

REKBEN TUBE WITH AR 3D FOR ELECTRICAL FLOW AMONG VOCATIONAL COLLEGE STUDENTS

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ABSTRACT

Purpose: The electric and electronic subject is one of the important subjects in vocational colleges. Admittedly, it is difficult to teach the concept of electrical flow based on the conventional method that relies on explanation using printed materials. The lack of technology-based materials has made it difficult for students to effectively learn such a concept. Against this background, this study was carried out to design, develop, and test a learning application based on Augmented Reality (AR) called RekBen Tube to help technical and vocational school students in learning the concept of electrical flow.

Design: The methods used throughout the production of *RekBen Tube* application technology education learning tools are the ADDIE Model and the TAM Model.

Findings: The actual image depiction of the electric current through the circuit is shown to clearly explain the movement of the electric current.

Research limitations: This study has developed an application of 10 flip cards for scanning by *RekBen Tube* app to generate 3D images on each of the different picture cards.

Practical implications: Much of the software used to produce this learning tool has been able to attract students to learn the basics of electricity.

Paper type: Research Paper.

Keyword: Technology Education Tool Kit, Augmented Reality, Electrical Flow, Technical and Vocational School, 3D Image

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I. INTRODUCTION

Today, learning experiences are accessible through student mobile devices such as smartphones and tablets as well as accessing them in classrooms with interactive desktops and whiteboards. Today, interactive ways of learning are changing with the flow of technology. Students not only use the keyboard and mouse to interact with the content on the screen, but students can use their entire body to interact with educational content that appears to exist in the physical world such as through the Augmented Reality (AR) technology application (Radu, 2014). Electrical and electronic engineering is a study that exposes theory before starting work in the workshop. Exposure to a knowledge of this theory is very important because a lack of understanding and mastery of theoretical knowledge will result in students having problems in practical practice (Suyitno, 2018). A study conducted by an electronic subject teacher in 2014 revealed that teachers had trouble teaching this subject because their syllabus was changing according to the latest technology and had to find their own reference. An external assessor responded that many teachers did not master this subject because their subject matter was changed according to the Vocational College Standard Curriculum (KSKV),

whereas proficient teachers were only in the old syllabus. Struggling with the problem, the students taught by the teacher got low marks in the assessment.

II. LITERATURE REVIEW

The purpose of this AR application is to make it easier for people to understand what is difficult to convey. The tools developed in this work have had a double effect as they allow teachers to improve their guidance during laboratory sessions and offer interesting teaching aids and motivational tools to students during the teaching and learning process in a classroom (Omar et al., 2019).

A. Technical And Vocational Education And Training (TVET)

Education in IR 4.0 will be shaped by innovation and some will train students to create higher and more complex innovations that will potentially transform society to get used to IR 4.0 technology (Noor, Ali, & Osman, 2002). IR 4.0 and TVET are closely related because vocational-born students are skilled students on the basics of technology that teachers have mastered in producing a product for the long term. No wonder the focus of the past research and now prefer TVET to co-lead by RI 4.0. The government is currently busy promoting and promoting the TVET field to all groups, especially the younger generation so that they can remain unemployed and able to stand strong despite the worldwide work and industrial revolution.

B. Learning Electronics And Electronic Subjects

Electrical and electronics engineering courses are considered as the basic courses in electrical and electronics in vocational engineering education. The concept of charge and power supply is a starting course, followed by the circuit elements and the principle of current (Omar et al., 2019). The subject of Electricity and Electronics is not only taught in Vocational College but also in the daily school also has sub-topics of study related to electricity and electronics. For example, students in Forms 1, 2, and 3 were exposed to studying electricity and electronics in the Life Skills subject (KH) which has now been replaced with the subject of Technology Design (RBT).

C. Teaching Aids

Teaching aids are teaching tools for teachers when teaching. Students will develop an interest in learning if teachers are able to diversify teaching aids within the teaching and learning and make teacher teaching better and thus determine students' memory level (Salsidu, Azman, & Pratama, 2018). This finding is supported by the study of Kristanto, Mustaji, Mariono, Sulistiowati, & Nuryati (2018) who stated that the teaching tools-based teaching method had a positive impact on students' understanding of the concept of food chains in the subject of Science in a primary school. Multimedia integration during the instructional session gives students the opportunity to become aware of teacher teaching and enhance student motivation and students are more likely to understand and remember important information presented by teachers (Ojha, 2016).

