



**Faculty of Cognitive Sciences and Human
Development**

**THE EFFECTS OF PROBLEM BASED LEARNING APPROACH IN
LEARNING GEOMETRY AMONG SECONDARY SCHOOL
STUDENTS**

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**THE EFFECTS OF PROBLEM BASED LEARNING APPROACH IN
LEARNING GEOMETRY AMONG SECONDARY SCHOOL
STUDENTS**

MCKENZIE ANAK LIM LENG

A dissertation submitted
in partial fulfilment of the requirements for the degree of
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The dissertation entitled **The Effects of Problem Based Learning Approach In Learning Geometry Among Secondary School Students** was prepared by Mckenzie Anak Lim Leng and submitted to the Faculty of Cognitive Sciences and Human Development in partial fulfilment of the requirements for the degree of Master of Science (Learning Sciences).

It is hereby confirmed that the student has done all the necessary amendments for examination and acceptance.

(DR.KARTINI BINTI ABDUL GHANI)

Date: _____

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LIST OF ABBREVIATIONS

| | |
|-------|--|
| PBL | Problem Based Learning |
| PAK21 | Pendidikan Abad Ke-21 (21st Century Learning) |
| SPSS | Inferential Statistical Software Packages for Social Science |
| TIMSS | Trends in International Mathematics and Science Study |
| HOTS | Higher Order Thinking Skills |

ABSTRACT

Problem-Based Learning (PBL) is a teaching approach in which real situations are used as the mean to stimulate the development of critical thinking skills, communication skills and problem solving abilities among students. In Malaysia, the 21st century learning (PAK21) that was formulated in the second wave of Malaysia Education Blueprint 2013 to 2025 requires that all teachers should embrace the teaching and learning approach to ensure the students are equipped with the correct skills and values for the future. This study aims to investigate the differences between problem-based learning approaches and traditional learning method in learning geometry among secondary school students in Padawan. Besides that, the perception of acceptance on the approach towards students' performance was also measured. The use of quantitative research method is to make sure that the outcome of the research can be clearly shown through objective data. The study involved sixty (60) Form Four student of Sekolah Menengah Kebangsaan Padawan. The data was obtained using the survey questionnaire that explored students' acceptance on the approach that was used during the intervention lesson. Pre and post test was conducted to measure the students' performance. The data obtained were analysed using inferential statistical software packages for Social Science Version 21.0 (SPSS). The findings from this research revealed that there was an increased in the students' achievement in learning geometry using PBL approach. This investigation has shed some insights regarding the implementation of PBL in school and other setting. Apart from that, it also enlightened the aspects that can be further improved or as a value-added to enhance learners' outcomes.

Keywords: Problem-based learning, 21st century learning, geometry

ABSTRAK

KESAN PENGGUNAAN KEADAH PEMBELAJARAN BERASASKAN MASALAH (PBM) DALAM PENGAJARAN DAN PEMBELAJARAN GEOMETRI DI KALANGAN PELAJAR SEKOLAH SEKOLA MENENGAH

