# DEVELOPMENT OF SELF DIRECTED PROBLEM BASED LEARNING (PBL) MODULE FOR HIGH SCHOOL BIOLOGY

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# ABSTRACT

This research aims to develop a valid and reliable Self-Directed PBL module using the adapted recommendations found in the models provided by Problem-Based Learning Network (PBLN) at Illinois Mathematics and Science Academy (IMSA) and the instructional design model for ill-structured problem-solving by D. H. Jonassen. These design concepts were combined to meet the module development model proposed by Sidek's Model. Biology educator's perception towards the Self- Directed PBL module's learning guide, facilitator guide, problem scenario assessment, self-directed learning planning assessment and learning activity were investigated using quantitative approaches. A total of 44 educators were selected using random sampling from a population of 50 in one of the Perak districts. The validity and reliability of the module were measured using percentage of expert agreement and Cronbach's Alpha respectively. A set of questionnaire was adapted and used to investigate the biology educator's perception towards the module's learning guide, facilitator guide, problem scenario assessment, self-directed learning planning assessment and learning activity. The data obtained was analysed using the ' Statistical Package for Social Science' (SPSS) to measure the percentages and mean. Findings showed that the Self-Directed PBL module has achieved 100% expert agreement for validity and a reliability value of 0.896. Biology educator's perception towards the five constructs in the questionnaire gained the mean of 4.30, 4.24, 4.38, 4.32 and 4.38 respectively. As a conclusion a valid and reliable Self Directed PBL module was successfully developed and gained positive perception from biology educators. This research implicates the development of Self Directed PBL module is capable to act as an additional support to educators in a PBL environment to fully harness the benefits of PBL in classrooms.

# PEMBANGUNAN MODUL PEMBELAJARAN BERASASKAN MASALAH LANGSUNG DIRI (PBL) UNTUK BIOLOGI SEKOLAH TINGGI

## ABSTRAK

Penyelidikan ini bertujuan untuk membangunkan satu Self-Directed PBL modul yang mempunyai kesahan and kebolehpercayaan dengan menggunakan pengesyoran yang terdapat dalam model yang disediakan oleh Problem-Based Learning Network (PBLN) di Illinois Mathematics and Science Academy (IMSA) dan instruksional model reka bentuk untuk penyelesaian masalah oleh DH Jonassen. Konsep reka bentuk ini digabungkan untuk memenuhi model pembangunan modul yang dicadangkan oleh Model Sidek. Persepsi pendidik biologi terhadap panduan pembelajaran modul PBL Self-Directed, panduan fasilitator, penilaian senario masalah, penilaian perancangan pembelajaran kendiri dan aktiviti pembelajaran telah disiasat menggunakan pendekatan kuantitatif. Seramai 44 orang pendidik telah dipilih menggunakan persampelan rawak daripada populasi seramai 50 orang di salah sebuah daerah negeri Perak. Kesahan dan kebolehpercayaan modul telah diukur menggunakan peratusan persetujuan pakar dan Cronbach's Alpha. Satu set soal selidik telah disesuaikan dan digunakan untuk menyiasat persepsi pendidik biologi terhadap panduan pembelajaran modul, panduan fasilitator, penilaian senario masalah, penilaian perancangan pembelajaran terarah kendiri dan aktiviti pembelajaran. Data yang diperolehi dianalisis menggunakan 'Statistical Package for Social Science' (SPSS) untuk mengukur peratusan dan nilai min. Dapatan kajian menunjukkan modul PBL Self-Directed telah mencapai 100% persetujuan pakar untuk kesahan dan nilai kebolehpercayaan 0.896. Persepsi pendidik biologi terhadap lima konstruk dalam soal selidik memperoleh nilai min masing-masing 4.30, 4.24, 4.38, 4.32 dan 4.38. Kesimpulannya, modul PBL Self-Directed yang mempunyai kesahan and kebolehpercayaan telah berjaya dibangunkan dan mendapat persepsi positif daripada pendidik biologi. Penyelidikan ini memberi implikasi pembangunan modul PBL Self-Directed mampu bertindak sebagai sokongan tambahan kepada pendidik dalam persekitaran PBL untuk memanfaatkan sepenuhnya faedah PBL dalam bilik darjah.

