A MODEL OF MOBILE LEARNING OBJECT DESIGN FOR CONCEPT COMPREHENSION USING RECIPROCAL TEACHING STRATEGIES AND AUGMENTED REALITY

Dayang Noorasura, A. T.
Research Assistant,
Faculty of Information and Communication Technology
Universiti Teknikal Malaysia Melaka
d.nasura@gmail.com

Sazilah S.
Project Leader, Associate Professor,
Faculty of Information and Communication Technology
Universiti Teknikal Malaysia Melaka
sazilah@utem.edu.my

***Abstract*— This paper describes an on-going research project, in which we implement Reciprocal Teaching strategy to help undergraduate engineering students on comprehending the concept of basic circuit instruments. We examined 55 students who enrolled for electronic instrumentation subject containing models designed to teach concept of D'Arsonval principle, basic component of a meter, measuring circuit resistance and circuit component arrangement. We did a preliminary analysis by carrying out a survey on students' understanding level about the subject and class observation on their learning progress. We found that students have difficulties in concept comprehension for the subject particularly in visualizing the circuit component. Therefore, we propose a mobile learning that uses Reciprocal Teaching strategy with augmented reality visualization. The development of mobile learning with augmented reality (MLAR) is provided as a learning aid tool that helps students to achieve the learning outcome for the subject.**

Keywords-reciprocal teaching; mobile learning; augmented reality; concept comprehension.

I. INTRODUCTION

Some students have difficulties in accommodating complex concept visualization to their way of understanding. This derived as a challenge to instructor where he/she have to try new ways of representing the concept to make it cognitively beneficial to the student. The research literature shows that this is a significant issue for teaching and learning in higher education.

Traditionally, during classroom teaching and learning process, instructor attempts to address circuit component in 2D form in PowerPoint slide and books illustration. Student performance statistic given by instructor shows students have problem in conceptions regarding principle applied in meter, circuit component arrangement and measurement the current and resistance in a circuit. The pedagogical challenge exists in forms where students and instructor inaccurately describing their understanding of basic electronic instrumentation and cause a confusing when it comes to marking exam or project paper.

This research examines the advantages of using Reciprocal Teaching strategies for improving students' concept comprehension by viewing and manipulating the circuit component through 3D objects in their mobile phone. There are two hypotheses that we want to prove: (1) Mobile learning with Reciprocal Teaching strategies applied, changes the way students come to understand certain concepts and component, (2) The uses of augmented reality in mobile learning gives better experience to students' visualization and manipulation of the circuit component.

The analysis of this research includes an examination of 3D object manipulation in mobile learning. While quantitative analysis takes part in pre- and post-assessment which allow us to measure students' performance for each learning outcome. The findings demonstrate the potential benefit of reciprocal teaching strategies in mobile learning with augmented reality (MLAR) in education and training.

II. CASE STUDY : AC AND DC METER

At Universiti Teknikal Malaysia Melaka (UTeM), our educational goal is to conduct academic and professional programmes based on the relevant needs of the industries. Undergraduates must possess the ability to analyze and design the required electronic circuits through course foundation, thus being the first choice by the industry.

The problem for student and instructor is to represent the model of circuit component accurately. Part of curriculum deals with learning outcome are to understand D'Arsonval Principle, basic component of a meter, AC and DC meter, calculating circuit resistance, arrangement of component for optimum performance, and understand each component functions. A poor understanding of these learning outcomes may cause in accurate understanding or difficulties when encountering more complex circuit and concept in circuit instrumentation course. Some instructor has attempts to use symbol of component that readily available in the course module for explaining component arrangement. Instructors are assuming the students will understand the metaphor. However, students still struggle with bringing these circuit arrangements with the real device arrangement for their lab project and most of the time the students cannot visualize the real circuit component based on the circuit symbol.

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III. METHOD

We investigate each of Reciprocal Teaching strategy to improve student performance for 55 students that enrolled in electronic instrumentation (BENP2183) during semester 1 session July-December 2010. The mobile learning is design and develops for applying Reciprocal Teaching strategies as a tool to improve concept comprehensions. Development Methodology used is Rapid Prototyping. The prototype using Adobe Flash CS5 platform as basic architecture combine with Papervision3D as augmentation 3D model engine. Platform testing is Nokia mobile phone with software S60 3rd edition and above.