Pembelajaran Berasaskan Masalah (PBM) adalah pendekatan mengajar di mana situasi sebenar digunakan sebagai cara untuk merangsang perkembangan kemahiran berfikir kritis, kemahiran komunikasi dan kebolehpemampuan menyelesaikan masalah di kalangan pelajar. Di Malaysia, pembelajaran abad ke-21 (PAK21) yang dirumuskan dalam gelombang kedua Rangka Tindakan Pendidikan Malaysia 2013-2025, dimana ia memerlukan semua guru harus menggunakan pendekatan pengajaran dan pembelajaran yang mana akan memastikan para pelajar dilengkapi dengan kemahiran dan nilai yang diperlukan untuk kegunaan masa depan . Kajian ini bertujuan untuk mengkaji perbezaan antara pendekatan pembelajaran berasaskan masalah dan kaedah pembelajaran tradisional dalam pembelajaran geometri di kalangan pelajar sekolah menengah di Padawan. Di samping itu, persepsi penerimaan pendekatan PBM ini terhadap prestasi pelajar juga diukur. Penggunaan kaedah penyelidikan kuantitatif juga digunakan bertujuan untuk memastikan hasil penyelidikan dapat ditunjukkan dengan jelas melalui objektif kajian yang telah ditetapkan. Kajian ini melibatkan enam puluh (60) pelajar Tingkatan Empat Sekolah Menengah Kebangsaan Padawan. Data diperolehi melalui penggunaan soal selidik kaji selidik yang meneroka penerimaan pelajar terhadap pendekatan yang digunakan semasa pelajaran intervensi, dan penggunaan ujian pra dan pasca untuk mengukur prestasi pelajar. Data yang diperolehi dianalisis menggunakan pakej perisian Statistik Inferens untuk Sains Sosial Versi 21.0 (SPSS). Hasil kajian menunjukkan terdapat peningkatan dalam pencapaian pelajar dalam pembelajaran geometri menggunakan pendekatan PBL. Siasatan ini telah memberikan beberapa pandangan mengenai pelaksanaan PBL di sekolah dan suasana lain. Selain itu, ia juga memberi pencerahan kepada aspek-aspek yang boleh diperbaiki atau sebagai nilai tambah untuk meningkatkan hasil belajar pelajar.

Kata kunci: pembelajaran berasaskan masalah, pembelajaran abad ke-21, geometri

CHAPTER ONE

INTRODUCTION

1.0 Introduction

Globally, the learning of mathematics has always been perceived as a challenging task due to the complexity of acquiring the fundamentals arithmetic knowledge. Students tend to think that mathematical knowledge is not relevant to the real world as they may not need to know all those complicated equations and calculations. Closer to home, the situation is more or less, similar. It is rather alarming to note that Malaysia's ranking in Mathematics learning fall from 21st rank in the year 2007 to 32nd in 2011 reported in Trends in International Mathematics and Science Study (TIMSS). The poor performance in international assessments has led to many implications. One of such implications is the strong conviction that the education system in Malaysia depends predominantly on examinations and students were merely taught on how to answer specific questions. Many of the students passed through memorising mathematical steps instead of fully understand the concepts. Our students are not taught to answer similar type of TIMSS questions which focused more on Higher Order Thinking Skills (HOTS) of synthesis, analysis and evaluations. Wagner (2008), has identified seven survival skills need to be mastered by students for the 21st century based

on his research and he has put the main emphasis on critical thinking skill and problem solving skill.

With the continuous decline in TIMMS evaluation as well as more and more students are losing interests in the subject, mathematics teachers need to discover approaches that would encourage students to think beyond the “fixed syllabus” of public examinations. . As highlighted by Sansome (2016), although many students may develop procedural fluency, they often lack the deep conceptual thoughtful necessary to look into new problems or make associations between mathematical thoughts. This capacity displays a test for teacher. One suggested approach and worth to be explored in schools is problem-based learning (PBL). PBL offers opportunities for teachers to address these difficulties. PBL occurs as a teaching techniques grounded in the beliefs of constructivism and student-focused learning (Roh, 2003).

The problem based learning approach was first used in the learning of medical field, thus most of the studies about problem based learning have been conducted in medical faculties (Hmelo-Silver, 2004). In the field of education, most of the research on problem based learning focus on its effects. For example, both Ahmad Talib and Ismail Kailani (2014) have observed on the practice of Problem Based Learning in Cooperative Situation (PBLCS) and studied its effect on the expansion of students’ personal intelligence. On the other hand, the studies by Tosun and Senocak (2013) exposed the consequences of problem based learning on the metacognitive consciousness and attitudes toward the teacher candidates with different academic qualifications.

When utilizing PBL, educators help the students to focus on tackling issues within a real-life circumstance, urging them to mirror the circumstance in which the issue exists and after that attempt to discover answers for that issue. The majority of studies on PBL focus on

its practice in schools, stresses on the use of collaborative small-group work, student-centred approach, educators as facilitator and the use of real-life problems as the arranging consideration.

