INVESTIGATION OF STUDENTS' LEARNING DYNAMICS IN AN AUGMENTED REALITY ENVIRONMENT TO SUPPORT INDIVIDUALISATION, COLLABORATION AND CREATIVITY

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This Report contains of two parts:

Part 1 is research on Development Of A Mobile Learning Object Design For Concept Comprehension Using Modified Reciprocal Teaching Strategies.

Part 2 is Research On A Study Of Consequences On Individual And Group Performances Using Visualisation Features For Cooperative Learning

PART 1

ABSTRACT

Concept comprehension is a necessary skill today. It is the process of understanding and extracting the required information from any medium of information. This research is aiming to model a learning object design using Reciprocal Teaching strategy in order to utilizes student ability to actively engage in reading or absorbing information. In the Reciprocal Teaching (RT) method, there are 4 main strategies applied in order to improve concept comprehension, those are (i)Predicting, (ii)Summarizing, (iii)Questioning, and (iv)Clarifying. This research proposed on additional strategy to modifiy RT that is the fifth strategy called (v)visualizing. Visualization plays an important role in understanding abstract and complex concepts and its refer to the usage of animation and 3D model. This research also aims to determine whether the use of 3D visualization (include animation and 3D model) combined with text, contributes to semester 1 students learning process. In the preliminary analysis, we implement traditional Reciprocal Teaching method to teach 55 undergraduate engineering students on comprehending the concept of basic circuit instruments including the concept of D'Arsonval principle, basic construction of a meter, measuring circuit resistance and circuit component arrangement. During the pre assessment result, we found that students have difficulties in concept comprehension for the subject especialy in visualizing the circuit component. Therefore, we propose a mobile learning application that uses modified Reciprocal Teaching method provided as a learning aid tool for assisting student in visualizing the concept. The development methodology used is Courseware Development Process. Instrument used to assess student performance is The four levels of Kirkpatrick's evaluation model, it is used to measure (i)Reaction of student, (ii)Learning capability, and (iii) Results performance. The results indicate that multimedia applications with interactive mobile learning application as well as with 3D and animations do in fact increase the interest of students and make the application more appealing to them during self-paced learning time. The findings also suggest that the most obvious and essential benefit of visualizations (3D illustrations) is that they leave the time control of learning to the students and decrease the cognitive load.

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1.1 Introduction

A learning approach in overall can be divided into Teacher-centered Learning (TCL) and Student-centered Learning (SCL). SCL is an approach of learning characterized by students' abilities to direct process and outcomes. It is where an education are the center for students, while its environment facilitates the exploration of meaning and content knowledge through personal and interpersonal discovery. The learning process of SCL implies an active involvement by the student and the integration of academics with the student's total development.

National Capital Language Resource Centered (NCLRC, 2010), state that SCL education places the student at the center of education, while its environment facilitates the exploration of meaning and content knowledge through personal and interpersonal discovery. Table 1 shows the comparison between TCL and SCL characteristic that would assist to elaborate the types of learning environment will be used together with mobile learning.

Table 1.1: Teacher vs. Learner-Centered Instruction (NCLR Centered website, 2010)

Teacher-Centered	Learner-Centered
Focus is on instructor	Focus is on both students and instructor
Focus is on language forms and structures (what the instructor knows about the language)	Focus is on language use in typical situations (how students will use the language)
Instructor talks; students listen	Instructor models; students interact with instructor and one another
Students work alone	Students work in pairs, in groups, or alone depending on the purpose of the activity
Instructor monitors and corrects every student utterance	Students talk without constant instructor monitoring; instructor provides feedback/correction when questions arise
Instructor answers students' questions about language	Students answer each other's questions, using instructor as an information resource
Instructor chooses topics	Students have some choice of topics
Instructor evaluates student learning	Students evaluate their own learning; instructor also evaluates

Based on Table 1.1, by applying SCL will outcomes skill mastery, long-term retention, or depth of understanding of course material, acquisition of critical thinking or creative problem-solving skills, formation of positive attitudes toward the subject being taught, or level of confidence in knowledge or skills.

Maryellen Weimer offers good definitions of the two terms in her book *Learner-Centered Teaching: Five Key Changes to Practice*. Weimer explains that in order to be learner-centered, instructional practice needs to change in five key areas. Those are the balance of power, the function of content, the role of the teacher, the responsibility for learning, and the purpose and processes of evaluation (Weimer, 2002). Since the focus in education today has been shifted from the teachers to the students, the idea of having SCL is to help student taking responsibility for their own education and learning by doing and working with others, they will be able to learn skills that will stay with them for the rest of their lives.

