Advances in Social Science, Education and Humanities Research, volume 438
4th Asian Education Symposium (AES 2019)

Improving Learning Outcomes on the Subject of Planning and Antenna Installation of Transceiver Systems at Vocational High School

Iwan Kustiawan*, Tommi Hariyadi, and Muhamad Aldhi
Universitas Pendidikan Indonesia
Bandung, Indonesia
*iwan_kustiawan@upi.edu

Deasy Rosanti Nurjannah
Politeknik TEDC Bandung
Cimahi, Indonesia

***Abstract*—This research aims at evaluating the effect of the use of Antenna simulator software on the subject of Planning and Antenna Installation of Transceiver systems. A quasi experimental, non-equivalent control group design was utilized. The subjects in this study were students of 2 classes of XII-Elkom (first one is an experiment using CST Microwave Studio and another one is control class using Power Point slides) at vocational high School 1 Cimahi, Bandung, West Java. The results showed that a significant increase in learning outcomes for the experimental class, that is 79.43 or *N*-Gain 72% and found differences in both classes. As innovative and low-cost media, the use of our media may significantly improve student learning outcomes in the cognitive, affective, and psychomotor domains on subject we focused.**

Keywords: low-cost learning media, learning outcomes, CST Microwave Studio

I. INTRODUCTION

The success of learning is largely determined by two main components, namely the teaching method and learning media. Learning media have an important role in the teaching and learning process [1,2]. And the use of instructional media can help teachers make it easier to deliver certain subject matter. Learning media in general can be interpreted as a communication tool to deliver learning material from teacher to student [3]. However, some formal education institutions still do not realize the importance of learning media needed by students.

In vocational high schools majoring in telecommunications engineering, there are subjects namely Antenna Planning and Installation, one of which is that students are able to understand antenna parameters and characteristics. For example, the teacher is asked to teach dipole, Yagi, and O ring antennas. Many academics who try to teach theories rely on Power Point media, including teaching antenna theory [4]. Unfortunately, there are limitations to the visualization of the shape of the antenna and the visualization of several parameters such as radiation patterns, gain, bandwidth, and Voltage Standing Wave Ratio (VSWR) which makes it difficult for students to understand and describe the concept. Moreover, when the material requires practicums with very expensive equipment [5]. As a result, the level of achievement of learning outcomes becomes somewhat biased. Here is the need for media that is easily accessible to teachers and students and is inexpensive.

Antenna simulators are needed to facilitate the realistic analysis of parameters and modeling of 3D antennas. One effort that needs to be done by the teacher so that the subject matter is easily understood by students is by developing learning aids that exist in schools in the form of software-based practice job sheets [6]. This job sheet is intended as a student practice guide to operate the learning media [7]. Therefore, in this study the application of software in this case CST Microwave Studio will be explained towards improving student learning outcomes. And how the differences are in student learning outcomes using and without using CST Microwave Studio software in the cognitive, affective, and psychomotor domains.

II. METHODS

In this study, the research method used was a quantitative research method using the experimental class and the control class. The flowchart of this study consisted of an experimental class and a control class that were given a pretest and then proceed with the treatment, after that a posttest was given.

This research was conducted at Cimahi State Vocational School 1, located at Mahar Martanegara Street, No. 275, Cimahi City, West Java 40533, Indonesia. The main subjects in this study were class XI students with Telecommunications Electronics expertise program in the academic year 2017/2018. We use a purposive sampling technique. These sample selection considerations are based on students' basic abilities and knowledge in understanding antenna types and their characteristics, and based on school recommendations.

We used several data collection techniques including observation, cognitive testing, and psychomotor observation sheets. Observation in this case in the form of a preliminary study with direct observation to the research location at the

Vocational School. The things observed are related to the curriculum used, learning activities, learning approaches, and learning media used in the planning and installation of the Transmitter and Receiver Antenna System. Objective tests take the form of multiple choice in the cognitive domain, while psychomotor observation sheets are used to assess the attitudes and skills of students in the experimental class during the learning process using CST Microwave Studio learning media (Figure 1).

