisfaction of the students on e-learning course for Theory of Structure I by MIAP teaching method is at good level.

II. LITERATURE REVIEW

In engineering education, e-learning is used in many fields of engineering such as Civil Engineering, Mechanical Engineering. E-learning is not only about training and instruction but also about learning that is supplied to each learner [3]. It is a teaching and learning activity through the internet or other digital contents, to achieve a new way of learning, which will change the role of the teacher as well as the relations between teachers and students in traditional teaching, so as to fundamentally change the nature of teaching and education [4]. It was found that the learning achievement of the e-learning course has obvious advantages when it was compared with traditional teaching method [5-7]. E-learning materials were completed with graphics, videos, lessons, examples and tasks in order to facilitate the better learning to the learners.

Traditional teaching methods are inadequate to transfer sufficient basic knowledge of the subject to the students. To solve this problem, researchers used alternative methods; hand-on experiments, graphical methods and computer simulation program and another method. Consistent with various researchers, there are many teaching methods or learning models such as CCAILM (constructionist computer aided instructional learning model), MISDOP (Motivation, Introduction, Solution, Discussion, Operation, Progress), REPEA (Recall, Explanation, Participation, Exchange, Assessment), KWSLPA (Know, What, Search, Learn, Practice, Assessment), and MIAP (Motivation, Information, Application, Progress) [8-12].

The MIAP teaching method is one of the teaching and learning methods that are used in science and technology courses. It is an experiential teaching method that is consisted of four steps of learning process [12]: a) Motivation (M), b) Information (I), c) Application (A), and d) Progress (P). To examine the satisfaction of the students, to get both theoretical and practical knowledge, and to be active in the learning process, researchers used the MIAP teaching method in their respective fields of studies [13-16].

In reviewing previous studies, e-learning course is used in teaching of Civil Engineering [6-7] and [17-18], but it is not applied for teaching these subjects by using MIAP teaching method. E-learning course applied for teaching Theory of Structure by MIAP teaching method is also not found [13-16]. Hence, in this study, e-learning course is constructed with the help of MIAP teaching method, using some experimental units, using only simple learning resources for e-learning course in the form of virtual classroom which includes documents, power-point presentations and videos. It is designed as the learning style in the form of the theoretical knowledge combined with the practical experiments. After that teachers can teach and improve the competency of the students since the students get both theoretical and practical knowledge in the classroom and then they can apply these knowledge in real places. It can also serve as a supplementary material for learning process in traditional classes. This study aims to develop e-learning course for Theory of Structure I by MIAP teaching method for using in teaching and learning process effectively.

III. RESEARCH METHODOLOGY

The research process consisted of constructing the research tool, developing the instructional media, submitting to two groups of experts to review and evaluate the IOC value and the quality of e-learning course and then modifying the e-learning course according to the suggestion of experts. Next, the teaching media were applied to the trial group of 10 students before the actual application of real group of 22 students.

After testing with the real group, the efficiency of e-learning course was evaluated according to E1/E2 criteria. Also, questionnaires with five level scale were used to evaluate the satisfaction of the students on e-learning course. Finally, data were collected and analyzed according to statistical analysis of average and standard deviation. The research methodology is shown in Fig. 1.

A. Population

The sampling group was the students from Department of Civil Engineering, Technological University (Dawei).

1) Ten students of fifth-year for trial group (Technological University (Dawei)) to examine the need and improvement of the e-learning course.
2) Twenty-two students of fifth-year for real group (Technological University (Dawei)) to determine the efficiency (E1/E2) and the satisfaction of e-learning course.

There were two groups of experts, one group was for evaluating the IOC value for the validation of the design

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content and behavioral objectives, and the validation of the behavioral objectives and questions. Another group was for evaluating the quality of the e-learning course.

Each of groups consisted of three experts, totally for two groups was six experts (four experts from KMUTNB and two experts from Technological University (Dawei)).