IV. MOBILE LEARNING OBJECT DESIGN

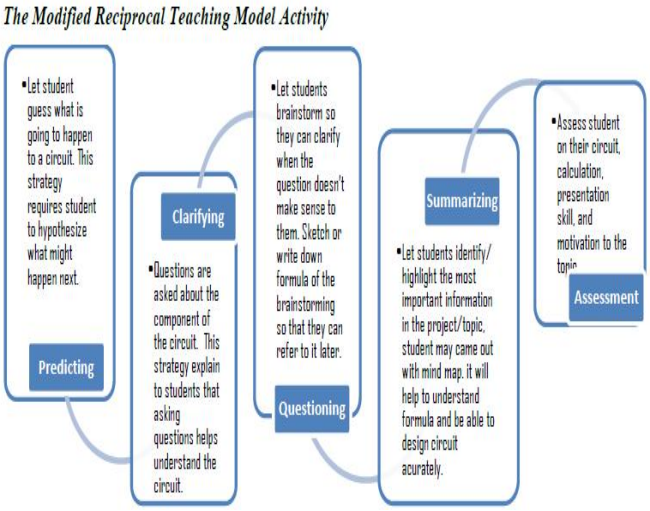


FIGURE 1: THE MODIFIED RECIPROCAL TEACHING MODEL SHOWING ACTIVITIES DURING THE TREATMENT PHASE.

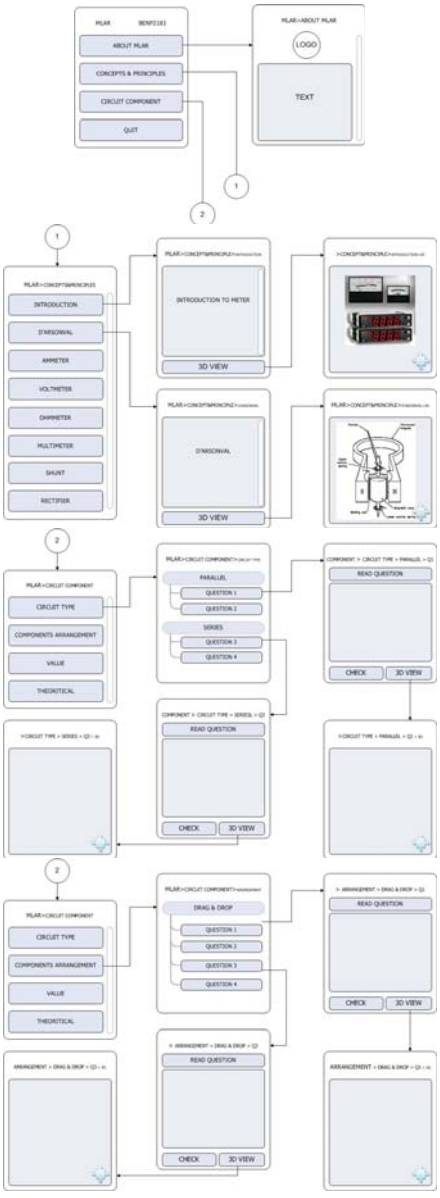
Figure 1 shows the modified Reciprocal Teaching model that we applied in the design of the mobile learning object. Each activity explains the role and tasks of students and instructors during the treatment phase.

TABLE 1: AREAS OF APPLYING RT STRATEGIES IN MLAR

Strategy	*Definition of activity*	*Suggested activity in MLAR*	*MLAR area*
Predict-ing	Hypothesize using the information given in the notes.	Look for the text and visual object in the notes to get ideas on what we reading about.	Notes area (Section1)
Summa-rizing	Identify and condense the most important points in the notes.	What is important to be remembered?	Notes area (Section1)
Questio n-ing	Generate appropriate question about the notes.	What the concept that have not fully comprehend or unsure about? Is there any unfamiliar word?	Circuit area (Section2)
Clarify-ing	Identify what makes a concept/visual difficult and seek an understanding of that difficult concept.	What other word/concept needs for further clarification and better understanding?	Circuit area (Section2)

In the notes area, students will need to perform describing, explaining and listing of information. In the circuit area, student will have to perform circuit calculation and designing. In circuit area student will have to perform activity regarding circuit calculation, component arrangement in circuit (drag and drop), fill in the blank and AR simulation of complete circuit. This activity will help students to perform RT strategies for Questioning and Clarifying. In term of AR simulation, it helps to provide student with visualization and interaction with the circuit.