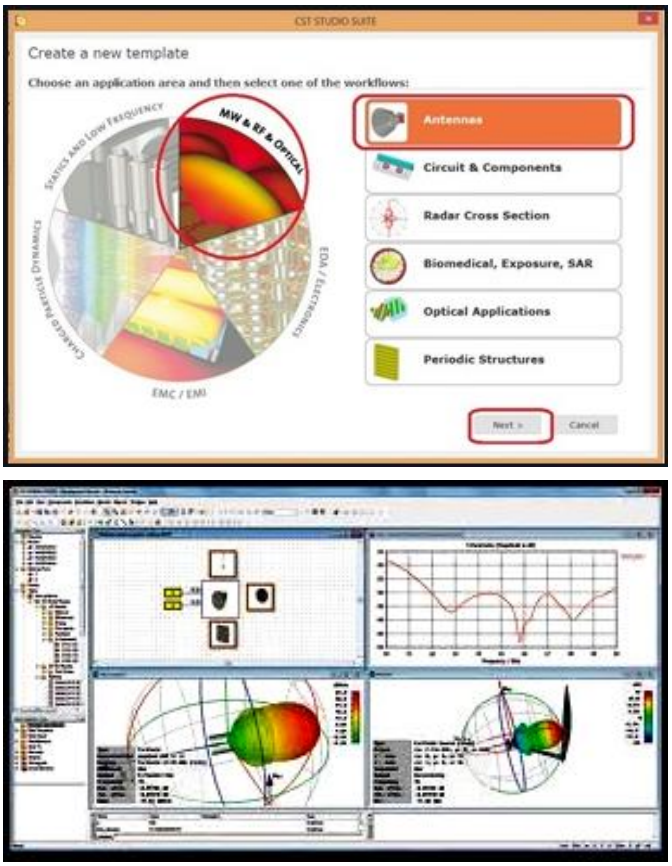

Fig. 1. A screenshot for using CST Microwave Studio for antenna modelling.

Before processing the data, the steps taken are as follows:

- Checking the results of the initial test and the final test of each student then give a score on the answer sheet. Questions answered wrongly given a score of 0 (zero) then we give a raw score on a scale of 0 to 100 on the results of students' answers. Scoring of students' answers is based on items answered correctly by students. After scoring each item, the next step is to add up the scores obtained by each student and convert them in the form of scores using the following formula:

$$\text{Student Score} = \frac{(\text{Score obtained})}{(\text{Maximum score})} \text{x100}$$

- Calculating normalized gain in order to determine the level of learning effectiveness of a course in promoting conceptual understanding. Calculation of normalized gain is obtained from pretest and posttest score data which is then processed to calculate the average normalized gain. The normalized gain or the g-factor has been widely used in assessing students' performance in pre-and post-tests [8]. The average g-factor can be defined using either the average scores of the class or individual student's scores as:

$$\langle g \rangle = \frac{\langle post \rangle - \langle pre \rangle}{100 - \langle pre \rangle}$$

Where brackets indicate class averages. This measure is commonly indicated as the amount students learned divided by the amount they could have learned. Normalized gain criteria can be seen in Table 1.

Assessment of psychomotor learning outcomes is done by direct observation and assessment of student behavior during the practice learning process takes place. In addition, it can also be done after participating in learning and even can be some time after learning is finished and later in the work environment. Data on psychomotor learning outcomes can be obtained using the following formula:

$$Psychomotor\ outcomes = \frac{(score\ obtained)}{(Maximum\ score)} x100$$

TABLE I. NORMALIZED GAIN CRITERIA

Gain score	Category
<g> ≥ **0,70**	High
0,30 ≤ <g> < **0,70**	Medium
<g> < **0,30**	Low

Table 2 shows the percentage of success rates of cognitive, affective, and psychomotor achievement.