D. The Use Of Augmented Reality (AR) In Education

Augmented Reality (AR) has a wide range of functions that can help various sectors such as education, business, advertising, and more. For the education sector, effective and engaging Education through the AR method has greatly impacted students' understanding and understanding. This research aims to develop learning media by leveraging AR application technology to make teaching-learning more interesting. This is because AR can display three-dimensional (3D) objects that can resemble their original shape (Saurina, 2016). The purpose of this AR application technology is to make it easier for people to understand what is difficult to learn in an oral way. The tools developed in this work have had a double impact as they allow teachers to improve their guidance during laboratory sessions and offer interesting teaching aids and motivational tools to students during the learning process (Martín-Gutiérrez, Fabiani, Benesova, Meneses, & Mora, 2015).

E. Comparison Of Existing Learning Tools

The education system in Malaysia has used various types of multimedia learning tools in education across different age ranges. Educational learning tools are popular among kindergarten students to easily learn to learn in the children's environment to draw their attention to the learning sessions. AR application

technology learning tool is a learning tool that has its own advantages along with AR applications. Learning tools such as picture cards are integrated into an interesting card book to make it easier for users to scan the material from the card to the AR image. Table 1 clearly shows the differences between the five types of innovations in existing learning tools with more digital applications of AR applications in 3D. Other tools are still in use but comparing existing tools with AR is far more technologically advanced and innovative

Table 1: Comparison of Existing Learning Tools

Name	Type of Innovation	Visual, Oral & Touch senses	Visual / Digital Imagination
Teaching-Kit	Creativity from the teacher	√	x
FlipBook	Uses offline browsing/internet browsing	x	√
Slide PowerPoint	The visual graphics are stationary/limited	x	x
Virtual Reality (VR)	Covering the real world and the real world	√	√
(Computer-assisted Learning)	Has engagement and feedback	√	x
Kit developed (RekBen Tube AR)	Includes real-world and virtual worlds added 3D element input	√	√

II. METHODOLOGY

Studies using quantitative methods involve quasi-experimental design. To this end, researchers have developed an Augmented Reality (AR) application-based technology learning tool called *RekBen Tube* to see the effectiveness of teaching basic electrical concepts to Electrical and Electronics Engineering students at Seri Iskandar Vocational College, Perak. The research framework for the development process is the ADDIE Model and the TAM Model for developing AR application technology learning tools while the most appropriate experimental process conducted in this study is a quasi-experimental study to determine the effectiveness of the technology learning tool. Accordingly, to collect data, researchers use quantitative methods to obtain data and interviews and observations in support of data for research findings.

A.ADDIE Model

Nine cards provided by the researcher for student use while studying basic concepts of electrical and electronic circuits. The nine cards are a combination of teaching aids packages by subject teachers, such as textbooks, reference books, exam questions examples, slide power points, journals, and circuit learning in the workshop. Researchers analyzed all of these teaching aids to create a card-based learning tool to enable students to flip through each card for scanning through an AR application on their smartphones. Problems may occur because the current learning model/method is no longer relevant to the target needs, learning environment, technology, teaching characteristics, and so on (Sari, 2017). This research selected the ADDIE model for the preparation of developing this AR application learning tool.

B.TAM Model

In addition to the use of the ADDIE Model in AR construction, there is also a TAM (Technology Acceptance Model) as a side model to form the understanding of AR application technology. TAM or Technology Acceptance Model has received the highest level of attention and application among researchers although various theories and approaches have been proposed in the field of information systems (Kalantari & Rauschnabel, 2018). TAM sees the use of any technology as a result of the perception and process of evaluating its use of technology and its ease of use. Recent studies on AR application technologies acknowledge their wide range of features and turn to more advanced technology implementation models, for example, integrated theory and adoption (TRA) theory (Hein, Jodoin, Rauschnabel, & Ivens, 2018).

