The STEM Learning Process using REPEA Model for Transmission Line Engineering Course

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***Abstract*- The objective of this research describes the development the REPEA learning model based on the STEM learning process for transmission line engineering course. The developed REPEA model consisted of 5 steps: 1) Recall 2) Explanation 3) Participation 4) Exchange and 5 Assessment.An instructional package consisted of 3 lessons, each lesson includes the content sheet, worksheet, assignment sheet, PowerPoint presentations, a simulation program and an achievement test. The developed STEM learning process was implemented in a classroom using 30 students' sample at the Department of Electronics and Telecommunication Engineering, Faculty of Technical Education at Rajamangala University of Technology Thanyaburi, the students' satisfaction towards using the research tools was at a high level (mean equaled 4.22 and S.D. equaled 0.12), the developed learning model had efficiency equaled to 1.04 which is in according to the standard criteria of Meguigans's formula. In conclusion, the developed learning model and instructional package can be used appropriately in the teaching of engineering education curriculum.**

Keyword: STEM learning process, REPEA learning model, Transmission line engineering.

I. INTRODUCTION

The twelfth national economic and social development plan (2017-2021) emphasizes the development of children's analytical thinking skill, creative thinking skill and the readiness to enter the labor market as follows: to modulate children's learning process to encourage them learning by doing based on the brain evolution focused on the development Science, Technology, Math, Arts, and foreign language skills and to encourage students to participate the activities.[1]

The STEM education is a guide for integrated learning management on Science, Technology, Engineering and Mathematics [2,3] which focuses on the learners using their knowledge to solve in real life problems. The learning activity arrangement such as Project-Based learning, Problem-Based learning and so on, helps learners developing skills and competencies according to the requirement of society and advancement in the 21st century.

Developing instructional model is important in producing learners to have various learning skills in the 21st century. From background as prior section, the development of teaching model based on STEM education for transmission line engineering course was proposed. The STEM learning process will promote learners to understand more contents and applications of transmission line theory.

A. Purposes of the research

To identify efficient the REPEA learning model based on STEM education for transmission line engineering.

B. Research hypothesis

The efficiency of developed instructional model was higher than standard Meguigans's formula.

II. THE RESEARCH THEORY

C. The STEM Learning Process

The STEM education is integration of four displinarys of science, technology, engineering and mathematics [4] that develop learning skill in the 21st century as communication skills, problem solving skills, and creative thinking and leadership skills into a cohesive learning paradigm based on real-world applications.

Science (S): Nature, materials and observing the physical universe, to establish the test and measurement based on behavior, are expressed in general terms.

Technology (T): The creation of technical of data, use and live with and combining environmental, industrial arts, engineering, design work is done on the applied sciences and pure sciences.

Engineering (E): The practical application of information, production on the basis of the design and construction of science is conducted.

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Mathematics (M): A group of related science, algebra, geometry and calculations regarding the number, the size is expressed with special notation form and with the relationships between them.

In this research, the STEM learning process is a guide line using integrated science, technology, engineering and mathematics that was emphasized on student-centered in the management of engineering education.

D. The REPEA Learning Model

The development of REPEA learning model in the teaching of transmission line engineering takes three learning theories including 1) apperception of Herbart 2) behaviorism of Thorndike and 3) Behaviorism of Bruner, [5] as shown in Figure 1. The process of developed REPEA model consists of five steps including recall, explanation participation, exchange and assessment. The framework for teaching and learning of transmission line engineering course using the REPEA learning model, was shown in Figure 1.