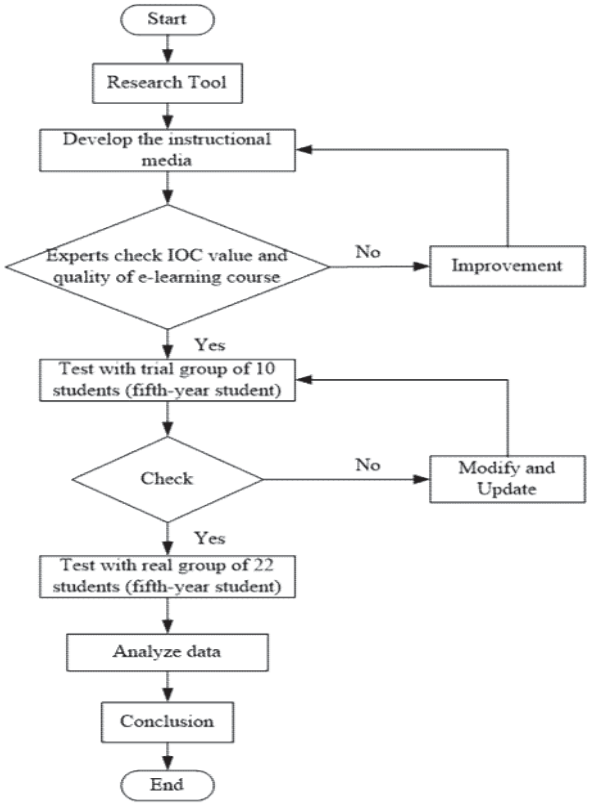

Figure 1. Research Methodology

B. Research Tools

The research tools (Fig.2) consisted of e-learning course with simple learning resources which includes power-point presentations, videos, information sheets, operation sheets and lab sheets for practical exercises, exercise sheets, experimental units[19], learning achievement tests consisted of pretest sheets and posttest sheets and evaluation form for the students' satisfaction on e-learning course with five level scale, and evaluation forms for evaluating IOC values and for quality assessment of e-learning media. Information sheets for four units were designed according to the behavioral objectives, and operation sheets for doing the experiments consisted of step by step procedures with text and pictures.

There were three evaluation forms for experts who evaluated and responded to the question of quality of e-learning course. Two forms were Item Objective Congruence (IOC), for evaluating the validation of the designed content and behavioral objectives, and the validation of behavioral objectives and questions. As for the third form, it was designed to find quality assessment for e-learning course with five level scale.

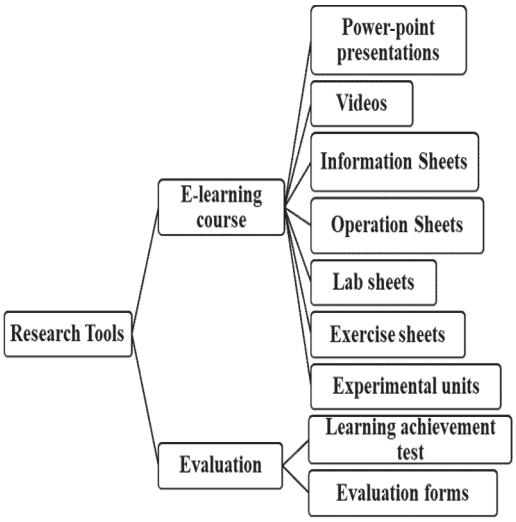

Figure 2. Research Tools

After calculating IOC results for evaluating the validation of the design content and behavioral objectives, the result revealed that each behavioral objective has IOC value higher than 0.5 that means each behavioral objective is consistent with the designed content as shown in Table I.

TABLE I Result of IOC between Design Content and Behavioral Objectives

Total Number of behavioral objectives	Number of behavioral objectives which had IOC value higher than 0.5	Number of behavioral objectives which had IOC value lower than 0.5
36	36	None

There were 61 questions with IOC value higher than 0.5 which were adequate and consistent with the behavioral objectives of the lesson, and only one question with IOC value lower than 0.5 which needed to be eliminated as shown in Table II.

TABLE II Result of IOC between Behavioral Objectives and Questions

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Total Number of Questions	Number of behavioral objectives which had IOC value higher than 0.5	Number of behavioral objectives which had IOC value lower than 0.5
62	61	1

C. E-learning Course Development

This research aimed to develop the e-learning course for Theory of Structure I subject for fifth year students in Department of Civil Engineering, Technological University (Dawei) by applying MIAP teaching method.