In the real scenario, for the PBL approach to work, teachers have to be compelled to withstand the role of a facilitator by encouraging students to figure through every problem (Ferreira & Trudel, 2012). This role needs flexibility. Once started employing a PBL model, research conclude that elementary teachers discover that it is tough to develop an appropriate hook during which a real-life problem that doesn't have one answer or pre-determined solution and, thus, allows students to develop a variability of answers. During this sense, the worth of the matter exists in in serving students to develop both an understanding of the mathematics and therefore the capability to use it.

1.1 Problem Statement

One of the topics in mathematics that requires special attention is geometry as students tend to think the topics is merely about shapes. As discovered by Jones (2002), as well as the experience shared by other teachers, the students often regard geometry as “easy”, only to discover the complexity of understanding the concepts when given specific mathematical problems related to geometry. In a typical geometry lesson, the educators tend to clarify to students the properties related with geometrical shapes and therefore the properties, and consequently, demanding the students to undertake the given exercises to point whether or not they have understood the topic that they are learning or just reacting from memorising the facts (Jones, 2002). Some attempts were made in boosting the students to clarify their rational and to create the links reasonably. Emerging the learners' thinking and geometrical minds is significant and the students want this by processing a compact thoughtful of the realities in geometry. This problem can be addressed by using a

teaching approach that specifically guide students to view the topic as an authentic real world problem as explained in PBL. This approach may support learners in making the mandatory connections exploiting the varied depictions of geometrical ideas and also the knowledge domain ideas in different space of mathematics (Schettino, 2012). Generally, the effects of PBL that have been studied so far include higher order mathematical thinking ability (Achmad Mudrikah, 2016; Widyatiningyas, 2015), mathematics achievement and retention (Ajai & Imoko, 2015), metacognitive awareness and attitude towards Chemistry (Tosun & Senocak, 2013), and students attitude toward Science (Ferreira & Trudel, 2012). Due to the reported outcomes of PBL in helping learners to process learning content through a more holistic understanding, it is the aim of this study to investigate its effect on the learning of geometry among secondary school students. Also, limited studies concerned with the implementation of PBL at secondary school levels in Malaysia and its usefulness remains a debateable area to be investigated. Specifically, this study will be conducted in SMK Padawan, where students are largely of average levels.

1.2 Research Objectives, Research Questions and Research Hypothesis

The aim of this study is to investigate the differences between problem based-learning approaches and traditional learning method in learning geometry among Form Four students in SMK Padawan. The following objectives were used to guide the investigation:

- I. To investigate whether there is any difference between traditional teaching approach and PBL teaching approach in students' performance in Geometry topic.
- II. To measure the acceptance of PBL on students' performance in Geometry topic.

The **research questions** for this study are as follows:

- i. What are the differences between traditional teaching approach and PBL teaching approach in determining students' result?

- ii. How does the use of PBL influence on students' performance in Geometry topic.

The **research hypotheses** of the investigation are as follows:

- i. H_{01} : There is no significant differences between traditional teaching approach and PBL teaching approach in students' performance in learning Geometry.

