Asia-Pacific Journal of Science and Technology. Volume. 23. Issue. 03. Article ID.: APST-23-03-03. Research Article

APST

Asia-Pacific Journal of Science and Technology

https://www.tci-thaijo.org/index.php/APST/index

Published by the Research and Technology Transfer Affairs Division,
Khon Kaen University, Thailand

Learning and teaching in telecommunication engineering course using MIAP learning model; a case study of basic antenna design

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Abstract

This research aims to develop and construct the instructional package on basic antenna design subject by using MIAP learning model and to evaluate students' satisfaction in using the instructional package. The research instrument is the instructional package consisting of 3 units, as the information sheet, the PowerPoint presentation program, achievement test, and the GUI-MATLAB simulation program and the antenna prototypes. The evaluated quality result by 5 experts was most appropriate (average value equaled to 4.54). Then, the MIAP learning model was implemented using a sample group of 24 undergraduate students in the 4th year students of Bachelor of Science in technical education program in electronic and telecommunication engineering and the 2nd year students of Bachelor of Industrial technology program, Rajamangala University of Technology Suvarnabhumi. The research results shown that the efficiency of constructed instructional package was equal to 78.13/77.78 that was consistent the standard criterion of 75/75. The evaluated result of students' satisfaction was very satisfying (average value equaled to 4.32, the standard deviation equaled to 0.71). Thus, the constructed instructional package on basic antenna design subject can be used effectively in the telecommunication education.

Keywords: MIAP Learning Model, Basic Antenna Design, Instructional Package

1. Introduction

The recent several years, wireless systems have been developed to speed up of the transferring of data, to make smaller package dimension and to be delivered in a long distance. The learning and teaching of telecommunication engineering are important to produce engineers become potential labors [1]. Then, the development of smart learning model based on modern technologies and supporting the life-long learning is considered. Nowadays, the educational management has many problem issues that effect on the learning achievement of students. Therefore, teaching in engineering and technology courses should use various teaching methods and appropriate instructional aides to promote students to have better understanding. The recent several years, researchers [2] have studied the learning and teaching problem issues of antenna engineering course. From the survey result found that students lack the revision and preparation of basic knowledge before attending classrooms. Some of content is too difficult and not efficiently corresponds to learners' graduated levels. Also, students have less participation in learning activities, instructional media is not available and examination does

not cover the behavioral objectives of the lesson. Moreover, we found that the most teaching model is based on the passive learning.

In solving these solutions of learning problem, teachers should develop the learning model following the 21st century learning skills using STEM education. As an example of best practice at Faculty of Technical Education (FTE), King Mongkut's University North Bangkok (KMUTNB), the MIAP learning model based on Germany practical education platform [3] was be used and implemented in the vocational teacher training more than 40 years ago. This learning aim suggests a common way. What has been tried in institutional training must also be employable for short training through appropriate reduction. The MIAP learning model is founded on this consideration. If the teaching activities of the counterparts are subjected to analysis following rough objectives, as the most important, can be deduced from the above-mentioned aim. Improving the achievement of learners, the teacher must be able to:

1. To formulate an observable learning objective with reference to a given topic or curriculum detail. He must be able to select learning objective for the group with regard to their importance for this group.
2. To pass on the necessary information for achieving the decided learning objective as efficiently as possible. For this he must be able to select and apply the medium and method suited to the content of the information and the difficulty of the information.
3. To measure the achievement in relation to the learning objective and to identify the factors which have prevented the obtaining of a satisfying achievement. This is an absolute condition for a continual improvement in teaching success.
4. To encourage productive co-operative of the learners, and enable them to learn independently as quickly as possible.
5. To bring the learners, transferred to other situations, to practice the newly won abilities.

The MIAP learning model [4] is an example of active learning model providing students to have the appropriated knowledge and skill competencies. This learning model process consists of four teaching steps; Motivation: M, Information: I, Application: A, and Progress: P, as shown in Figure 1.