E-learning course in this research was designed in the form of the theoretical knowledge combined with the practical experiments.

E-learning contents includes 1) simple learning resources and 2) e-learning lessons [3].

1) Simple learning resources such as information sheets, operation sheets, power-point presentations, and video files performed as motivation part (M) and information part (I) according to the step of MIAP teaching method.
2) E-learning lesson for teaching Theory of Structure I in this study was focused on Arches and Suspension system, which consists of four learning units: a) two-hinged arch, b) three-hinged arch, c) parabolic arch, and d) suspension bridge system. E-lessons were designed according to the behavioral objectives of the teaching plan of the course, which were also performed as the motivation part and information part.

This e-learning course consisted of two parts: 1) Theory part and 2) Practical experiment part. First, the students studied theoretical part in the classroom with e-learning lessons with simple learning resource, watched videos for doing experiments. After that they did experiments according to the operation sheets and videos in the laboratory. They were asked to compare the theoretical and experimental results to see if they can understand the behavior of the structural member when the structure is applied by the external load.

D. Virtual Classroom

In this research, e-learning course for teaching Theory of Structure I was constructed in the form of virtual classroom. A virtual classroom was the instructional method which was most similar to traditional classroom, as it was lead completely by the teacher [3].

MIAP Teaching Method

The MIAP teaching method is an experiential teaching method that was operated by the teachers consisted of four steps of learning process [12].

Motivation: This step motivated the interest of the students into the subject that they learn in the classroom by asking them with some questions, or other media.

Information: This step gave the information to the students. E-learning contents were designed and developed according to the sequence of teaching plan and presented to the students. Pictures, texts and recorded laboratory videos were used in the presentation of each lesson to motivate and inform the lessons to the students.

Application: In this step, the teacher checked the learning outcome of the students between the success of pre-study and post-study, by using pretest, posttest, and exercises sheets, and let the students doing the experiments following the operation sheets of each practical jobs.

Progress: In this final step, the teacher calculated the activities of the students and results that come from pretest, posttest, and exercises.

MIAP teaching method for teaching Theory of Structure I is described as shown in Fig. 3.

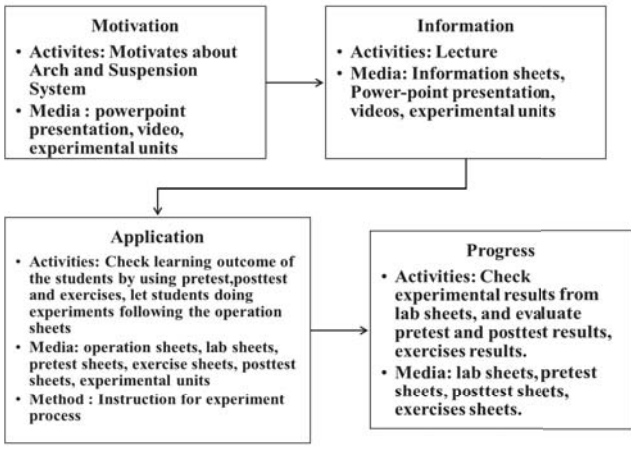

Figure 3. MIAP teaching method for teaching Theory of Structure I.

E. Implementation of e-learning course according to MIAP Teaching Method

1) The first step of MIAP teaching method, the researcher used the power-point presentations, video files and experimental units to motivate the students about the learning topic shown in Fig.4.

2) The second step, the researcher (Fig. 4) motivated and informed the lessons to the students by using information sheets, also power-point presentation, video files and experimental units. The operation sheets were given to the students and explained how to operate the experimental units and how to do

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the practical jobs.

3) After that, in the application step (Fig.5), the researcher let the students to do the experiments following the operation sheets, and the exercises in the exercise sheets. The researcher also checked the learning outcome of the students by pretest and posttest examinations.

4) Finally, at the progress step, the researcher evaluated the activities of the students and the results of pretest, posttest and exercises, then compared the learning achievement and the efficiency (E1/E2) of the e-learning course.