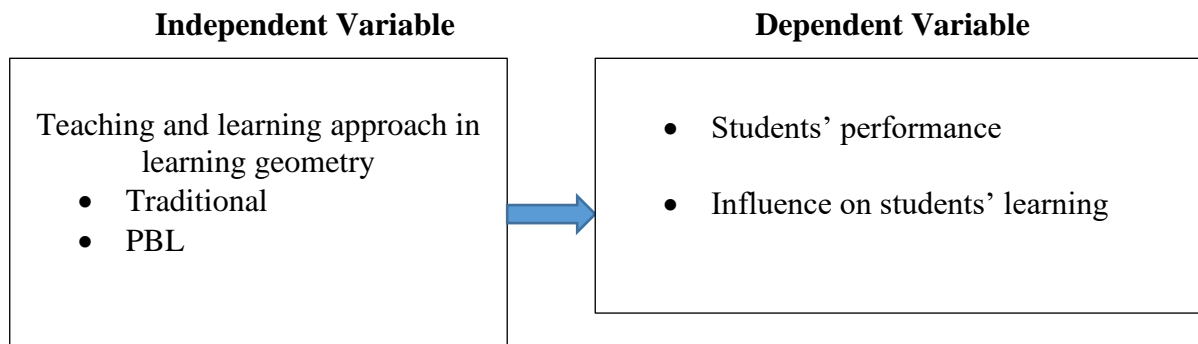


Figure 1: Correlation between independent variables and dependents variables

For the purpose of data collection, the students divided either into a comparative group and a control group. The comparative group refers to the group of students who have been taught by using problem based learning in learning geometry. Other than that, the control group refers to the group of students who were taught using traditional learning (using the conventional chalk and talk explanation by the teacher).

To investigate the performance of the students before and after the treatment (use of PBL), the study will use pre-test and post-test to investigate the differences between the two approaches in teaching and learning and its effect on students' performance/understanding the geometry lesson. The pre-test is used to access the participants' prior performance of the topic. The learning outcomes are measured by the post-test after teaching and learning process been conducted. The test items in both tests were identical and merely varied in the

order of displaying the questions and options. Table 1 shows the research design of my research.

Table 1

Research design

| | | | |
|-------------------|----------|---|-----------|
| Control group | Pre-test | Traditional teaching approach | Post-test |
| Comparative group | | Teaching and learning with the use of problem based learning approach | |

CHAPTER TWO

METHOD

2.0 Research Design

Students from Sekolah Menengah Kebangsaan Padawan, Kuching participated in this research. A non-random convenient sampling was chosen because the groups were not randomly assigned but the groups that have already been formed in the school were used instead. The sampling method is chosen as it gives the researcher control on the type of students to be involved in the study so as to obtain meaningful data for analysis. The sample size of this study involved sixty (60) Form four (4) A and B students who took mathematics subject. The students were divided into two groups: a comparative group that use problem based learning and a control group that learn only with traditional teaching and learning approach. The consent form has been distributed to the participants to obtain their permission in becoming the sample of the study. The students were instructed to read and sign the form upon deciding on the terms and condition of the research. One consent form will be kept by the researcher whereas the other copy will be saved by the respondent.

2.1 Research instrument

The subtopic of Sphere was chosen as the intervention lessons as it was comprised in Form 2 topic of Geometry. PBL sessions will be held within two weeks after regular class time and students will meet twice a week. In total there are four sessions going on. The time allocated for each session is for one hour. The PBL model that was being integrated in the teaching and learning session was adopted from the model by Lee and Bea (2017). (see Figure 2)

Session 1: Overview, Perceive the Situation, and Examining of Information (on-going)

- The students were given the situation and they were given time to understand and analyze the problem.
- Students are allowed to discuss in group and subsequently seeking for information individually or in group to enhance their understanding of the problem.
- Teachers as the facilitators will monitor the discussion process to ensure that students do not deviate from the learning objectives.

Session 2: Collecting and built solutions.

- Students will gather all the important information from each group member, discuss in groups and preparing a draft and finally get the most accurate solution to the given problem.

Session 3: Group presentation and Feedback

- Representatives from each group will present their findings within 7-10 minutes

while other students will take important notes from the presentation.

- Teachers will monitor and ensure students complete their assignments. Students are encouraged to ask related questions to reflect during the session.

Figure 2: The design of PBL intervention.

Intervention Problem

During a study tour to a recreational park, John found a broken ceramic bowl and he believed the bowl was round. To form a replica of a complete bowl, John knew he had to look for a radius for the bursting of the broken bowl but he had a deadlock idea of how to solve the problem.

How did you and your group members help John to identify the steps in finding the radius for the broken bowl and the missing pieces?

Your assignment is to find the effective strategies on how to find the radius of the broken bowl.