The flow of design for the first section in this mobile learning is same from the menu item introduction, D'Arsonval followed until Rectifier. As for the second section, circuit type will ask for student comprehension regard the subject outcome from basic circuit component, circuit type, calculation and component arrangement.



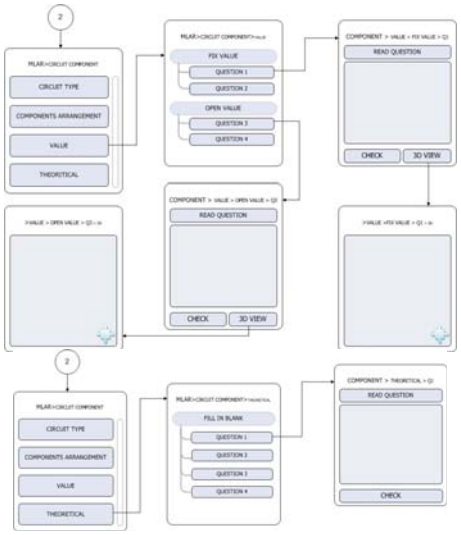


FIGURE 2:INTERACTIVE STORYBOARD FOR MOBILE LEARNING OBJECT DESIGN WITH AR

A. *Pre-assessment and preliminary analysis*

The preliminary analysis starts with gathering student academic achievement from the faculty as trends comparison to be analyzed according to survey being done with the students. The research starts with gathering student academic performance statistic from the faculty to be analyze according to survey being done with the students. Most of the students were having difficulty in comprehending of circuit principle and circuit component, includes of describing principle, explaining function, confuse of formula need to be used in circuit calculation, and perform simple errors in reading and converting meter measurement.

Pre-assessment that has been conducted on 50 FKEKK Semester 2 students with open-ended test regarding the subject outcome. The assessment consists of 5 questions. Each question measures each learning outcome outlined for the subject. The total mark for the assessment is 20, the instructor specifies that a student who get 9/20 or below is having difficulty in the subject.

Analysis of the results shows that 70.8% of them were having difficulty in comprehending of circuit principle and circuit component, including ability of describing principle, explaining function, confuse of formula need to be used in circuit calculation, and perform simple errors in reading and converting meter measurement and come to conclusion that students have inconsistence performance in test, quizzes and exams.

Therefore, the research hopes that with the implementation of Reciprocal Teaching strategy in the mobile learning application is hoped to improve the percentage of student get above 9% marks in the post assessment into above 90%.

V. RESEARCH PROCEDURE

Figure 3 shows our research procedure conducted for testing the research hypotheses. The experimental design is based on Solomon 4Group Design & Threat to Internal Validity to ensure that the cause and effect relationship is highly valid.

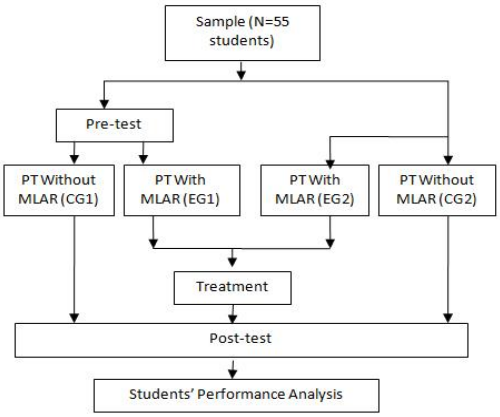


FIGURE 3:RESEARCH PROCEDURE IN TESTING THE HYPOTHESES

VI. PROJECT SIGNIFICANCE

This research is beneficial to students and the faculty. The prototype will assist students during their Self-paced Learning time and help student to have an Active learning. The research outcome helps to provide better visualization of circuit and component as well as concept comprehension. As for the Faculty, this research let to improve the quality of learning process and could be embedded as a learning object in the university Learning Management System. This research would add-up value to self-learning.

VII. LESSONS LEARNED & FUTURE WORK

Other aspects of mobile phone learning object design development can be significantly different from larger platforms. Take note of low memory footprint and memory bandwidth are essential requirements for embedded development. Consequently, features such as dynamic linking and interactivity between user and the object itself can be problematic. Moreover, many embedded devices can only perform fixed point computations, and have no or only very limited parallel execution. All code must be developed to meet these constraints and still perform efficiently. This means that not only the coding style but also the choice of algorithms can differ very much from conventional practices.

Overall, in future we hope there is more open source API's that is available for lower specification of mobile phones so that students can afford it.

VIII. ACKNOWLEDGMENT

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