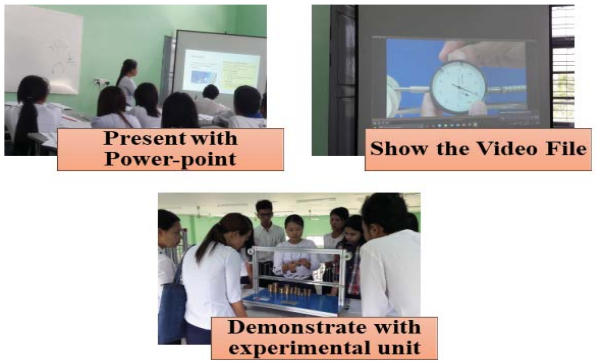

Figure 4. Motivation and Information Steps

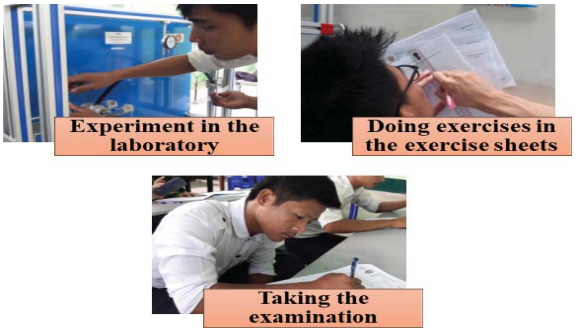

Figure 5. Application step

F. Experimental units

Experimental units for Arches and Suspension System that were implemented in this research [19] consisted of four units: 1) Two-hinged arch unit (MFL), 2) Three-hinged arch unit (MART), 3) Parabolic arch unit (MARP), and 4) Suspension unit (MVS) shown in Fig. 6. These experimental units were used in the step of Motivation (M), Information (I) and Application (A) part of MIAP teaching method.

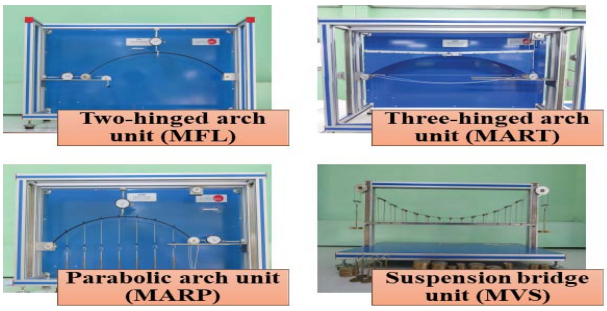

Figure 6. Experimental Units

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G. Data Collection

In this research, the researcher collected and analyzed only the results of the real group of students.

The data collection process has the following steps:

1) The teacher introduced the prepared e-learning course to the trial student group before the actual teaching to the real group.
2) The real student group took the pretest examination before studying shown in Fig.7 to attain the student's background knowledge. The pretest scores were collected.

Figure 7. The real student group during the pretest examination

3) The students studied Theory of Structure I subject according to the prepared e-learning course with virtual classroom (Fig. 8).

Figure 8. Teaching of Theory of Structure I Subject according to e-learning course with virtual classroom.

4) During the teaching process, the students did exercises and experiments in the laboratory (Fig. 9) and the researcher collected the data.

Figure 9: The experiment in the laboratory

5) After studying the four learning units with e-learning course, the students took the posttest examination and the researcher collected data to receive the efficiency of e-learning course and to compare the success of the learning after and before study.
6) Then, learning achievement was compared by using average score of pretest and posttest results with dependent sample t-test.

IV. RESULTS OF THE STUDY

In operating the development of e-learning course for Theory of Structure I by MIAP teaching method, the research results are found as the followings:

A. Quality Assessment of e-learning course by experts

The result of the quality assessment of e-learning course is displayed in Table I. The result showed that the quality of the developed e-learning media was at a good level (average equal 4.13), evaluated by three experts.

TABLE I The Result of the Quality Assessment of e-learning Course by experts

Assessment Items	Average	S.D.	Interpret
1. Content and Continuity	4.25	0.29	Good
2. Image, language and sound	4.20	0.58	Good
3. Font and color	4.08	0.43	Good
4. Test after finished	4.00	0.00	Good
5. Lesson sequences	4.13	0.23	Good
Total Average	4.13	0.31	Good

B. Result of E1/E2 for Theory of Structure I by MIAP Teaching Method

The evaluation for the result of E1/E2 for Theory of Structure I by MIAP teaching method from 22 fifth year students majoring in Civil Engineering was shown in Table II and Table III.