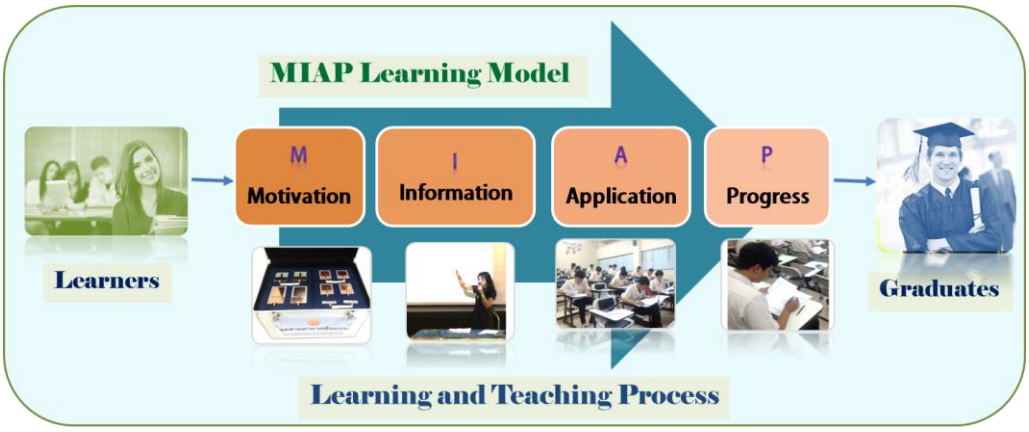

Figure 1 The MIAP learning model

The MIAP learning model is an active learning focused on student centered learning, students will get knowledge and skills using "learning by doing" or "doing by learning". This learning model has support in the training vocational and engineering teachers following the Germany vocational educational model since 1969 until presently. It includes four steps as follows: [5-6]

1) Motivation: (M), the aims of this step are to encourage students to take an interest in, and solve the problem, to encourage students to want to learn and lead the students into the subject with that intention. This intention and motivation should be maintained throughout the lesson to keep the students engaged, and therefore, improve knowledge retention.

2) Information: (I), this step is the actual delivery of the content to the students. As part of this, the content should be sorted and separated into smaller chunks, appropriate for what the students are able to absorb and retain.

3) Application: (A), to make sure the students have a better understanding of the content, they practice using the new knowledge to solve specific problems. At this stage, the learners need to be checked, and given the opportunity to use the knowledge in the process of finding a solution to a problem, ensure the students have understood the lesson, and to review their knowledge.

4) Process: (P), the final step is to monitor and evaluate of achievement of the objectives. If the objectives are not achieved, the instructor will need to make adjustments until the students properly understand the content, and complete it.

In this paper, the learning and teaching of telecommunication engineering using MIAP learning model will be presented to encourage students to get highest learning achievement. The research objectives are to develop the efficient instructional package in the teaching of basic antenna design subject by using the developed GUI-MATLAB simulation and to evaluate students' satisfaction in using developed instructional package.

2. Materials and methods

The research processes of developing instructional package on basic antenna design subject by using MIAP learning model are as follows:

2.1 The curriculum analysis

In analyzing antennas and propagation course [7], the framework of course description will provide the content topics, as shown in Figure 2.

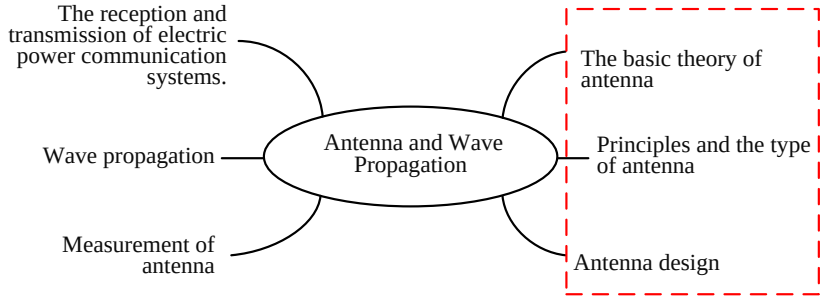

Figure 2 The curriculum analysis of antennas and propagation course

Figure 2 presents the six main content topics of antennas and propagation course including the principles theoretical of antenna, antenna design, measurement, wave propagation, the transmission of electric power communication systems. In this research, the basic theory of antenna, principles and type of antenna and antenna design were developed and implemented in a classroom. The behavior objectives of each lesson were reformed to be as guidelines of preparing content, instructional media used in teaching and learning achievement test.

2.2 The research instrument development

The research instrument developments used in the research are as follows:

2.2.1 Lesson plan development using the MIAP learning model

We will study the theory of active learning. Then, to analyze what the contents, instructional materials and time schedule to use in the learning and teaching of each lesson, finally, to design several activities in learning and teaching. The developed research instrument was reviewed by experts and improved to get perfect instrument. The research procedure is shown in Figure 3.