C.Quasi-Experiment

The design of this quasi-experimental study is used to replace the true experimental design when the selection process of the respondents, random distribution is not possible. An overview of the actual

experimental design is a quasi-experimental study in which the study sample was taken from an intact group (Rubani, Norrahim, Hamzah, Ariffin, & Subramaniam, 2017). This study drew on the pre-test and post-test design of the unbalanced groups of control and treatment groups. This design study is the most commonly used study by researchers to conduct their research. To obtain the objective of the study and the question of data collection by pre-test and post-test, and the questionnaire form while supporting the data to get the results of the study, interview method and observation were done before this study was conducted.

D.Pre-Test And Post-Test

Pre-test and post-test were conducted on a sample of 30 first-year students of Electrical and Electronics Engineering at the Iskandar Vocational College in Perak to see the effectiveness of using AR application technology learning tools to their level of understanding. Pre-test was performed on both groups of control and treatment groups. After three weeks, the researcher conducted a postal test for both groups.

E.Data Collection

Pre-test and post-test designs are used to obtain an analysis of the effectiveness of AR application technology. *T*-test is a statistical analysis method that researchers have chosen to analyze differences in the performance of control groups and treatment groups whether significant or not (Baharudin & Ikhsan, 2016). Evidence from this *t*-test will also influence the findings of the study as to whether it will impact the students' research on it. The statistical test was used in the following cases Piaw (2014) where the sample size contained 10 subjects and above, the sample population distribution was normal and studies were conducted to determine if there were statistically significant differences between the two data sets.

III. RESULTS AND DISCUSSION

Researchers get the materials they need to develop into an application, the researcher builds an Augmented Reality (AR) based application to the basic concept of the desired electric circuit. Here the researcher elaborates a few cards after preparing the entire range of cards that can be scanned by smartphones using the *RekBen Tube* app which can be uploaded into an android smartphone. Figure 1, 2, and 3 are shown the results clarity of the images created after the cards are scanned individually using *RekBen Tube* application technology.



Figure 1. Graphics of Electric Flow Indoor

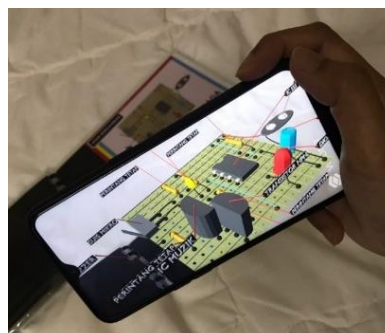


Figure 2. Components of the Schematic Circuit with the Component Name



Figure 3. Nine Image Cards to Scan On Smartphones

Data analysis was performed using *t*-test statistics. The *t*-test is used because the researcher uses the mean score as the basis of the calculation. Statistical Package for Social Science (SPSS) software will be used to analyze the *t*-test. The independent variables were two groups of controls: the control group that did not use the *RekBen Tube* and the treatment group that used the *RekBen Tube*. The dependent variable is the effective use of application technology learning tools for students of Electrical and Electronics Engineering students at Seri Iskandar Vocational College, Perak. A total of 30 respondents were involved in this study which was divided into two strategies for delivering the *RekBen Tube* in a classroom at a Vocational College in Central Perak and Seri Iskandar district was selected for purposive sampling. Table 2 summarizes the details of the sample distribution by the control group and treatment group.

Table 2: Sample Distribution by Difference in Control Group and Treatment Group

Group type	Number of Students	Percentage (%)
Control Group	15	50
Treatment Group	15	50

A.T-test Results

In this analysis, the researcher studied two different groups in the pre-test and post-test where the signatures were seen in the pre-test for the control group (KPr) and pre-test for the treatment group (RPra). The analysis also saw the signatures for the post-test for the control group (KPos) and the post-test for the treatment group (RPos). Table 3 shows the overall comparative analysis of the scores of the two study groups.

