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DEVELOPING AND EVALUATING
INTERACTIVE LECTURE DEMONSTRATION MANUAL

GLORY SAMICKANOO

DISSERTATION SUBMITTED IN FULFILLMENT OF THE
REQUIREMENT FOR THE DEGREE OF MASTER OF EDUCATION PHYSICS
(MASTER BY MIXED MODE)

FACULTY OF SCIENCE AND MATHEMATICS
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DECLARATION

With this I, GLORY SAMICKANOO, metric No M20081000051 declare that this dissertation is the result of my own research writing.

All reference and quotation in this dissertation have been given due acknowledgement**.**

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06.06.2014

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DEDICATION

This work is dedicated to the memory of my late father and mother, Mr.I.Samickanoo and Mrs.Poonamal Yesudial Samickanoo. They taught me to read and write before I stepped foot in school and they continued to encourage me to be a lifelong learner. Without their encouragement and support, I would not have come this far. Even though they are not here by my side now, but their blessings are always with me and has helped me to finish my work. I love you both.

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I would like to thank my family and friends for their love and support over this period of time. My family has been my greatest support and I would not have made it this far without them.

Last but not least, I would like to thank God for being with me and enabling me to finish this dissertation. All glory to Him.

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ABSTRACT

This research aims to develop and evaluate an instructional manual for Interactive Lecture Demonstration using PASCO DataStudio.The manual developed is based on the ASSURE model and is evaluated in terms of its content, objectives, presentation and design. Other aspects include its suitability as an instructor's reference and the setting and running of the demonstration. The manual was validated by two experts in the field of Physics who have prior experience using PASCO DataStudio. Using the survey method, the revised manual was evaluated by a group of 20 Physics teachers in the Ipoh area. They were selected through purposive sampling method where zero exposure to PASCO DataStudio was one of the selection criteria. Results show that both experts gave a positive evaluation on almost all aspects of the manual with a percentage agreement of 100% except for the aspect of setting and running of the demonstration, whereas the teachers gave a positive evaluation on all aspects of the manual with a percentage agreement of between 70 and 80%. This suggests that the manual has face and content validity and useful as an instructors' reference manual about an Interactive Lecture Demonstration. However it is slightly lacking in terms of enabling instructors to set up and run the demonstration.

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MEMBINA DAN MENILAI MANUAL PENGAJARAN DEMONSTRASI KULIAH INTERAKTIF

ABSTRAK

Kajian ini bertujuan membina dan menilai manual pengajaran bagi kaedah Demonstrasi Kuliah Interaktif yang menggunakan PASCO DataStudio. Pembinaan manual adalah berdasarkan model ASSURE dan dinilai dari segi isi kandungan, objektif, rekabentuk dan persembahan. Di samping itu aspek lain yang dinilai termasuk kesesuaian manual sebagai sumber rujukan pengajar, dan dalam menyedia dan menjalankan demonstrasi. Kesahan Manual ditentukan oleh dua pakar dalam bidang Fizik yang mempunyai pengalaman menggunakan PASCO DataStudio. Manual yang telah dimurnikan diuji menggunakan kaedah tinjauan keatas 20 orang guru Fizik di sekitar kawasan Ipoh. Mereka dipilih melalui pensampelan bertujuan di mana satu daripada kriteria pemilihan ialah tiada pendedahan kepada PASCO DataStudio. Penilaian pakar adalah positif bagi semua aspek manual dengan peratus persetujuan 100%, kecuali dalam aspek menyedia dan menjalankan demonstrasi manakala penilaian guru adalah positif dengan peratus persetujuan antara 70% - 80% bagi semua aspek manual. Dapatan ini menunjukkan bahawa manual ini mempunyai kesahan muka dan kandungan serta berguna sebagai bahan rujukan pengajar tentang Demonstrasi Kuliah Interaktif. Namun terdapat sedikit kekurangan dari segi membolehkan pengajar menyedia dan menjalankan demonstrasi.

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CHAPTER 6 CONCLUSION

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter gives general opinion about the background of the research, problem statement, research objectives, research questions, significance of the research definition of terminology and the limitation of the research.

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1.2 Background of the Research

With the growth of technology and increasing complexity of that technology, there is a great demand for technically skilled people. If we want to increase the number of scientifically literate and technologically proficient people, we must ensure that lecturer is using the most effective methodologies available for their education.