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PT is one of several learning method listed under SCL category. PT method is a part of learner-centered orientations which may be consistent if have better support and flexibility for managing the learning situation by lecturer, especially in a small interactive pair/group for example, a college or university.

This research study is intended to identify Reciprocal Teaching (RT) strategy under PT method that can be implemented at higher education level, especially in university, as a tool to support concept comprehension for a subject.

1.2 Project Background

UTeM has placed its general educational goals as to conduct academic and professional programmes based on relevant needs of the industries. The industries are using more electronic systems in machine and process control as well as automatic manufacturing. Among the main application of electronic systems in the factories are robot control system, electrical machine drives and PLC (Programmable Logic Controller).

Therefore, UteM focused to produce university graduates that possess the ability to analyze and design the required electronic circuits. They must also possess the practical skills in industrial control system, thus being the first choice by industry.

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For this reason, Reciprocal Teaching (RT) strategy will be investigate and analyse to produce a mobile learning object design (mLO design) for industrial electronic course to assist students in becoming professional engineers that are skilful and possess strong fundamental knowledge in industrial electronic engineering through the uses of mobile learning application.

Research approach begins with understanding each of RT strategy through literature review. This research aim is to design and develop a Mobile Learning application with RT strategy. The module is specifically targeted to be implemented as a tool to assist learning for BENP2183 subject.

BENP2183 (Introduction to Electronic Instrumentation) chapter 2 content was selected for the application module based on lecturers comment in meeting held between research team and the lecturers. During the meeting, lecturer of the subject describe that their student have difficulty to comprehend the principle in circuit instrumentation.

From the lecturer experiences, she found that, it is because of the student were lack of references during the subject material especially when the resources they have are limited to textbook and lecture notes.

Therefore, she would like to have an application for helping student with comprehension difficulties in order to learn basic circuit design. The intended mobile application must be able to support student interactivity and learning dynamic.

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The strategy or technique to be used must be able to help students become self-regulated readers and learners. In order to attain this goal, Lecturer or instructor must help students become knowledgeable about strategies and why the information is important for them to use. Each of components in the strategy is responsible on building student basic understanding about the subject taken.

1.3 Problem Statement

An observation on students result for semester 1/2010 on students that enrolled *Introduction to Electronic Instrumentation* subject has been conducted to see the trend of student achievement in this subject. Result for each test, quizzes, mid-term examination and final examination were recorded for comparison.

According to the observation, it was found that students are facing problem in understanding the topic principle, components function and formulation, thus gives them difficulty to achieve the objective of subject learning outcome.

Another difficulty faced by the students when designing the circuit is lack of attractive references or assisting tool. Students have limited resource of reference and experimentation of designing the circuit and exercising to apply the concept principle.

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So there is a requirement to have an application that could assist students in comprehending concept on theoretical and practical way, using an Augmented Reality technology as visualization technique.

Hence, this project focuses on developing a mobile application as a tool to assist student in understanding the concept principles and help to give clear visualization of how the circuit arrangement and calculation need to be done.

1.4   Research Question

There are several important questions that need to be explored and answered throughout this research. Those are:

i.   What step or process in Reciprocal Teaching strategy that can be used to assist students in improving concept comprehension for *AC and DC Meter* topic?

ii.   How to design a learning object design using those step or process for a mobile learning application?

iii.   How effective RT to assist student in improving their concept comprehension through a mobile learning application?

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1.5   Research Objectives

There are three objectives to answer the research questions and at the same time to achieve research objectives in this research, those are:

i.   To investigate the characteristic or steps of Reciprocal Teaching strategy to be implemented in a mobile learning environment.

ii. To design a concept comprehension module and develop a prototype for applying Reciprocal Teaching method.

iii. To measure the effectiveness of reciprocal teaching strategy in a mobile application.

1.6   Research Hypothesis

i.   The used of RT strategy in a mobile learning application will assist students to perform a significant improvement in concept comprehension.

ii. The used of Reciprocal Teaching strategy in a limited location such as PC platform will lead to a marginal improvement in student performance for concept comprehension.

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1.7 Research Expected Output

RO1: The step or process or characteristic of Reciprocal Teaching strategy is described to know how its helps and how it can be done in a mobile learning environment.

RO2: A learning design, storyboard, interface design and flows of application is developed for a Reciprocal Teaching module.

RO3: A Difference in student performance for implementing Reciprocal Teaching strategy is differ between in a mobile learning environment and PC platform.