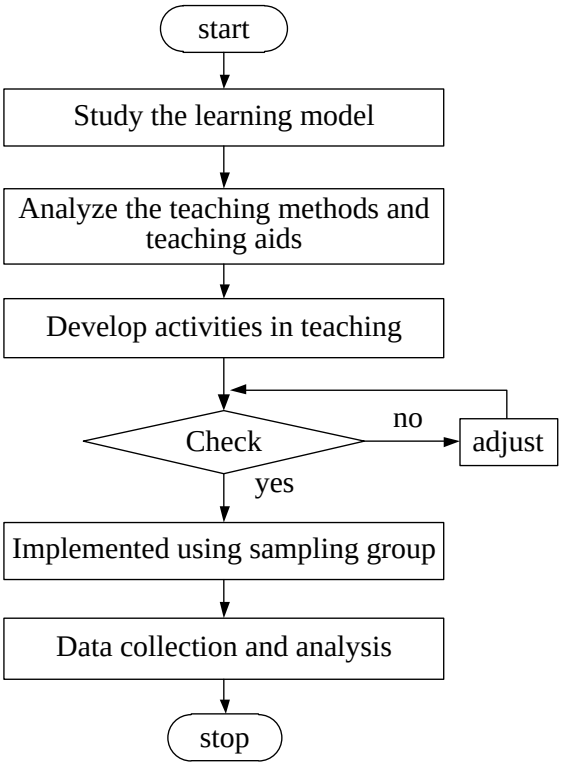

Figure 3 Research procedure

2.2.2 Teaching aids development

The teaching aids development was developed in following behavioral objectives for each lesson. The teaching aids consist of the course contents, PowerPoint presentation program and the antenna prototype set [8], as shown in Figure 4.

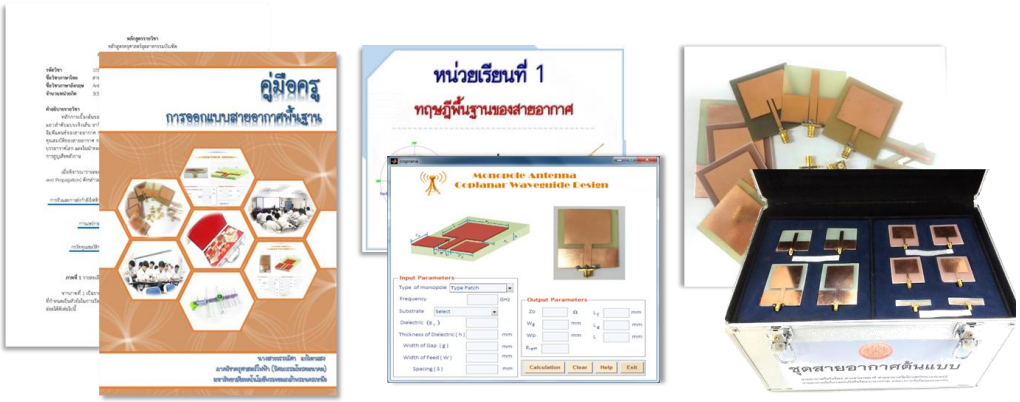

Figure 4 Instructional aids development

The details are as follows:

1. To create the qualified and relevant handout, researcher collected and analyzed data from text books, implicated researchers, websites, antenna experts who are specialists in and basic antenna design. In this case, the handout was built suitably for learners.

2. To create the instructional media, researcher considered an agreement of every part such as background and content.

3. To create simulated program for antenna design, researcher considered input, output, display, and program processer of GUI-MATLAB simulation program, as shown in Figure 5.

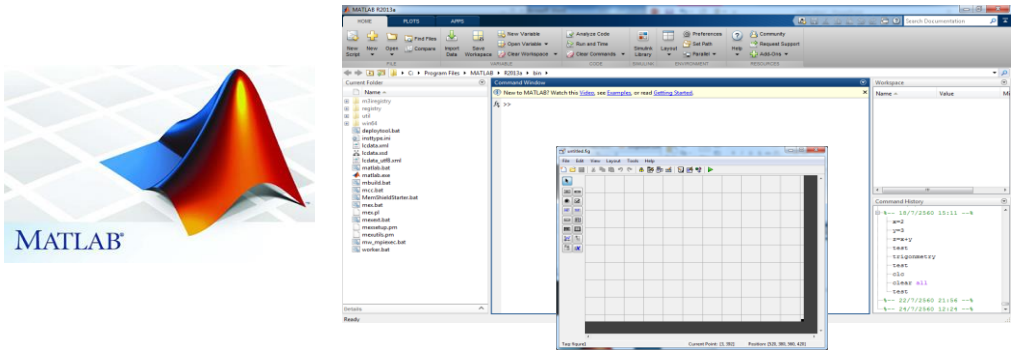

Figure 5 Creating the GUI-MATLAB simulation program

In this case, researcher has sketched of the program's structure consisted of 5 main parts, part one is a part showing topic, part two is a part displaying antenna structure, part three is about input helping users to manage parameter in the program, part four is the result of antenna parameter calculation, and part five is about controlling knots of GUI-MATLAB simulation program, as shown in Figure 6.