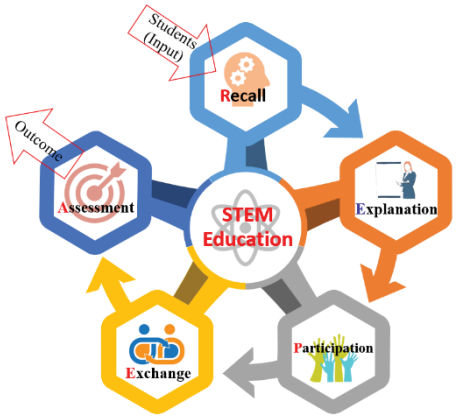

Figure1. The REPEA model based on the STEM education

III. THE STEM LEARNING PROCESS

The process of this research is presented in this topic. The experimental research based on the STEM education using the REPEA learning model was implemented using 30 bachelor students at the Department of Electronics and Telecommunication Engineering, Faculty of Technical Education at Rajamangala University of Technology Thanyaburi. Before the teaching, the instructor given the guideline the learning processes using the REPEA learning model and then the students took a pretest. The developed learning processes were implemented using the 3 lessons, consisting of 1) foundation of high frequency transmission line, 2) wave equation of transmission line, and 3) Smith chart and applications. The period time of each lesson was about 3 hours a week. After teaching and learning, the learning achievement of students was evaluated using the multiple choice test. The process of learning and teaching using the REPEA learning model was as follows:

1) The first process (Recall step: R) contains learning activities such as testing background knowledge, presentation of information, conclusion of basic knowledge, as shown in figure 3.

Figure 2. Learning step of recall (R)

2) The process of learning (Explanation step: E) contains

learning activities such as gathering of content received and questioning, in learning and teaching using several teaching materials, such as content sheet, PowerPoint presentation and authentic media, as shown in figure 4.

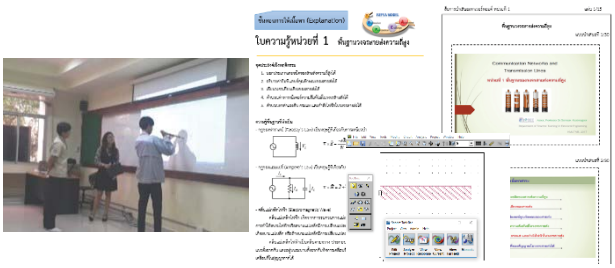

Figure 3. Learning step of explanation (E)

3) The step of practice (Participation step: P) contains learning activities such as, working in small group, brainstorming, discussions and collection of information, as shown in figure 5.

Figure 4. Learning step of Participation (P)

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4) The step of knowledge exchange (Exchange step: E) contains learning activities such as, working in a team, brainstorming, discussions and collection of information as shown in figure 6.

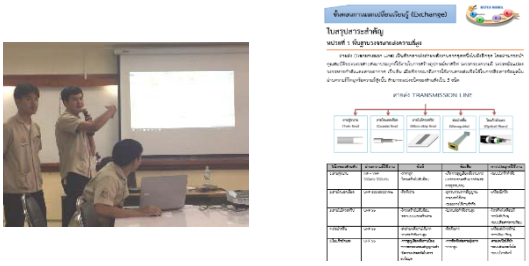

Figure 5. Learning step of exchange (E)

5) The step of learning evaluation (Assessment step: A) contains learning activities such as, the knowledge gain was measured and evaluated, as shown in figure 7.

Figure 6. Learning step of assessment (A)

Finally, the research data in according research hypothesis was analyzed and the students' satisfaction was evaluated using educational statistics such as mean, standard deviation and percentage.

IV. RESEARCH RESULTS

The research results were presented in 3 sections as follows 1) the result of developed instructional package, 2) the efficiency of instructional package and 3) the student's satisfaction. The details are as following.

D. The result of developed instructional package

The developed instructional package consists of teacher's manual, information sheet, worksheet, assignment sheet, PowerPoint presentations, GUI simulation program and an achievement test and questionnaires, as shown in Figure 7.

E. The evaluated result of efficiency of instructional package

The developed instructional package using the REPEA learning model was tried out by using a sampling group of 30 bachelor students who registered in the Communication Network and Transmission Line Engineering course, Faculty of Technical Education at Rajamangala University of Technology Thanyaburi, the students took the pretest before learning, and took the posttest when finishing learning. After that, the data was evaluated and analyzed by using Meguigans's theory [6].

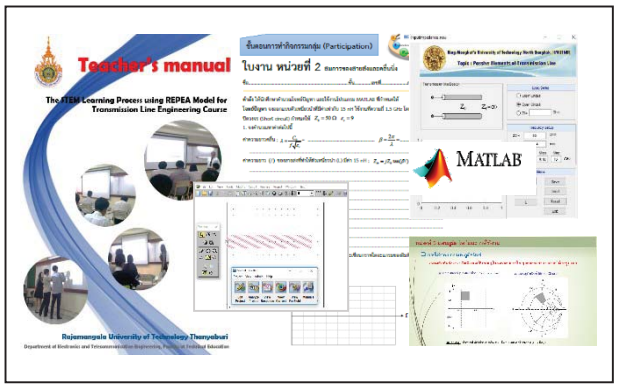

Figure 7. Results of an instructional package

Figure 7. The implementation in the teaching using sampling group.

