EASR

Engineering and Applied Science Research

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

Published by the Faculty of Engineering, Khon Kaen University, Thailand

The development of case-based learning for an antenna engineering course using folklore

Thanatip Chankong*[1] and Nopadon Maneetien[2]

[1]Department of Electrical Engineering, School of Engineering, University of Phayao, Phayao 56000, Thailand
[2]Department of Electrical Engineering, Rajamangala University of Technology Lanna, Chiang Mai 53000, Thailand

Received 21 August 2017
Accepted 29 November 2017

Abstract

Several subjects, including antenna engineering in a communication engineering program, is a math-intensive subject where most students say that it is difficult to understand and visualize. Students are unable to relate theoretical knowledge to real world applications. To overcome this issue, we proposed to motivate students' curiosity using fun and interesting ways of teaching based on real cases in the community. In an antenna engineering course, there are folklores that performance of an antenna can be improved by attaching items such as basins to the antenna or using everyday objects as an antenna. Theoretical explanations have not been developed yet. In this research, we aim to propose the idea of using folklores as a case-based learning (CBL) exercise. Based on the process of CBL, a 15-week course plan starts with establishing the case in the first week, followed by weeks of theoretical study, lectures and group discussions. Group discussions on the case are established on the 5th and the 10th weeks to share the problems and the new findings. The results of the study are presented in the 15th week. Impressively, the pre-evaluating result shows that 97.5% of students who never attend an antenna engineering class were interested in joining the challenge. The proposed idea will be applied in an antenna engineering course for 4th year students in communication engineering, at the University of Phayao, in the first semester of the 2017 academic year in August 2017.

Keywords: Case-based learning, Local wisdom, Antenna engineering, Course development

1. Introduction

Several subjects, including antenna engineering in a communication engineering program, are math-intensive subjects that most students find difficult to understand and visualize. Student are unable to relate theoretical knowledge to real world applications. The feedback from students on traditional lecture-based methods indicate that learning is hard and that leads to a lack of motivation.

Active learning or student-centered learning is an approach to engage learners in the learning process. They build their own knowledge and understanding while teachers play a role of facilitator or activators of learning rather than lecturers who deliver instruction and ideas [1].

The case-based teaching method is an active learning approach. It has been used in medical, business and law education for years. Nowadays, this teaching technique is used as a teaching strategy in science and technology education. The study in [2] reported that case-based teaching increased student perceptions of learning gains associated with oral and written communication skills compared to traditional methods of content delivery in a biology course.

The engagement of students to apply their knowledge to design and implement antennae using two topical approaches was presented in [3]. Measurement, simulation software and laboratory experiments with project and design problems were used in their final capstone senior design project sponsored by two companies. The constructivist educational approach was introduced in [4]. These pedagogies have been discussed and recommended for use in problem-based learning to help students become active learners. The design of the problem-based learning provides off-the-shelf materials and components for the students to design patch and conformal antennae following mathematical derivation and simulations. This can encourage students to design and implement antennae, as well as to verify their results. In the study of [5], an innovative teaching approach in electromagnetics (EM), antenna theory and signal propagation were presented to undergraduate students. The teaching techniques included lecture, classroom demonstrations, laboratories, and a capstone design project.

Moreover, new technologies, such as augmented reality, have been applied in wireless engineering education [6]. The case study of AR was an antenna radiation pattern visualization to help student see "things" and gain understanding of the topic.

To develop learning in an antenna engineering course, we proposed a process to motivate student curiosity using fun and interesting ways of teaching based on real cases in the community. In antenna engineering, there are folklores that hold that antenna performance can be improved by attaching common items such as basins to the antenna or using the

*Corresponding author. Tel.: +6686 922 4144
Email address: thanatip.ch@up.ac.th
doi: 10.14456/easr.2018.32