TABLE II. SUCCESS RATES OF STUDENT ABILITY ACHIEVEMENT

Predicate	Score (Scale 100)	Scala 4	Attitude
A	96 – 100	4	Very good
A-	91 – 95	3,66	
B+	86 – 90	3,33	Good
B	81 – 85	3	
B-	76 – 80	2,66	
C+	71 – 75	2,33	Enough
C	66 – 70	2	
C-	61 – 65	1,66	
D+	56 – 60	1,33	Less
D	≤55	1	

III. Results and Discussion

Based on research that has been carried out, the obtaining of the average value of pre-test and post-test control classes is 21.69 and 72.61. While the average pre-test and post-test scores of the experimental class were 26.59 and 79.43. Improved student learning outcomes after using the CST Microwave Studio learning media can be seen from the results of the increase in the average pre-test, post-test, and *N*-gain scores presented in Table 3.

Table 3. shows that the *N*-gain value of the control class of 0.65, then the *N*-gain value is included in the medium category according to the criteria in Table 1. While the experimental class obtained an *N*-gain value of 0.72, then the *N*-gain is included in the high category. These results indicate that learning by using CST Microwave Studio Software can improve student learning outcomes.

TABLE III. Obtaining *N*-Gain Values

Class	*Pretest*	*Posttest*	*N*-gain
Control	21,69	72,61	0,65
Experiment	26,59	79,43	0,72

Measurement in the affective domain aims to find out how students' attitudes during learning activities, both those that use CST Microwave Studio Software or those who do not. Measurements are made by observing, which is to fill in the affective domain instrument sheets which have been adjusted to our curriculum (curriculum 2013 released by educational ministry). In this curriculum it is explained that affective assessment is divided into two, namely the assessment of spiritual attitudes and the assessment of social attitudes. The assessment of spiritual attitudes is carried out in order to shape students' attitudes in respecting, living and practicing the teachings of their religion. Whereas the assessment of social attitudes is carried out to determine the development of students' attitudes in respecting, living and interacting effectively with the social and natural environment within the reach of relationships and being.

The criteria measured in this study are honesty, discipline, responsibility, cooperation, and confidence. Measurements show the average affective value for the control class of 83.89 so that the average value of students has good criteria. Furthermore, for the experimental class the average value of affective students was 85.41, so the affective value of students had good criteria.

Measurement in the psychomotor domain aims to determine the skills of students during practice, both those using CST Microwave Studio Software and those who do not. Measurements were made by observing and filling out a psychomotor domain assessment sheet. The psychomotor domain criteria measured in this study are performance appraisals that are tailored to our curriculum. Psychomotor domain measurement results were obtained an average value for student skills during learning is (84.44, good criterium) and (89.10, very good criterium) for the control and experiment class, respectively.

Based on research that has been done, starting from the preparation stage to the final stage, researchers found that the use of this application can improve student learning outcomes in the cognitive, affective and psychomotor domains. In addition, we also found differences in student learning outcomes using CST Microwave Studio Software and those without CST Microwave Studio Software. In the cognitive domain, student learning outcomes using the CST Microwave Studio Software media and those without CST Microwave Studio are very significant differences, where students who use this media, their learning outcomes indicate an average above the minimum graduation standard. While those without CST Microwave Studio, the average learning outcomes are still below the minimum criteria. This result is supported by our hypothesis testing by a statistical approach through the *t* test (assuming that the data are normally distributed and homogeneous).

Next, we found that there was little effect of CST Microwave Studio Software on learning outcomes in the affective domain. Whereas in the psychomotor domain, we found that students were easier to carry out practice with simulations compared to ordinary practice tools. This is because simulation learning only requires a computer with CST Microwave Studio pre-installed. Through simulations, students also find it easier to see the difference between which antenna output patterns are correct and not. In addition, the processing time is also faster. Therefore the psychomotor value of the experimental group is greater than the control group.