1.8 Scope

Here are the list subject covered, platform of development and implementation, sample selection and limitation of this project.

Subject covered

i. ONLY Chapter 2 AC and DC Meter from BENP2183 syllabus.
ii. This chapter will be designed for concept comprehension in RT way.
iii. Concept comprehension will have to cover on principles, component function and theoretical contents.

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Platform covered

i. Development platform is using Personal Computer and a Notebook

ii. Device testing for development is Nokia Express Music model 5800 and Symbian S60 latest than 3rd edition based smart phone.

iii. Testing platform for the control group is Personal Computer. PC that installed in the tutorial lab.

Sample Selection

i. Participant is selected from student that enrolled BENP2183.

ii. 50 students as sample population.

iii. 5 students as pilot testing sample.

iv. Total of 55 students were participated.

v. Studnets are divided into control groupd and experimental group.

Limitation:

The following limitations to the investigation are noted:

i. Only those students that registered for the subject will participate in the study. This may adversely affect the composition of the sample population.

ii. The project duration will directly affecting the treatment duration. This is because the syllabus not to burden student with additional task/take home assignment.

1.9   Project Significant

The implementation of RT strategy in mobile learning application will encourages students to actively participate in learning process. RT is used to increase student understanding of topic learned by improving visualization of circuit design using 3D object views. It is motivates students by strategies offered in RT such as predicting, questioning, clarifying and summarizing.

The development of this project is stressed on learning object design with the used of multimedia elements such as image, text, audio, video, interaction and visualization of 3D object through AR manipulation. AR is a new visualization technique that help student to figure out the component design in various contextual elements. AR in this application is just an additional features to support concept comprehension through RT strategy.

In the other perspective, student can have this application with them at anytime and anywhere as their reference while performing basic circuit design using given component. Therefore, student will also be able to use this application on their self-pace learning time for preparation on their exam or future benefit. This application also can be embedded in UTeM learning management system for further application.

Overall for UTeM as an innovative institution, this research finding can be applied suitable engineering subject that may require visualization of design or component. It can help student to master the subtopic and will lead to increase of student performance in their academic result.

1.10 Research Methodology

The proposed research methodology for the whole research is starts with preliminary analysis that will come out with literature review and framework of research, followed by treatment, data, analysis and documentation.
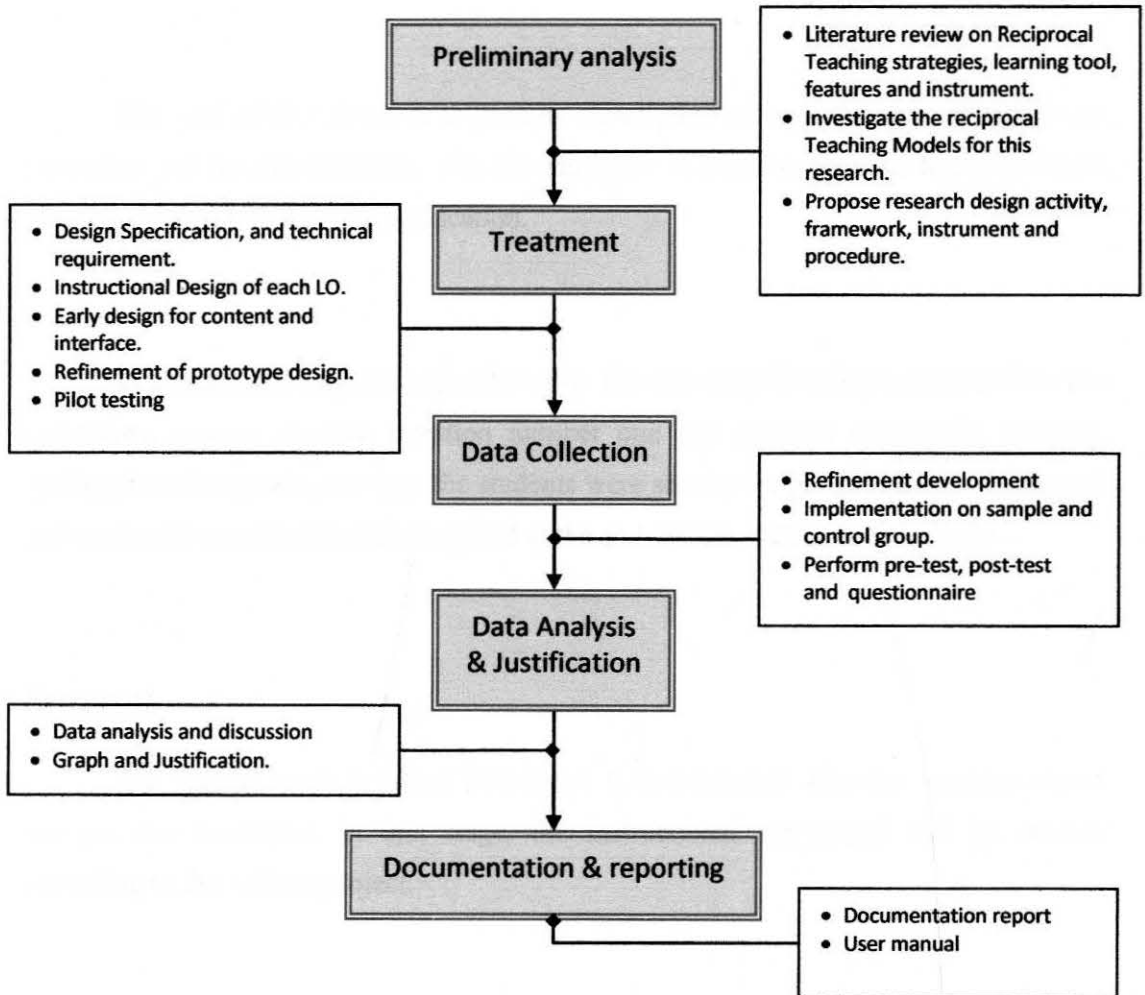