Physics courses have been traditionally taught throughout one whole lecture. These lectures are usually based on textbooks that dictate the curriculum. Physics Education Research (PER) has shown the ineffectiveness of traditional instructional methods in Physics Education. The traditional methods have resulted a poor conceptual understanding on the part of introductory physics students (Halloun & Hestenes, 1985b; McDermott, 1991; Thornton, 1996). There are developments of a number of nontraditional lectures in the field of physics education such as *Workshop Physics* (Laws, 1997), *Tools for Scientific Thinking* (Thornton & Sokoloff, 1990), and *RealTime Physics* (Sokoloff, Thornton, and Laws, 1998) which are all activity-based curricula that stress students' conceptual understanding and scientific reasoning. A survey of student's performance in both traditional courses and active-engagement courses (Hake, 1998) indicate that proper implementation of these research-based, interactive engagement strategies can improve the effectiveness of introductory mechanics courses.

If we are to improve students' conceptual understanding in introductory physics courses, we must not only focus on the importance of the material that we are presenting but also on the way, we present it to the students.

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Redish (1993) proposes that we should ask the following questions in judging the value of any innovation in physics education:

(a) What are the detailed goals of our students?

(b) What is the state of our students' knowledge and expectations of learning when they begin?

(c) What can we do to help students change the state of their knowledge?

A majority of the research done show that the initial knowledge state of many introductory physics students includes some misconceptions. Compounding this problem is the fact that traditional instructional techniques are ineffective at overcoming these common sense beliefs.

In 2003, Malaysian government devoted a substantial portion of their budget for computer and technology in education. The government spent RM400mil to purchase the equipment for education. This is an effort to transform teaching and learning by equipping education with high technology equipment such as Computer and LCD. With this large investment in computer and technology we must dedicate serious efforts to determine how to use these resources effectively.

According to the Oxford dictionary, technology is the application of scientific knowledge for practical purposes. The use of technology such as the commercially available and affordable equipment itself would not change the education, what is

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important is how it is used. Most of the conventional methods of lecturing make use of computer technology. The use of technology and the possibilities it offers for learning is an important area of research. However, the computer is not the focal point of education. The technology of computer is only one of many tools used to make lecturing more effective.

In the world of technology, computer hardware and software have come in the form of interface and sensors. They have been developed for the use in the science laboratory. Microcomputer-based laboratories (MBL) 1989 use computer to incorporate active engagement learning. The research by Thornton & Sololoff 1990 shows MBL to be successful in overcoming misconception and promoting conceptual understanding.

However, not all universities have the resources to provide this specialized equipment for each of their science laboratories. The question remains, are there any other activities that can be equally effective in improving students' understanding fundamental concepts? Here in the physics department of Universiti Pendidikan Sultan Idris, set up in 1997, academicians have been searching and experimenting various ways to help students understand physics better and thus increase the students' performance in the university's standard assessment exercise at the end of each semester. Students understand physics better when they are actively involved in the process of learning. However, in general at tertiary education level, getting students in a large-enrolment class with a fixed seating to participate actively is a challenge. In addition, introductory

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physics courses have been structured in a way that so much content is expected to be covered in a short period of time. Fourteen topics are scheduled to be covered in one semester for the introductory physics course within fourteen weeks.

Educators' use of the term "active learning" has relied more on intuitive understanding than a common definition. Consequently, many academics assert that all learning is inherently active and that students are therefore actively involved while listening to formal presentations in the classroom. Eric in the Educational Resource information Center analysis of the research literature “Seven Principles for Good Practice” (Chickering and Gamson 1987), however, suggests that students must do more than just listen: They must read, write, discuss, or be engaged in solving problems. Most importantly, to be actively involved, students must engage in such higher-order thinking tasks as analysis, synthesis, and evaluation. Within this context, it is proposed that strategies promoting active learning be defined as instructional activities involving students in doing things and thinking about what they are doing.

One way to do this is by integrating Interactive Lecture Demonstration (ILD). Interactive Lecture Demonstration was developed by David R.Sokoloff and Ronald K.Thornton in 1991 at University of Oregon. ILD is designed to engage students in the learning process and convert the passive lecture environment to a more active one. In this research, the researcher develops a manual to carry out an active learning using ILD.

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1.3 Problem Statement

The current lecture experience in the introductory physics courses at Universiti Pendidikan Sultan Idris (UPSI) and almost all other public universities in Malaysia are based on the traditional, one-way learning pedagogical model where the students are passive recipients of science knowledge and the lecturer functions as the provider of knowledge (Nurulhuda Abd.Rahman et al., 2007). While this approach provides an efficient way to teach a large number of students, it allows minimal creativity and critical thinking on the part of the students. It has also been shown by numerous researches that traditional lecture setting does little to promote deep conceptual understanding of physics fundamentals (Nurulhuda Abd.Rahman et al., 2007).