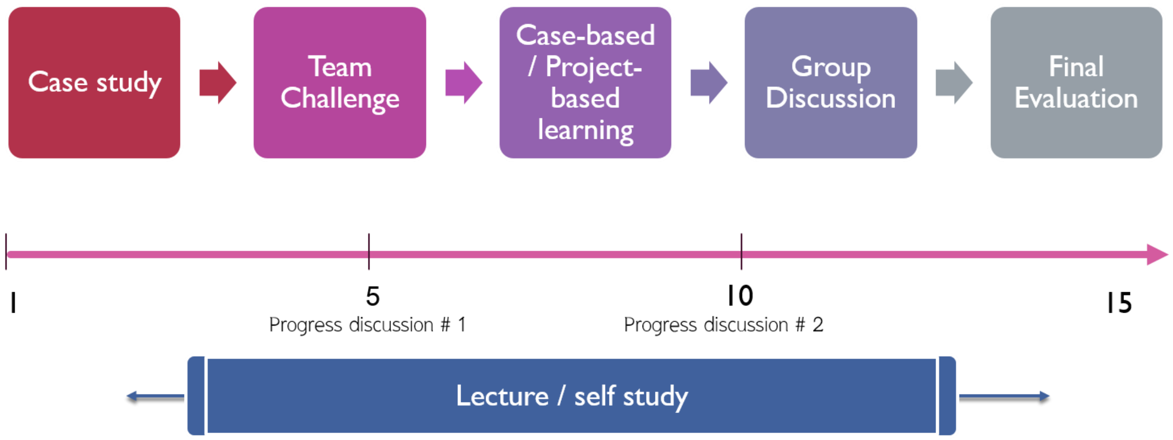

Figure 1 A 15-week course plan of an Antenna Mythbuster learning approach

everyday objects as an antenna. Theoretical explanation, however, has not been developed. We propose the idea of turning students into "Mythbusters" testing antenna myths.

2. Materials and methods

2.1 Obstacles in learning antenna engineering course

A survey of graduates who passed an antenna engineering course was conducted to evaluate the learning problems of this course and to obtain suggestions for improving teaching and learning methodology. From the 25 responses, 65.33 % said they are unable to bridge theory and practice, 57.33% said the subject is too hard to understand and visualize, 41.33% have difficulty because it is a math-intensive subject.

The top three suggestions from the survey were using real world cases from examples to discuss, field trips to antenna sites, and, using real antennae as teaching aids.

We strived to improve teaching and learning using a real-world case. The main objective was to facilitate students to relate the case to theory. A Mythbuster idea was used to make the case more challenging.

2.2 The Mythbusters [7]

MythBusters is a science television program that premiered on the Discovery Channel in 2003. The hosts of the show use the scientific method to test the validity of rumors, myths and movie scenes [8]. The process of busting the myths consists of two steps, which they described as "replicate the circumstances, then duplicate the results". The first step is to recreate the claimed circumstance of the myth and observe the results. If the first step fails, the next step is to expand the circumstance to create the results claimed by the myth. Outcomes of the experiments are rated as "busted", "plausible", or "confirmed".

2.3 The case-based teaching method

The Case-based Teaching and Learning (CBT) method is a pedagogical methodology to embed practice- based knowledge into teaching [9]. The process of conducting case-based teaching can be summarized as follow [2-3]:

1) Selecting the case: The selected case should be typical, representative and reveal the theory.
2) Introducing the case to students: A teacher should introduce the case with a simple description.
3) Analyzing the case: A teacher as a facilitator encourages students to engage in learning by inspiring them to think, finding questions, engage in group discussions and find the solution to their questions by themselves.
4) Concluding the case: After group discussion, teachers summarize the necessary conclusion.
5) Writing the report: Student should write a report that details of the process of studying the case and arriving at conclusions.

2. 4 Proposal of a Mythbusters learning approach to an antenna engineering course

The Mythbusters learning approach follows the ideas of the TV show and the process of case-based teaching method. The 15-week course plan starts with establishing the case in the first week, followed by weeks of theoretical study, lecture and group discussion. Progress discussion on the case is established on the 5th and the 10th week to share the problems and the new finding of each group. The results of the study are presented in the 15th week. A diagram depicting the course timeline is shown in Figure 1.

The process was as follows:

1) Two cases of antenna myths or local wisdom were selected. The background of each case is introduced to the students. The details of the case are described in Section 2.4.
2) The students work in teams. Each team is challenged to prove both cases and rate the cases at the end of the course on the 15th week as "busted", "plausible", or "confirmed". The team must present their proof, experimental results any evidence to convince other teams and facilitators.
3) As a facilitator, the teacher will provide basic and necessary knowledge throughout the course. The teacher also facilitates the team discussions and brainstorming steps. To confirm the learning outcomes of the students, the facilitator conducts an experiment to obtain a theoretical solution to both cases used for comparison of results or guidelines for students. Group discussions are conducted every two weeks after the lecture to facilitate students to apply the theory they have learnt to the case.
4) On the 5th and 10th week, each team shares their problems and new findings. Teams are allowed to

adopt another team's ideas and methods to improve their own experiments.