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## LIST OF ABBREVATIONS AND SYMBOLS

| | |
|---|---|
| DBR | Design Based Research |
| IMSA | Illinois Mathematics and Science Academy |
| PBL | Problem Based Learning |
| PBLN | Problem-Based Learning Network |
| PPSMI | Pengajaran dan Pembelajaran Sains dan Matematik Dalam Bahasa Inggeris |

## SENARAI LAMPIRAN

# CHAPTER 1

# INTRODUCTION

## 1.1 Context of the study

The implementation of Government Transformation Projects demonstrates the Malaysian government's commitment to changing the country into a high-income, productive nation. Meanwhile, Malaysia faces a shortage of highly skilled workers in Science and Technology. Since 2007, there has been reduced number of secondary and tertiary students enrolled into science stream (Osman et al., 2013). According to some research, Malaysian students do not dislike or fear science, but instead gravitate toward the social sciences due to their relative control (Malaysia Education Blueprint, 2013) .

Further analysis by Malaysian Education Blueprint (2013) stated that for science “Malaysian students have extremely limited scientific knowledge that can only be applied to a few familiar situations. They can present a scientific explanation that follows explicitly from the given evidence but will struggle to draw conclusions or make interpretations from simple investigations” (Malaysia Education Blueprint,

2013). According to specific studies in biology context, most biology teachers still use outdated teaching approaches. Teachers direct students to memorise biology material for exams, but this does not train pupils to solve complex biology problems (Zamri Mahamod & Mustapha, 2007).

This serves as a wake-up call for the Malaysian government to take action to enhance the country's science and mathematics education standards.

Malaysia's Ministry of Education have indeed taken some bold measures to address this issue. Since the Education Blueprint (Malaysia Education Blueprint, 2013) stated that improving the current science curriculum is a priority, revisions are scheduled to be completed in 2017. Among the contents of the new science curriculum will be the incorporation of more problem-based subjects, formative assessments, and an accelerated learning pathway for high-achieving students.

The form and methodology of teaching the 21st century generation have also been discussed many times and, in many works of literature, have commented on the education system that could fulfill the hopes and needs of the future. Experts agree that methods of teaching and learning should change along with technological advancements and advancing internet access. Conventional teaching styles such as ‘chalk and talk’ are not able to attract student attention and therefore a more dynamic and creative methodology for teaching is needed along with content that is relevant to the current development trend (Malaysia Education Blueprint, 2013).

## 1.1 Statement of the Problem

According to Khairiyah et al. (2005), PBL originated in medical education and quickly gained widespread acceptance. Over the last decade, there has been an increasing global movement to incorporate PBL into other fields, including engineering. PBL is also used in a variety of fields in Malaysia, and has emerged as one of the most promising innovations in the country's higher education teaching and learning environments. It holds a great reputation in the fields of engineering, information technology and multimedia, physics, as well as medical and dental education (Barman et al., 2006).

However, given the majority of teachers' lack of experience with open-ended teaching strategies, (Land, 2000), new PBL instructors are likely to encounter challenges in all three areas of PBL instruction: planning, implementing, and assessing. At each level, significant variance in PBL practises was discovered, and when the obstacles were analysed, it was discovered that many of the challenges were not specific to any particular practise but were rather common to facilitators of PBL.

Current PBL practise places a premium on students improving their ability to solve real-world, open-ended, and ill-structured problems, which presents significant obstacles for teachers and students in terms of time and effort commitment. Teachers in PBL courses had a greater workload than they did in traditional teaching courses because they were responsible for providing guidance resources, practical experiences, and teamwork facilitation throughout the entire process of finishing projects, rather than simply giving lectures and setting exams (Dos Santos et al., 2009; Hassan et al., 2014; Palmer & Hall, 2011).