Table 3: Comparison of Mean Scores and Significance of Pre-test and Post-test for Both Study Groups

Group	N	Min	
		Pre-Test	Post-Test
Conventional Teaching	15	36.00 (16.28)	55.27 (11.85)
Teaching with <i>RekBen Tube</i> Tool Kits	15	49.27 (18.64)	82.27 (6.92)
Comparison	-	-13.267	-27.000
Significant (p)	30	> 0.093	< 0.000

* KPr / RPra = p > 0.05

KPos / RPos = p < 0.05

In conclusion, this study found that there was a significant change in students' effectiveness on test scores given after using the *RekBen Tube* during the teaching and learning process while there was a slight

change in achievement test scores for teaching and learning who did not use the *RekBen Tube*. Therefore, *RekBen Tube* is successful in impacting student learning.

B.Questionnaire Results

This form is provided after the post-test is completed in both groups of experiments. The control group was given the *RekBen Tube* learning tool before answering the questionnaire as they were experimental groups that did not learn to use this application. After spending time using the application learning tool, the students were asked to fill out the questionnaire form to obtain satisfaction. The statement of the questionnaire form is the same as the pilot test conducted at the beginning of the previous study. The analysis in table 4 and table 5 is the data analyzed in the form which covers the questions in Section A, Part B, and Part C in the form of a scale of choice 1-5.

Table 4: Analysis of Questionnaire Part A (Presentation Design)

No	Presentation Design	Scale				
		1	2	3	4	5
1	This Augmented Reality (AR) design is interesting and appropriate.	0 (0.00)	0 (0.00)	0 (0.00)	8 (26.67)	22 (73.33)
2	The app uses clear, easy-to-view pictures.	0 (0.00)	0 (0.00)	0 (0.00)	4 (13.33)	26 (86.67)
3	The graphics used help learning.	0 (0.00)	0 (0.00)	0 (0.00)	7 (23.33)	23 (76.67)
4	The colors used in the video are appropriate and effective for attracting users.	0 (0.00)	0 (0.00)	1 (3.33)	9 (30.00)	20 (66.67)
5	The imagery used is appropriate and does not interfere with the user's focus on learning.	0 (0.00)	0 (0.00)	1 (3.33)	12 (40.00)	17 (56.67)

*n = 30 * (Scale: 5 = Strongly Agree; 4 = Agree; 3 = Strongly Agree; 2 = Disagree; 1 = Strongly Disagree)*

Table 5: Analysis of Questionnaire Part B (Design Understanding)

No	Design Understanding	Scale				
		1	2	3	4	5
1	This app is easy to interact with me.	0 (0.00)	0 (0.00)	0 (0.00)	13 (43.33)	17 (56.67)
2	This app is easy to understand with its contents.	0 (0.00)	0 (0.00)	0 (0.00)	7 (23.33)	23 (76.67)
3	Content delivery is ideal for learning.	0 (0.00)	0 (0.00)	0 (0.00)	10 (33.33)	20 (66.67)
4	This application helped me to understand the concept better by using animations than static models.	0 (0.00)	0 (0.00)	0 (0.00)	8 (26.67)	22 (73.33)
5	This app is able to encourage users to access it	0 (0.00)	0 (0.00)	0 (0.00)	15 (50.00)	15 (50.00)

*n = 30 * (Scale: 5 = Strongly Agree; 4 = Agree; 3 = Strongly Agree; 2 = Disagree; 1 = Strongly Disagree)*

Analysis of the questionnaire form after completing the experiments on both groups found that there was a positive effect on the effectiveness of *RekBen Tube* usage. This result is more positive because students

choose the 'strongly agree' option higher than the 'agree' option on a Likert scale. This shows that students were impressed with *RekBen Tube* in their three-week study in electrical workshops.

IV. CONCLUSION

After performing the analysis using the Paired-T Test method to compare achievements, there is an advantage for Electrical and Electronic Engineering students who use *RekBen Tube* application technology learning tools with students who do not use this application. This can be proven after a significant increase of $p = 0.000$. In order to produce highly qualified educators with a more systematic level of competence (Sulaiman & Wan Ahmad, 2018), information technology such as the diversification of teaching aids has been one of the ways of contributing to and supporting the ministry's efforts in maintaining a quality education system. The researchers hope that this kind of learning tool will have a place in educational institutions and will accelerate the use of Augmented Reality (AR) application technology in Malaysia in all fields.

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