5) Every team presents their conclusions with proof and evidence on the 15th week.

2.5 Antenna folklore

2.5.1 Case 1: "The Euro 2012 Thailand"

In 2012, The EUFA Euro 2012 was broadcasted via free TV channels. At Mr. Itsada residence, there was a problem with the antenna while he was watching the match. The problem was solved by using a mobile charger as the antenna as shown in Figure 2. It is claimed that the quality of the signal is 80% [10-11].

Myth: Can a mobile charger act as an antenna? If it can, how?

Guideline experiments conducted by facilitator: Measure the characteristic impedance of the mobile charger. Calculate the theoretical length of the dipole antenna and compare it to the actual length of the mobile charger.

Figure 2 The Euro 2012 Thailand case [11]

2.5.2 Case II: "The local wisdom of the antenna"

The picture of the antenna with a tin basin on the top on the roof of the local residence is posted on a Thai web board [12]. The caption of the picture claimed that the tin or aluminum basin helps improve the quality of the signal. The original source of the picture shown in Figure 3 is unknown.

Myth: A tin basin can improve the signal quality of an antenna. What is the effect of placing the tin basin on the Yagi- Uda antenna? Can the tin basin improve the quality of the antenna? If it can, how?

Experimental guidelines conducted by facilitator: Simulate the scenario using the Yagi antenna training system. Place an aluminum object on the top of an antenna and compare the measured parameters to the result without the object.

Figure 3 An antenna with a tin basin on the top [12]

2.6 Expected outcomes

1) Knowledge: Students can:
   - describe fundamental antenna properties
   - describe antenna parameters
   - recognize the structure of the antennas
   - recognize the principles and practical methods for the measurement of the major antenna characteristics
2) Skill: Students can
   - calculate the radiation pattern of the most common antenna types
   - analyze the main antenna types
   - perform antenna measurements
3) Attitude: Students can
   - work with other people as a team
   - discuss with team members
   - design experiments to prove or disprove the myth

2.7 Implementation

The proposed idea will be applied in an antenna engineering course for 4th year students in communication engineering, at the University of Phayao, in August 2017.

3. Preliminary result

To pre- evaluate the effectiveness of the Mythbuster model, we challenge two target populations, graduates who passed the antenna engineering course and students who have not attended the course, to be an Antenna Mythbuster by challenging them with Case I. The outcome is rated as "busted" (not possible), "plausible", "confirmed" (possible), "inconclusive" and "not interested to participate". Students are asked to give reasons or evidence to support their answer. The aim of this experiment is to determine if challenging students with a case- based method can motivate them to engage in learning.

A number of graduates and current students joined the challenge. The number of participants in the challenge is shown in Table 1. From the overall response, 80% of graduates were willing to participating the challenge. Impressively, 97.5% of current students were interested in joining the challenge.

Table 1 Number of the graduates' and current students' responses to the challenge

	Graduates		Current students	
	person	%	person	%
Number of respondents	25		40	
participate the challenge	20	80.0	39	97.5
not participate the challenge	5	25.0	1	2.6

Table 2 Example of supported idea for each outcome

Outcome	Supported Idea
Busted or impossible	- the mobile charger and the antenna is designed for different functions
	- the antenna socket and the size of mobile charger jack is different
Plausible	- successfully tested with another metallic object and assumed that the mobile charger works in the same way
Confirmed (possible)	- already did the experiment using the mobile charger to prove the case.