Instructors have also expressed frustration with the length of time required to plan and implement problem-based experience (Simons et al., 2004). According to Brush & Saye, (2000) "successfully implementing student-centered learning requires skills and resources that are very different from those required by more traditional, teacher-centered classroom activities". While there is evidence that shifting responsibility for learning from the teacher to the students fosters the development of students' critical thinking and problem-solving abilities, (Saye & Brush, 2001), this transition does not happen naturally or easily, as students may develop resentment toward the new strategy if they do not receive the necessary support or guidance. Thus, teachers may be tempted to revert to their teacher-directed strategies in response to this frustration (Ertmer & Simons, 2006). Teachers reflected that they need more supportive materials, resources, and policies from the faculty to improve the effectiveness of PBL (Arman, 2018; Clyne & Billiar, 2016; Hosseinzadeh & Hesamzadeh, 2012). For pupils, a lack of resources can also be a source of frustration. In numerous instances, students expressed dissatisfaction with the amount of direction and assistance they received from facilitators or supervisors (Sahin, 2010; Setiawan, 2019).

Grant & Hill (2006) in press; in their study have identified 'confidence in integrating appropriate tools and resources as one of the factor that could also influence educator's adoption and use of problem-based learning. Without support from a variety of sources, classroom teachers are unlikely to readily adopt a PBL approach. To increase their chances of success, PBL teachers require support from a variety of sources that will enable them to address the diverse challenges they are likely to face as they plan, implement, and evaluate the PBL process (Ertmer & Glazewski, 2006).

With the examples quoted above, it is quite evident that support is needed to implement any changes to support the shift in teaching and learning approaches especially if PBL was to be implemented. However, implementation issues in PBL have received scant consideration in the current review works, and even less attention has been paid to how these implementation challenges are related to the varied PBL approaches. To increase the likelihood that PBL will be effectively integrated within Kurikulum Standard Sekolah Menengah (KSSM) (Standard Based Curriculum for Secondary Schools ) contexts, a variety of resources is needed to support both teachers' and students' efforts. For example, teachers will need guidance as they adopt new roles, facilitate student inquiry, provide constructive feedback, and apply new types of classroom management strategies.

It is possible that these resources will provide teachers with a reasonably comfortable entry into the process. Nonetheless, we hope that by implementing some of the strategies and scaffolds outlined here, teachers will come to appreciate the potential of PBL in the classroom. By assisting teachers in their initial and ongoing efforts, we hope to move closer to our goal of developing flexible thinkers and effective problem solvers. By recognizing and addressing the problems, the research aims at developing a PBL module that could act as a support material for teachers and students in a PBL environment to fully harness the benefits of PBL in classrooms.

## 1.2 Objectives

i. To develop a Self-Directed Problem Based Learning Module for Form 4 Biology

ii. To determine the validity of the Self-Directed Problem Based Learning Module for Form 4 Biology

iii. To determine the reliability value of the Self-Directed Problem Based Learning Module for Form 4 Biology

iv. To determine the perceptions of Biology teachers on Self-Directed Problem Based Learning Module for Form 4 Biology

## 1.3 Research Questions



i. What is the validity of the Self-Directed Problem Based Learning Module?

ii. What is the reliability value of the Self-Directed Problem Based Learning Module?

iii. What is the perception of teachers on the Self-Directed Problem Based Learning Module?

## 1.4 Significance of Study

According to Malaysia Education Blueprint (2013), 21st-century skills are defined as skills that will help create Malaysian students who are balanced, resilient, inquisitive, principles informed, caring, patriotic as well as effective thinkers, communicators, and team players. As society evolves, so do the skills that citizens require in order to

navigate the complexities of everyday life (NCREL & Metiri, 2003). This has had an impact on the nature of the workforce, with a high level of technological proficiency becoming a requirement in order to compete on a global scale. As a result, employers in the industry are in desperate need of a more flexible workforce with advanced technical skills combined with well-developed generic skills such as creative thinking, problem-solving, and analytical skills in order to meet the challenges faced by businesses (Osman et al., 2010).