As a reminder, the most correct answer (radius length) is not a must, but the answer must be logical and applicable to the presented situation. Finally, each group will present their findings along with justification to the answers given.

Figure 3: The PBL Problem

The interventions lessons involved two Form Four classes and the processes were implemented simultaneously and two mathematics teachers were assigned to facilitate the

whole process. During the intervention, the students in the comparative (PBL) group were divided into 4 groups for each class. Each group had to assign a leader, a presenter and writer to make sure the tasks are divided fairly among all group members. The groups were then given papers of a PBL model, a designed intervention problem and a blank A4 papers to record the findings of each group members. After that, the groups were instructed to solve the presented PBL problem based on real-life situation which is not been covered in the syllabus. The question were planned according with the important aspects of PBL which was ill structured, contextualized and related to real life situations (Hung, 2009).

During the intervention process, students were encouraged to actively participate in the group discussion and questioning session. Teachers supervised the PBL discussions among students. Apart from that, the students were recorded their findings from the discussion besides contributing ideas to be shared among group members. In addition, teachers act as facilitators to the problems discussed during the intervention session so that students do not deviate from the primary objective of PBL. The process of finding and collecting information within the group took about 25 minutes where students were allowed to refer to any source during the process of obtaining information including from textbooks and virtual search from the internet. Besides, students were also permitted to bring their assignments back home to continue the process of seeking for information. This was carried out as an on-going process. At the next meeting, the students were collaborated with colleagues in the group to collect and analyze the information they have acquired. The students then make a draft on the steps and strategies to solve the problem. During this phase every member in the group will evaluate and analyze the findings from each member of the group and subsequently decide to choose the best solution for that particular problem. Then the selected speakers from the group members present their answers within 10 minutes and at the same time the other students write their reflection about the presentation in a piece of

paper. A whole-class discussion was conducted after each presentation to allow interactions in giving constructive feedback following by a wrapping up session (Shahrill & Prahmana, 2017).

While the PBL group was doing their intervention lessons, the class for the control (traditional) group on geometry topic will adapted the methods and techniques that were commonly used by the teacher, which were teacher's description using textbooks and activity books. There was a one way communication between teachers and students during the lesson. For this intervention, the students will have limited opportunities to voice up their views and opinions due to time limitations because teachers need to complete the topics quickly according to the syllabus's requirement and there was no space for group discussion.

In this research, the instruments that will be used to study the relationship between the independent variable and dependent variable were the survey questionnaire, pre-test and post-test. This questionnaire was indicated through Likert Scale, ranging from strongly disagree, disagree, neutral, agree and strongly agree. The language used in this questionnaire is dual language and respondent answered the questions by circling the best scale that indicates their degree of agreement.

The learning outcomes were measured by a post-test after two weeks of treatment during classroom session. The test items consisted of questions that examine the students' prior knowledge on basic geometrical terms of a sphere and their procedural skills in searching the unknown angles and sides in a sphere. The marks allocated for the test was 20 marks in total and students were given forty (40) minutes to complete the answer.

2.2 Pilot study

The preliminary test of the instrument is to identify and eliminate problems and make corrective changes or amendments before actual collecting data from the targeted population. The purpose of the pilot study is to maximize the validity and reliability of the survey instrument. In this research, the data that has been collected from the pilot test were analyzed using Statistical Package for Social Science (SPSS). For this study, a pilot study was conducted which the participants were among different set of students at the same school and the result was analyzed using SPSS to do the validity test to examine the correlation between the instruments.

Response from the pilot test will be inform whether the respondents comprehend all the terms used in the survey questionnaire and test papers correctly, interprets the questions similarly and responding the questions properly.

2.3 Reliability and validity

The term reliability refers to ability of the **research instrument** to yield the same result on repeated trials (Key, 1997). Joppe (2000 as cited in Golafshani, 2003) explain of what reliability in quantitative research:

“The extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable.”

In quantitative research, validity is concerned with the **truthfulness of the research findings** (Golafshani, 2003). Joppe (2000 as cited in Golafshani, 2003) defines validity as: