.

UNIVERSITI PUTRA MALAYSIA

EFFECTS OF PROBLEM BASED LEARNING ON MATHEMATICS PERFORMANCE, INSTRUCTIONAL EFFICIENCY AND AFFECTIVE ATTRIBUTES IN SECONDARY SCHOOLS, PORT DICKSON, MALAYSIA

NUR IZZATI LOJININ BT ABDULLAH

IPM 2009 1

EFFECTS OF PROBLEM BASED LEARNING ON MATHEMATICS PERFORMANCE, INSTRUCTIONAL EFFICIENCY AND AFFECTIVE ATTRIBUTES IN SECONDARY SCHOOLS, PORT DICKSON, MALAYSIA

By

NUR IZZATI LOJININ BT ABDULLAH

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

August 2008

Abstract of thesis presented to the Senate of Universiti Putra Malaysia
in fulfillment of the requirement for the degree of Master of Science

EFFECTS OF PROBLEM BASED LEARNING ON MATHEMATICS PERFORMANCE, INSTRUCTIONAL EFFICIENCY AND AFFECTIVE ATTRIBUTES IN SECONDARY SCHOOLS, PORT DICKSON, MALAYSIA

By

NUR IZZATI LOJININ BT ABDULLAH

AUGUST 2008

Chairman: Associate Professor Rohani Ahmad Tarmizi, Ph.D

Faculty: Institute for Mathematical Research

Problem Based Learning (PBL) is an engaging instructional strategy in which students are given 'triggers' or realistic, simulated problems that are puzzling, vague or ambiguous before they experience any instruction in a specific content area. Previous research had discovered that students are trained to develop critical thinking, are adaptable to change, able to work independently, demonstrate effective communication skills and become continual learners through PBL.

A quasi experimental study with non-equivalent control group posttest only design was conducted to investigate the effects of PBL on Form Four Malaysian students' mathematics performance and instructional

efficiency. The experiment was carried out for six weeks involving 53 Form Four students randomly selected from the district of Port Dickson. The experimental group (n=29) were exposed to the to the PBL instruction whereas the control group (n=24) were taught conventionally.

There were five instruments used in this study namely, a posttest, Paas Mental Effort Rating Scale, learning assessments during the acquisition phase, a questionnaire on perception towards group work, interest in mathematics and perception towards mathematics learning experience and a rubric evaluating students' effective use of Polya's problem solving procedures, mathematical communication and teamwork.

The results indicated that there was no significance difference in the mean scores of the overall mathematics performance ($F = 1.46$, $p > .05$) between the PBL group ($M=67.38$, $SD=19.75$) and the CT group ($M=60.58$, $SD=17.90$). On the other hand, there was a significance difference in mean mental effort per test problem for the PBL group ($M=5.02$, $SD=1.60$), and the CT group ($M=3.90$, $SD=1.38$; $t(51) = 2.70$, $p < .05$). An independent sample t-test conducted on the mean relative condition efficiency index showed that there was no significant difference ($t(51) = -1.70$, $p < .05$) between the PBL group ($M = -0.26$, $SD=1.26$) and the CT group ($M = 0.32$, $SD=1.22$).

The findings of the study showed that the PBL group used the Polya's problem solving procedures more effectively, displayed better mathematical communication skills and showed stronger teamwork compared to the CT group. However, minimal differential effect on mathematics performance and instructional efficiency was obtained between the PBL and CT group. Hence, this indicated that the efficacy of PBL has yet to be explored in enhancing mathematical performance and to develop problem solving skills, critical thinking and communication skills among learners.

Overall, the PBL instructional strategy has promising implications in teaching and learning of Form Four mathematics specifically in enhancing thinking and communication skills among learners in order to develop critical, creative and competent human capital with first-class mentality who are able to face and overcome the challenges of globalisation in Malaysia.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KESAN STRATEGI PENGAJARAN PROBLEM BASED LEARNING TERHADAP PENCAPAIAN MATEMATIK, KEBERKESANAN PENGAJARAN DAN ATRIBUT AFEKTIF DI SEKOLAH MENENGAH, PORT DICKSON, MALAYSIA

Oleh

NUR IZZATI LOJININ BT ABDULLAH

OGOS 2008

Pengerusi: Professor Madya Rohani Ahmad Tarmizi, Ph.D.

Fakulti: Institut Penyelidikan Matematik

Pembelajaran Berasaskan Masalah (PBM) atau *Problem Based Learning* (PBL) adalah satu strategi pengajaran menarik di mana pelajar diberikan ’pencetus’ atau simulasi masalah yang kurang jelas dan kabur sebelum mempelajari isi kandungan sesuatu pelajaran. Kajian terdahulu mendapati bahawa melalui pembelajaran secara PBL pelajar dilatih untuk berfikir secara kritis, mudah menyerap perubahan, berdikari, menunjukkan kemahiran berkomunikasi serta mengamalkan pembelajaran berterusan.

Satu kajian kuasi-eksperimen dengan reka bentuk ujian pos sahaja bagi kumpulan kawalan tidak serupa dikendalikan untuk mengkaji kesan PBL ke atas prestasi dan keberkesanan strategi pengajaran PBL (*instructional*

efficiency) pelajar Tingkatan Empat di Malaysia. Eksperimen yang dikendalikan selama enam minggu ini melibatkan 53 pelajar Tingkatan Empat yang dipilih secara rawak dari sebuah sekolah di daerah Port Dickson. Kumpulan eksperimen (n=29) telah didedahkan dengan pengajaran secara PBL manakala kumpulan kawalan (n=24) menjalani pembelajaran menggunakan strategi pengajaran konvensional.

Terdapat lima instrumen yang digunakan dalam kajian ini iaitu lembaran kerja matematik, ujian pos, *Paas Mental Effort Rating Scale*, soal selidik persepsi tentang bekerja dalam kumpulan, minat terhadap matematik dan persepsi terhadap pengalaman pembelajaran yang dilalui dan rubrik yang mengukur penggunaan kaedah penyelesaian masalah Polya, komunikasi matematik dan kerjasama berkumpulan.

Dapatan kajian menunjukkan bahawa tiada perbezaan yang signifikan dalam skor min ujian pencapaian matematik ($F = 1.46$, $p > .05$) antara kumpulan PBL ($M=67.38$, $SD=19.75$) dan kumpulan konvensional ($M=60.58$, $SD=17.90$). Sebaliknya, terdapat perbezaan signifikan dalam min *mental effort per test problem* antara kumpulan PBL ($M=5.02$, $SD=1.60$) dan kumpulan konvensional ($M=3.90$, $SD=1.38$; $t(51) = 2.70$, $p < .05$). Analisis t-test tidak bersandar yang dijalankan terhadap min *relative condition efficiency index* menunjukkan tiada perbezaan signifikan

(t (51) =-1.70, p < .05) antara kumpulan PBL (M= - 0.26, SD=1.26) dan kumpulan konvensional (M = 0.32, SD=1.22).

Dapatan kajian juga menunjukkan bahawa kumpulan PBL didapati menggunakan kaedah penyelesaian masalah Polya dengan lebih berkesan, menunjukkan kemahiran komunikasi matematik yang lebih baik dan kerjasama berkumpulan yang lebih kukuh berbanding kumpulan CT. Walaubagaimanapun, tiada perbezaan ketara dari segi pencapaian matematik dan keberkesanan strategi pengajaran (*instructional efficiency)* antara kumpulan PBL dan kumpulan konvensional. Ini menunjukkan bahawa keberkesanan strategi pengajaran PBL perlu diterokai lagi dalam meningkatkan pencapaian matematik dan juga mengembangkan kemahiran menyelesaikan masalah, pemikiran kritis dan kemahiran berkominikasi di kalangan pelajar.

Secara keseluruhan strategi pengajaran secara PBL menunjukkan implikasi yang memberangsangkan dalam pengajaran dan pembelajaran matematik Tingkatan Empat terutama sekali dalam membentuk kemahiran berfikir dan berkomunikasi di kalangan pelajar. Ini adalah penting untuk membangunkan modal insan yang kreatif dan berkebolehan serta mempunyai mentaliti kelas pertama dalam menghadapi dan menangani cabaran globalisasi di Malaysia.

ACKNOWLEDGEMENTS

"If you would count up the favors of Allah, never would you be able to number them: for Allah is Oft-Forgiving, Most Merciful." (Al-Nahl, 18)

Alhamdulillah, all praise be upon the Most Benevolent and Most Merciful for without His blessings, this study would never have been started and completed succesfully. Here I would like to acknowledge all those who were instrumental in supporting, guiding, encouraging and praying for me in the duration of my study from the beginning to the end.

First and foremost, I wish to express my deep and sincere gratitude to Associate Professor Dr. Rohani Ahmad Tarmizi, my main thesis supervisor, for your personal guidance, encouragement and friendly advice during the course of my research. Your expertise, research insight and detailed and constructive comments had helped me tremendously especially in the writing of my thesis. I am also deeply grateful to members of my supervisory committee, Associate Professor Dr. Rosini Abu and Associate Professor Dr. Mat Rofa Ismail. Thank you for your valuable advice, continuous support and genuine interest in this study and ensuring that I was able to complete my research on time.

I would also like to extend my gratitude to Professor Dr. Aminah Ahmad, Professor Dr. Kamariah Abu Bakar and Associate Professor Dr. Mohd Majid

Konting for imparting solid foundations of educational research methodology, research designs and statistical analysis in their lectures. I have gained much from the enlightening and engaging discussions in your classes.

A special word of thanks to Professor Dr Fred Paas for taking time to reply to my questions and queries on instructional efficiency and Kathy Gabric for offering suggestions to improve my research procedures and analysis on PBL.

This study would not have been possible without the assistance and cooperation of the students, mathematics teachers, Heads of mathematics departments and principals of SMK Tinggi Port Dickson and SMK Dato Hj Abdul Samad for welcoming me warmly and making sure I felt ‘at home’ in their schools. A great big ‘thank you’ to the students of class 4A5 and 4A6 in SMK Dato Hj. Abd. Samad for being wonderful and willing participants in this study. My thanks and appreciation to the validators and translators of the instruments; Pn. Arayee A/P Andy, Mr. Toh Hong Meo, Pn. Siti Norbaya and Pn. Nur Nabillah Abdullah who, despite their busy schedules took time to review and comment on the instruments. I also wish to thank the Scholarship Division of the Malaysian Ministry of Education for awarding me the scholarship to pursue my studies full time.

During this study I have gained a remarkable friend and an admirable role model. Generosity, kindness and sincerity was personalised in the form of Nor'ain Tajudin. Kak Ain, a mere thank you will not be enough for the immeasurable amount of support and assistance you had generously shared throughout this study.

Many individuals have also lent their ears, spent their time, expressed concern and offered words of encouragement, prayers and advice throughout this study. I would like to acknowledge the staff of INSPEM; Hanizah, Zahratun, Siti, Salwa, Suhana, Wani and Aishah for helping with the official and technical aspects of the research. To my close and dear friends; Rozie, Siti, Norbaya, Tuti, my PPP/NCUK support network, my former colleagues at SMK Tinggi Port Dickson and the present ones at the Islamic Teachers' Training Institute, thank you all for being there for me.

Finally, this study could not have been completed without the unconditional love, consistent encouragement, unfailing support and continuous prayers of those closest to my heart. I especially would like to dedicate this thesis to them; to my patient soul mate, Mashanizat, my children, Syafiqah and Habil, my supportive mum and dad, mak, abah and all family members. Thank you for enduring and bearing with my periods of neglect and absence especially throughout the trying stages of the thesis writing. Without all of you, this study would not have been accomplished.

I certify that an Examination Committee has met on **25 August 2008** to conduct the final examination of Nur Izzati Lojinin bt. Abdullah on her Master of Science thesis entitled **"EFFECTS OF PROBLEM BASED LEARNING ON MATHEMATICS PERFORMANCE AND AFFECTIVE ATTRIBUTES IN LEARNING STATISTICS AT FORM FOUR SECONDARY LEVEL"** in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the student be awarded the Master of Science.

Members of the Examination Committee were as follows:

Habsah Ismail, Ph.D
Fakulti Pengajian Pendidikan
Universiti Putra Malaysia
(Chairman)

Wan Zah Wan Ali, Ph.D
Associate Professor
Fakulti Pengajian Pendidikan
Universiti Putra Malaysia
(Internal Examiner)

Mokhtar Bin Dato' Hj. Nawawi, Ph.D
Fakulti Pengajian Pendidikan
Universiti Putra Malaysia
(Internal Examiner)

Munirah Ghazali, Ph.D
Associate Proffesor
Fakulti Pengajian Pendidikan
Universiti Sains Malaysia
(External Examiner)

_____
HASANAH MOHD. GHAZALI, Ph.D
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirements for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Rohani Ahmad Tarmizi, PhD
Associate Professor
Institute for Mathematical Research
Universiti Putra Malaysia
(Chairperson)

Rosini Abu, Ph.D
Associate Professor
Faculty of Education
Universiti Putra Malaysia
(Member)

Mat Rofa Ismail, Ph.D
Associate Professor
Institute for Mathematical Research
Universiti Putra Malaysia
(Member)

_____
HASANAH MOHD. GHAZALI, Ph.D
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:12 February 2009

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not currently, submitted for any other degree at Universiti Putra Malaysia or any other institution.

_____

Nur Izzati Lojinin Bt Abdullah

Date: 24 November 2008

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

ANCOVA	Analysis of Covariance
CDC	Curriculum Development Centre
CLT	Cognitive Load Theory
CT	Conventional Teaching
EDA	Exploratory Data Analysis
EPRD	Educational Planning and Research Division
ICT	Information and Communications Technology
JPNS	Education Department of Negeri Sembilan
KBSM	New Curriculum for Secondary School
KBSR	New Curriculum for Primary School
MOE	Ministry of Education
NCTM	National Council for Teachers of Mathematics
PBL	Problem Based Learning
PMR	Lower Certificate Examination

SDT	Social Development Theory
SPM	Malaysian Certificate of Education
SPSS	Statistical Package for the Social Science
STPM	Higher Certificate of Education
TIMSS	Trends in International Mathematics and Science
UPSR	Primary School Evaluation Examination
WM	Working Memory
ZPD	Zone of Proximal Development

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Science and Technology is instrumental in achieving Malaysia's aspirations as stated in Vision 2020. The vision was proposed by the country's fourth Prime Minister, Tun Dr Mahathir Mohamad. In his presentation to the Malaysian Business Council in 1992, nine challenges were posed in order to achieve a developed nation status. The sixth challenge of the vision was "establishing a scientific and progressive society, a society that is innovative and forward-looking, one that is not only a consumer of technology but also a contributor to the scientific and technological civilisation of the future." (Vision 2020, 1997). Concurrently, Malaysia has charted a chronological order of the nation's development policies and plans that has been and is in the process of being implemented in order to achieve a knowledge-based economy (k-economy) that will advance the country's economic growth and competitiveness (refer to Table 1.1).

These plans were initiated in order to build up more knowledgeable workers who not only are able to utilise technology but are also productive in contributing to the development of a scientific, technological, progressive, ethical, moral and caring society (Nik Azis, 2005).