Based on the aforementioned explanation, it can be said that the CST Microwave Studio Software learning media can help students understand the material delivered by the teacher better, attract, and increase student interest in learning, especially antenna theory, so that learning outcomes from students in the experimental group, the increase is bigger. This is in line with findings [9,10] that the use of instructional media in a classroom teaching environment can create interesting teaching and challenging assignments. The teacher may need to create optimal interactions with students in the class while reducing or at least minimizing obstacles. In addition, using simulation-based teaching can reduce equipment costs [11]. Students freely explore antenna types, visualize graphical functions, and simulate antenna performance based on parameters designed previously.

IV. Conclusion

We conclude that application of CST Microwave Studio Software can improve student learning outcomes in the cognitive realm. The increase can be seen from the average pre-test and post-test which is then tested how much the increase. While the learning outcomes in the affective and psychomotor domains cannot be seen an increase, because it is based on observations during the learning process.

In the cognitive domain, student learning outcomes using the CST Microwave Studio Software increase is greater than those without CST Microwave Studio. Thus, the average value of students who use CST Microwave Studio Software is above the minimum graduation criteria, conversely students without

CST Microwave Studio have an average grade of less than criteria. In the affective domain there are also differences in student learning outcomes using CST Microwave Studio Software and those without CST Microwave Studio, but the difference is quite small, this is because the aspect of attitude is the most visible difference when practicing only on the aspects of discipline and confidence. So the results of learning in the affective domain that uses CST Microwave Studio or not, both include good criteria.

Furthermore, student learning outcomes in the psychomotor domain also have differences where student learning outcomes using CST Microwave Studio Software are greater than those without CST Microwave Studio. The difference in psychomotor values is also small because the average psychomotor aspects are the most visible differences in the aspects of preparation, results, and time.

REFERENCES

[1] D. Laurillard. Rethinking university teaching: A conversational framework for the effective use of learning technologies. Routledge. 2013.

[2] A. Collins, P. Neville, and K. Bielaczyc. “The role of different media in designing learning environments”. International Journal of Artificial Intelligence in Education, 11(1), pp.144-162. 2000.

[3] M.K. Lee, C.M. Cheung, and Z. Chen. “Acceptance of Internet-based learning medium: the role of extrinsic and intrinsic motivation”. Information & management, 42(8), pp.1095-1104. 2005.

[4] P. Felten. Visual literacy. Change: The magazine of higher learning, 40(6), pp.60-64. 2008.

[5] S. Yusuf, T. Baden, and L.L Prieto-Godino. “Bridging the gap: establishing the necessary infrastructure and knowledge for teaching and research in neuroscience in Africa”. Metabolic brain disease, 29(2), pp.217-220. 2014.

[6] P.H. Winne, A.F. Hadwin, and C. Gress. “The learning kit project: Software tools for supporting and researching regulation of collaborative learning”. Computers in Human Behavior, 26(5), pp.787-793. 2010.

[7] R. Otty and L. Milton. “Promoting Soft Skills with the HOT (Higher Order Thinking) Sheet Assignment”. Journal of Instructional Pedagogies, 22. 2019.

[8] L. Bao. “Theoretical comparisons of average normalized gain calculations”. American Journal of Physics, 74(10), pp.917-922. 2006.

[9] M. Anshari, M.N. Almunawar, M. Shahrill, D.K. Wicaksono, and M. Huda. “Smartphones usage in the classrooms: Learning aid or interference?” Education and Information Technologies, 22(6), pp.3063-3079. 2017.

[10] S. Choi and R.E. Clark. “Cognitive and affective benefits of an animated pedagogical agent for learning English as a second language”. Journal of educational computing research, 34(4), pp.441-466. 2006.

[11] P. Moreno-Ger, J. Torrente, J. Bustamante, C. Fernández-Galaz, B. Fernández-Manjón, and M.D. Comas-Rengifo. “Application of a low-cost web-based simulation to improve students’ practical skills in medical education”. International journal of medical informatics, 79(6), pp.459-467. 2010.