UNIVERSITI PUTRA MALAYSIA

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

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By

NUR IZZATI LOJININ BT ABDULLAH

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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 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 kuku 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.
"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 successfully. 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.

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I certify that an Examination Committee has met on 25 August 2008 to conduct the final examination of Nur Izzati Lojin 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:

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**HASANAH MOHD. GHAZALI, Ph.D**  
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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  
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**HASANAH MOHD. GHAZALI, Ph.D**  
Professor and Dean  
School of Graduate Studies  
Universiti Putra Malaysia
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
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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
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<td>Social Development Theory</td>
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<td>Zone of Proximal Development</td>
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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).