Recent research on UPSI's student teachers' state of physics conceptual understanding (Nurulhuda Abd. Rahman et al., 2007) shows a lack of deep understanding about basic concept of Newtonian Mechanics and the presence of several common misconceptions. The study investigated students' learning against lecturers' teaching styles, students' academic performance (CGPA result) and gender and found that all four lecturers involved in the teaching of mechanics have a traditionalist tendency of teaching style and that there was an insignificant learning gain after students have gone through mechanics courses for a semester. In other words, the current teaching practices do little in terms of promoting deep understanding and overcoming misconceptions of force and motion among the students. One possible way to make a

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lecture more interacting is through an Interactive Lecture Demonstration (ILD). ILD has been shown to promote deeper understanding of physics fundamentals, better problem solving skills and attitudes towards physics teaching (Thornton, 2003). It is based on innovative best practices emerging in education and technology.

However, not everyone who has tried to implement ILD has been so successful. Both Ian McFarland and Michael Wittmann have given report on American Association of Physics Teachers (AAPT) conference presentation in which they reported less than satisfactory learning gains associated with ILD used (Timothy French,2002). This is in contrary to Sokoloff's successful invention and studies suggesting a problem in the way ILD is used. I would like to identify these issues and address the problems since I firmly believe ILD will be a great tool for teaching Physics.

The main issue identified is some instructors struggle to implement ILD as effectively as the others. This could largely be due to the way in which the instructor delivers the demonstration. Therefore, I am very keen to develop ILD Manual for effective Physics teaching.

Technology used in instruction itself would not change education; what matters is how it is used. ILD the active engagement approach teaching utilize a combination of experiential evidence, obtained through hands-on activities, and interactive discussions that allows students to confront their misconception. To obtain a good

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hands-on activity requires a guide. The manual will be the guide for lecturers to develop active engagement of ILD. In this research, the researcher developed ILD Manuals based on the following topics Force and Motion which are Bouncing Ball, Free Fall Ball and Impulse using Microcomputer-based Laboratories, MBL equipment. This research will focus on development and the validation of the Manual.

1.4 Research Objectives

This study embarks on the following objectives:

1. To develop an Interactive Lecture Demonstration Manual on Force and Motion using Pasco DataStudio.

2. To evaluate the on the perception of the Manual in terms of:
    - content of Manual,
    - suitability of Manual objectives,
    - design and presentation of Manual,
    - suitability of Manual as an instructors’ reference
    - setting up and running the Manual demonstration

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1.5 Research Questions

The main aim of the research is to develop and evaluate an Interactive Lecture Demonstration Manual which incorporates Instructor's Guide and Student Prediction Sheets. Specifically the research aims to answer the following questions:

1. What are the experts' perception about the terms of the content, objectives, design and presentation of the manual, the suitability of the manual as a lecturers' reference and the setting up and running of the demonstrations suggested in the manual?
2. What are the evaluation by teachers about terms of the content, objectives, design and presentation of the manual, and the suitability of the manual as a lecturers' reference and the setting up of the demonstrations suggested in the manual?

1.6 Definitions of Terminologies

Interactive Lecture Demonstrations (ILD) is designed to enhance conceptual learning in physics lectures through active engagement of students in the learning process. Students observe real physics demonstrations, make predictions about the outcomes on a prediction sheet, and collaborate with fellow students by discussing their predictions in small groups. Students then examine the results of the live demonstration

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(often displayed as real-time graphs using computer data acquisition tools), compare these results with their predictions, and attempt to explain the observed phenomena.

Microcomputer- based laboratories (MBL) is a computer sensor which is an effective system implemented by Thornton to collect, analyse, and present experimental data in real-time.

A **manual** is a competency-based tool focused on what an instructor will know or able to do as a result of using the tool. Manual content highlights learning outcomes, activities designed to achieve the outcomes and procedures for evaluating the achievement. Resources are provided or suggested that meet the instructor's need and directly relate to achievement of the stated outcome.

Prediction sheet is a sheet where students record their prediction. This could include graphs where the students could fill in their predictions of the shape of the curves, as well as a few conceptual questions.

Perception according to Oxford Dictionaries is the ability to see, hear or become aware of something through the senses. It also the way in which something is regarded, understood or interpreted.

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According to Oxford Dictionaries, **evaluation** is the making of a judgment about the amount, number or value of something; assessment.

1.7 Operational Definition

A survey method is used to evaluate the perception of the manual. This perception is assessed based on the five Likert Scale; strongly agree, agree, undecided, disagree, strongly disagree.

The researcher intended to evaluate the perception of the manual on the basis of five categories as listed below:

- content of manual,
- objectives and learning outcomes,
- manual design and presentation,
- suitability of manual as instructor's reference,
- setting up and running the demonstration

The perception on the content of the manual is evaluated based on four items namely; does the manual content fulfill the instructor's expectations, is the manual suitable for the instructor's needs, is the manual content easily understood and

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