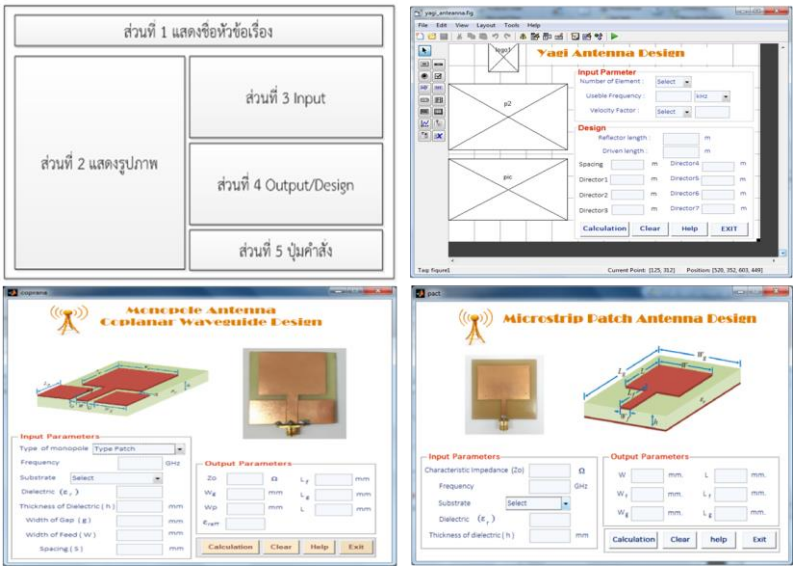

Figure 6 GUI-MATLAB simulation program

4. To design antenna for supporting students virtually learning, theory was used to set the size that meeting resonant condition, and then researcher constructed antennas and evaluated antenna properties. Antennas that were used in this case are patch microstrip, monopole, dipole, and wire antenna. An example of constructed antenna package and its frequency response between measurement and simulation is shown in Figure 7.

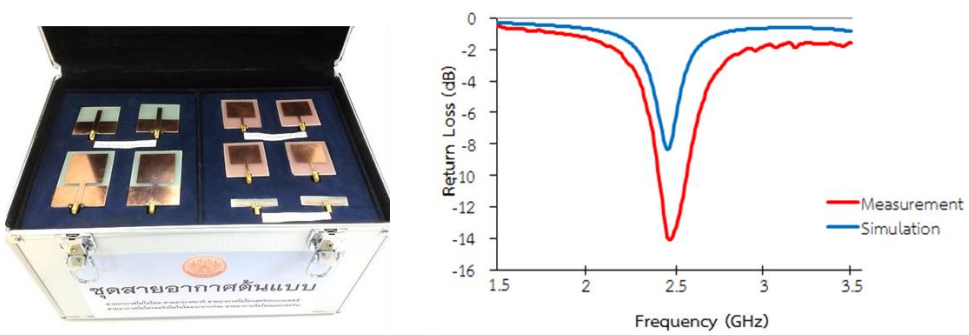

Figure 7 Antenna package and its frequency response

2.2.3 Learning achievement test development

The assessment development process was shown in Figure 5. The assessment test was designed following the behavioral objective of course analysis. All of test is 36 questions covering 3 lessons. After that each question was evaluated the IOC by experts. It can be seen that the IOC varied from 0.80 to 1.00 with the overall average value equaled to 0.93 denoted that all developed assessment test can be used in the teaching and learning as well.

2.3 The evaluating quality of research instrument

After developing the instructional instruments for teaching of basic antenna design, the quality of research instruments was evaluated by 5 experts. The analyzed results were summarized in Table 1.

Table1 Evaluation of instructional package

Topics	$\overline{X}$	S.D.	Appropriate levels
Course contents	4.64	0.51	Very High
Achievement Test	4.48	0.81	High
Instructional medias (Antenna prototype set)	4.48	0.62	High
PowerPoint presentation Program	4.56	0.51	Very High
Total average value	4.54	0.61	Very High

The results shown that the overall opinion in the quality of developed research instruments was average value of 4.54 of 5 maximal points, which was very high appropriate.