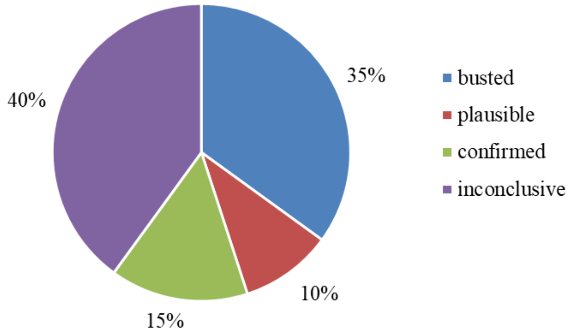

Figure 4 Outcome of the Antenna Mythbuster challenge of the graduates

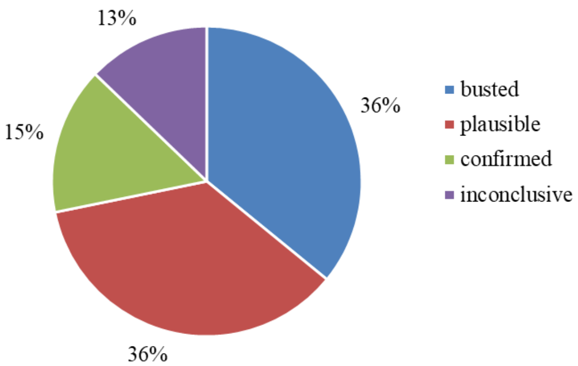

Figure 5 Outcome of the Antenna Mythbuster challenge of the current students

The outcome of the antenna Mythbuster challenge of the graduates and current students is shown in Figures 4 and 5, respectively. Figure 4 shows that 40% of the graduates said that the case cannot be concluded without further experiments. Of the current students, 36% thinks that the result is not possible. Another 36% thinks that the results are plausible. Fifteen percent of students said that the result is possible and 13% said further experiment is required to confirm the outcome. Example of the supporting ideas for each outcome are shown in Table 2.

4. Conclusions

The World Economic Forum reported that the top two skills that will be required in 2020 are the ability to do complex problem solving and critical thinking [13]. The role of teacher or lecturer nowadays should be as a facilitator to provide experience and an environment that encourages students to identify questions and find appropriate solutions by themselves. Using case studies is an active method of learning that can help in problem solving and encourage development of critical thinking skills. A case study that can spark student curiosity if is relevant in their lives and can motivate students to pursue lifelong learning.

5. References

[1] Getting started with active learning [Internet]. Cambridge assessment international education. [cited 2017 Aug 20]. Available from: http://www.cambridge-community.org.uk/professional-development/gswal/index.html.

[2] Bonney KM. Case study teaching method improves student performance and perceptions of learning gains†. J Microbiol Biol Educ. 2015;16(1):21-8.

[3] Lumori MLD, Kim EM. Engaging students in applied electromagnetics at the University of San Diego. IEEE Trans Educ. 2010;53(3):419-29.

[4] Bajwa H, Mulcahy-Ernt P. Redesigning teaching approaches for undergraduate engineering classrooms. IEEE 2nd Integrated STEM Education Conference; 2012 Mar 9; Ewing, USA. USA: IEEE; 2012. p. 1-4.

[5] Crilly P. An innovative approach to teaching an undergraduate electromagnetics, antennas and propagation course. In: Kongar E, editor. The 2014 Zone 1 Conference of the American Society for Engineering Education; 2014 Apr 3-5; Bridgeport, USA. USA: IEEE; 2014. p. 1-5.

[6] Sahin C, Nguyen D, Begashaw S, Katz B, Chacko J, Henderson L, et al. Wireless communications engineering education via Augmented Reality. 2016 IEEE Frontiers in Education Conference (FIE); 2016 Oct 12-15; Erie, USA. USA: IEEE; 2016. p. 1-7.

[7] MythBusters [Internet]. Discovery. [cited 2017 Aug 20]. Available from: https://www.discovery.com/tv-shows/mythbusters/.

[8] MythBusters [Internet]. Wikipedia. [cited 2017 Aug 20]. Available from: http://en.wikipedia.org/w/index.php?title=MythBusters&oldid=795147415.

[9] Courtney N, Poulsen C, Stylios C. Case based teaching and learning for the 21st century. UK: Libri Publishing; 2015.

[10] VoiceTV [Internet]. Bangkok News [cited 2017 Aug 20]. Available from: http://news.voicetv.co.th/thailand/41602.html.

[11] Itsada Sirijinda. Euro 2012 in Thailand [Internet]. [cited 2017 Aug 20]. Available from: https://www.youtube .com/watch?v=6aJcK_DTk1U.
[12] Science-News [Internet]. RMUT Physics [cited 2018 Sep 7]. Available from: http://www.neutron.rmutphysics.com/science-news/index.php?option=com_content&task=view&id=2384&Itemid=4.
[13] World Economic Forum. The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution [Internet]. 2016 [cited 2017 Aug 20]. Available from: http://reports.weforum.org/future-of-jobs-2016/.