Figure 1.1 : Research Methodology

Preliminary Analysis

In first stage is Preliminary Analysis, investigations will be done to identify how Reciprocal Teaching strategies help students to improve their reading comprehension. This phase is gathering information from literature reviews of previous researches and published material.

The goal of this phase is to produce description of each strategy in Reciprocal Teaching and its characteristic. The characteristic is used to propose learning object designs for a mobile learning application.

In general, the information collected in the first stage is being used to refines the objectives, answer research question number one and produce hypothesis. Besides, during preliminary analysis step, the students were seating for pre-test questionnaire and the result will be recorded and compared at the end of data collection stage later.

Treatment

The second stage is called Treatment. It is conducted after the learning object designs are developed. In this stage, the instructional storyboard will be created according to the learning object.

The learning objects have to meet the chapter's learning outcome. The prototype were developed using rapid prototyping development methodology. The prototype will have some refinement before being tested to pilot group. The outcome from pilot group will help to prepare the framework and setting for data collection stage.

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Data Collection

The third stage is called Data Collection stage. This stage is responsible for conducting the implementation of prototype into sample environment for a period. Participants will be given with a copy of the mobile application to test it within allocated time and at the end of the period, they need to seat for post test.

The result in post test will be compared to pre test result in preliminary analysis to prove whether the reciprocal teaching strategy improving their concept comprehension or not. At the end of this phase, it will produce a graph to show how much students improves on their achievement.

Data Analysis

In the final stage is Data Analysis, data collected through the third stage will be analysed using the independent samples test procedure to evaluate the significant differences between the variables.

Besides, the difference of pre-test result and post test result will be analysed. The performance of the experimental groups is to be measured and compared against the controlled groups. The both group result for both test is presented using chart and justification of any moderator influencing the outcome.

Milestone

In order to keep track the project development, the project has come out with list of milestone for periodic outcome. Here is the milestone for this project:

Table 1.2 : MLAR Development Milestone

No.	Outcome	Deliverable	Notes.
	SCHEDULE OF MLAR DELIVERY		
	Phase 1		
1	Reciprocal teaching strategy **Start 11/1/2010** **End 11/4/2010**	1. Description of each strategy 2. Characteristic of each strategy 3. Example of application for each of strategy 4. Literature review on learning using reciprocal teaching	Examples of reciprocal teaching implementation notes.
	Phase 2		
2	Content (BENE1183) analysis of MLAR. **Start 24/6/10** **End 30/6/10** **Meeting on 25/6/10** **& 02/7/10**	1. Comparison table on existing model / interaction design for collaborative AR apps 2. List of LO. 3. Data Collection procedure & instruments to assess each LO. 4. Propose model for reciprocal and team learning for implementation.	1. Design *interaction* for covered content in MLAR. Data collection procedure of implementation 2. LO list for chapter 2 *AC and DC meter*. 3. Date of implementation, procedure of implementation for these LOs, Instruments to assess each LO. 4. Features and model comparison on existing AR apps or collaborative model need to be done in a table.

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