2.4 Data collection and analysis

In teaching of basic antenna design subject, the constructed instructional package based on the MIAP learning model was implemented using 24 bachelor students of Bachelor of Science in technical education program and Bachelor of industrial technology program at Rajamangala University of Technology Suvarnabhumi. The detailed steps are as follows:

1. The researcher introduced clearly the details of learning and teaching processes.
2. The constructed instructional package was implemented for three hours a lesson between January 9, 2017 to January 27, 2017, as shown in Figure 8.

Figure 8 The implementation in a classroom

3. After completing of each lesson, students took the test of each lesson, and after finishing all lessons, the learning achievement test was processed to measure and evaluate the students' knowledge, as shown in Figure 9

Figure 9 Students took the test of each lesson

4. The efficiency of the constructed instructional package was evaluated in consistent to standard criterion of E1/E2 using the after lesson test and learning achievement test.

5. The students' satisfaction in using the constructed instructional package was evaluated and analyzed. Then the research was concluded.

3. Results

3.1 The evaluated results of efficiency

The efficiency of instructional package on the basic antenna design subject by using the MIAP learning model with a sampling group of 24 students was presented. The results of efficiency of the constructed instructional package were shown in Table 2.

Table2 The evaluated result of efficiency of the constructed instructional package

Topics	Full score	Number of students	ıverage points	Percentage of efficiency
After lesson test	36	24	28.13	78.13
Achievement Test	36	24	28	77.78

Table 2 shows the analyzed results of the efficiency of instructional package on the basic antenna design subject using 24 students. We found that the average score of after lesson test for all 3 units are equal to 28.13 points of 36 maximal points to be as 78.13 percentages, the average score of achievement test are equal to 28 points of 36 maximal points to be as 77.78 percentages. Therefore, the efficiency of the constructed instructional package (E1/E2) is equal to 78.13 / 77.78 that are consistent to the standard criterion of 75/75.

3.2 Analyzed results of students' satisfaction

The analyzed result of students' satisfaction of 24 students was shown in Table 3. It can be seen that the students were satisfy so much to learn the constructed instruction package (overall average score equaled to 4.32). Moreover, they found that the constructed instruction package has been created by integrating modern technologies and developing process management as well until it can provide the smart educational innovation.

Table3 Analyzed result of student's satisfaction

List	Average value	S.D.	Satisfaction levels
Course Contents	4.23	0.77	High
PowerPoint presentation program	4.38	0.75	High
Teaching medias (Simulation Program / Antenna set, ect)	4.34	0.72	High
Measurement and Evaluation	4.30	0.58	High
The Average Value	4.32	0.71	High

4. Discussion

From the research results, it can be discussed the results of the research as follows:

1. Our instructional package has been examined by the experts and the instructors who provided recommendations as follows;

1.1 Adjust the content to be in line with students' knowledge levels.

1.2 Adjust the achievement test to be able to clearly measure achievement.

In this regard, we have revised our instructional package accordingly so they are complete that we have applied to the sampling group effectively.

2. During experimental period, by observation and interview, researcher found that students did not clearly comprehend the lesson because it was new and complicated for students. After using the learning activity, the students' ability has improved conforming to the standard of Meguigans. Finally, satisfaction of students showed that students have overall satisfaction on learning activities at the high level.

3. The MIAP learning model is an active learning focused on student centered learning, students will get knowledge and skills using learning by doing or doing by learning. In addition, we can apply our instructional package to this type of student-centered learning model, for instance, to let constructivism, problem-based learning, etc. During 21st century learning skills [9], this model has encouraged students to be equipped with not only theoretical knowledge but also the corresponding practical skills to be aligned with current environments and technologies.

5. Conclusions

This research has developed the learning and teaching of telecommunication engineering using the MIAP learning model. The instructional package on basic antenna design was implemented using a sampling group of 24 bachelor students. It can be seen that the developed instructional package was more appropriate and had the efficiency of 78.13/77.78 which is consistent to standards criteria of 75/75. In considering the learning and teaching of telecommunication engineering in 21st century skills, the modern instructional package development using active learning model, smart educational innovations and activities appropriate, is necessary and important to product graduate to have specific knowledge and skill competencies following the expected learning outcome of course requirements.

6. Acknowledgements

We are sincerely thank you to Associate Professor Dr. Somsak Akatimagool for his invaluable help and advice throughout of this research. In addition, we are grateful for the teachers Department of Electronics and Telecommunication Engineering, Faculty of Industrial Education, Rajamangala University of Technology Suvarnabumi, Supanburi and others person for suggestions and all their helping hand.

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