In the Table 1 shown the developed instructional package using the REPEA learning model, the average points of pre-test and post-test were 21.27 and 45.80 respectively, which the efficiency was according to standard critical to Meguigans's formula (equaled to 1.04), and the comparison of learning achievement between the pretest and posttest was different as statistically significant at the .05. Thus, the developed instructional package can be used efficiently in the learning and teaching of transmission line engineering course.

TABLE I-Results of efficiency of the REPEA learning model

Test	Mean		S.D	df	t	P	Meguigan theory
Pre-test	21.27		7.90	29	14.52	0.000	1.04
Post-test	45.80		6.40				

F. The evaluated results of satisfaction of students

Testing of satisfaction level in 30 students by using the instructional package found that mean value was between 4.02- 4.51.

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TABLE II-Results Of Quality Of Instructional package

Topics	Appropriate Level		
	Mean	*S.D.*	*Interpret*
Learning and teaching			
1. Activities plan integrated the STEM education learning process	4.27	0.58	high
2 Durtion of learning activity	4.17	0.53	high
3 Teaching methods using four academic disciplines	4.27	0.69	high
4. Appropriation of teaching activities	4.20	0.48	high
5. Measurment and evaluation	4.20	0.76	high
Average value	**4.22**	**0.27**	**high**
Information sheet			
6. Content covers course objective.	4.23	0.63	high
7. Content is accurate.	4.17	0.65	high
8. Content is suitable for learners.	4.20	0.55	high
9. Content is arranged appropriately.	4.33	0.55	high
10. Pictures and languages are used appropriately.	4.30	0.84	high
Average value	**4.25**	**0.37**	**high**
Instruction media (PowerPoint Presentation)			
11. Presentation covers course objective.	4.17	0.65	high
12. Appropriation of font size and picture	4.17	0.59	high
13. Content is arranged appropriately.	4.37	0.56	high
14. Appropriation of content	4.40	0.56	high
15. Encourage students to learn	4.20	0.55	high
Average value	**4.26**	**0.32**	**high**
Instructional media (GUI Simulation tool)			
16. Instruction media is consistent to course objective	4.50	0.55	high
17. Appropriation of teaching	4.50	0.55	high
18. Appropriation of design	4.53	0.55	very high
19. Media is appropriate for the learner.	4.57	0.55	very high
20. Easy to use and accuration	4.47	0.55	high
Average value	**4.51**	**0.29**	**very high**
Measurement and Evaluation			
21. Examination is consistent to course objective.	4.03	0.61	high
22. The number of test are appropriate.	3.83	0.53	high
23. Questions and answers are clear and appropriately.	4.10	0.48	high
24. Time durtion of test	3.93	0.58	high
25. Level of difficulty - easy are Appropriately.	4.20	0.61	high
Average value	**4.02**	**0.27**	**high**
Total value	**4.22**	**0.12**	**high**

Considering in the topic of instruction media (GUI simulation tool), the students' satisfaction is at very high level (mean value equaled to 4.51). Moreover, in the learning and teaching topic, the students' satisfaction is at high level (mean value equaled to 4.02). The overall appropriation of instructional package is at high level (mean value equaled to 4.22), as shown in table II.

V. CONCLUSION

This research has presented the development of the STEM learning process using the REPEA learning model that consists of five steps: Recall (R), Explanation (E), Participation (P), Exchange (E), and Assessment (A). The developed instructional package for learning and teaching of transmission line engineering comprises the teacher's manual, PowerPoint presentations, GUI simulation program, achievement test that promotes students to have expected learning outcome of engineering curriculum. In addition, the STEM learning process can be used to encourage students to be active in teaching and learning, as well as assertive behavior, interaction with others. Moreover, students can take obtained knowledge using the STEM learning process to be applied in everyday life.

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