In Table II and Table III, the efficiency of the learning process (exercise results) (E1) was 91.58 and the efficiency of the learning outcome (posttest results) (E2) was 96.14, so the efficiency of e-learning course E1/E2 is 91.58/96.14 is above 80/80 criterion.

TABLE II The Result of the Efficiency of the Learning Process (Exercise Results)

Learning Unit	Number of students	Number of questions	Total score of questions	Total correct answer	E1 (%)
1	22	17	374	345	92.25
2	22	17	374	351	93.85
3	22	21	462	416	90.04
4	22	6	132	117	88.64
Total		61	1342	1229	91.58

TABLE III The Result of the Efficiency of the Learning Outcome (Examination or Posttest Results)

Number of students	Number of questions	Total score of questions	Total correct answer	E2(%)
22	20	440	423	96.14

C. Comparison of the learning achievement of e-learning course for Theory of Structure I

Table IV shows that the learning achievement of the students who learned e-learning course for Theory of Structure I with the post-test score had an average of 19.23, higher than the pre-test score which had an average of 16.82, which is significantly at 0.05 statistical significance level.

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TABLE IV Comparison of the Learning Achievement of e-learning Course

Test	N	Score		t	Sig. (two-tailed)
		Average	S.D.		
Pre-test	22	16.82	2.108	5.196	p = .00 < 0.05
Post-test	22	19.23	1.020		

D. The satisfaction of the students on e-learning course for Theory of Structure I by MIAP teaching method.

Table V showed the results of the satisfaction of the students on e-learning course for Theory of Structure I by MIAP teaching method. The satisfaction of the students on the developed e-learning course had an average value of 4.48 and S.D. equal 0.60. Thus, the developed e-learning course was found to be effective to use in the teaching of Theory of Structure I subject.

TABLE V The Result of the Satisfaction of the Students on e-learning course

Assessment Items	Average	S. D	Interpret
1.Content			
1.1. The lesson content is easy to understand.	4.77	0.43	Very good
1.2. Dividing the content into sub-topics make the students more understand.	4.45	0.67	Good
1.3. Lesson presentation is in the appropriate order.	4.36	0.73	Good
1.4. Length of content is appropriate for students	4.27	0.70	Good
1.5. Students can review and understand the content.	4.59	0.59	Very good
Average	4.49	0.62	Good
2. Technique			
2.1. Screen design is beautiful and appropriate.	4.55	0.51	Very good
2.2. Image is appropriate for the content of the subject.	4.41	0.50	Good
2.3. Sound composition is appropriate.	4.14	0.83	Good
2.4. Font size and color of the characters used are clearly defined.	4.59	0.50	Very good
2.5. Examination sheet motivates the students more willing to learn.	4.68	0.57	Very good
Average	4.47	0.58	Good
Total	4.48	0.60	Good

V. CONCLUSION

In this paper, the development of e-learning course for Theory of Structure I by MIAP teaching method, was performed under the selected topic (Arches and Suspension System). According to the result of the quality assessment of e-learning course evaluated by three experts, it was found at a good level (average 4.13 and S. D. 0.31). The efficiency of e-learning lessons on Theory of Structure I E1/E2 is 91.58/96.14 attaining above the standard level of E1/E2 80/80. This means the developed e-learning course was able to enhance the learning outcome of the students. The satisfaction of the students had an average value of 4.48 and S.D. equal 0.60. Thus, it can be concluded that the developed e-learning course has good quality to use in the teaching of Theory of Structure I subject. In addition, the comparison of the learning achievement of e-learning course showed that the success of the learning after studying was higher than before studying at 0.05 statistical significance level. Therefore, it was suggested that teaching with e-learning course combined with practical exercises as well as by applying MIAP teaching method could be an alternative way to enhance learning process in the classroom. In conclusion, the e-learning course can be effectively used in teaching Theory of Structure I subject and it helps make learning more enjoyable for the students. In the future, some more advance technologies can be added to improve the learning outcome of the students in the classroom.

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