This simply directs towards the need for a generation with higher inventive thinking and self-direction. According to Osman et al. (2010), inventive thinking skills consist of adaptability and managing complexity, self-direction, curiosity, creativity, risk-taking, higher-order thinking, and sound reasoning. As a result, the educational system must undergo comparable changes in order to achieve its societal goal, which is to prepare students for life outside the classroom.



However, implementation issues in PBL have received scant consideration in the current review works, and even less attention has been paid to how these implementation challenges are related to the varied PBL approaches. To promote and be successful in problem-based learning (PBL) implementation in classrooms, the hurdles put forward by teachers need to be overcomed. This study looks into development of a teacher support module in which the resources could indirectly push towards more self-direction throughout the implementation thus reducing the guiding time factor cited by educators. From the perspective of guidance and being intentional in designing a problem, a series of problems and activities to drive and motivate learning would be included to reduce planning time of educators. All problems and activities will be aligned to the new curriculum known as KSSM (Kurikulum Standard

Sekolah Menengah) syllabus of form four Biology covering one the selected topic. The module is expected to function within or outside of a classroom context provided the suggested lesson plans included in the module is used to scaffold.

Therefore, the rush to complete syllabus is avoidable as the module itself serves to cover the chosen topic within the syllabus inclusively without extension to the teaching periods and the materials would significantly reduce the planning time factor Simons et al. (2004). Pre-reading materials and activities of the module would be aligned to the standards of the curriculum to ensure all intended learning outcomes set as standards by the ministry is met.

It is anticipated that by assisting teachers in their initial and ongoing efforts, more teachers will recognise the potential of PBL as an effective instructional approach for developing learners who are flexible thinkers and successful problem solvers.The perception of educators on the possibility of a self-directed PBL module may add value in further understanding the value of support and resources given to educators and may assist more effectively targeting the development of variety of resources across the syllabus for the benefit of our educators.

## 1.5 Definitions

### 1.5.1 Self-Directed Module

This study would adopt Miflin et al., (2000) 's definition of self-directed learning in PBL which could range from preorganized teaching and learning materials, student-initiated and -selected facilitator-guided learning, to completely self taught learning through the module.

### 1.5.2 Problem Based Learning

Problem based learning in this study context is arranged in order as suggested by Barrett (2016). Students are presented with a problem. Students discuss the problem in a small group PBL tutorial. They clarify the facts of the case. They define what the problem is. They brainstorm ideas based on the prior knowledge. They identify what they need to learn to work on the problem, what they do not know (learning issues). They reason through the problem. They specify an action plan for working on the problem and students engage in independent study on their learning issues outside the tutorial. This can include: library, databases, the web, resource people and observations. Students come back to the PBL tutorial(s) sharing information, peer teaching and working together on the problem. Finally, they present their solution to the problem. Students then review what they have learned from working on the problem. All who participated in the process engage in self, peer and tutor review of the PBL process and reflections on each person's contribution to that process

### 1.5.3 Module

Sejpal (2013)'s definition of a module was used in this study. In this study, a module refers to a self-contained unit of work within a course of instruction that has clearly defined objectives and systematically organised learning opportunities.

### 1.5.4 Perception

According to Jaafar et al. (2021), perception is the perspective and point of view of teachers on a given topic using direct questions. This study explored the perception and point of view of educators on Self-Directed PBL module.



### 1.5.5 Validity

Validity is defined as the extent to which a concept is accurately measured in a quantitative study (Heale & Twycross, 2015). In this study, validity refer to what extend the experts approve the content of the Self-Diredted PBL module and the questionnaire on educator's perception about Self-Directed PBL module.

### 1.5.6 Reliability

According to Fuad et al. (2019), reliability refers to the consistency and stability of a module in treating what should be treated as in the objectives of a module. In this study the reliability is the measure of consistency and stability of Self-Directed PBL module and questionnaire on educator's perception in treating what should be treated as in the objectives of the PBL module and the questionnaire.

## 1.6 Conceptual Framework

A Self-Directed PBL module was designed and developed for instruction in a high school biology classroom. An instructional-design model was adapted based on the recommendations found in the models provided by Problem-Based Learning Network (PBLN) at Illinois Mathematics and Science Academy (IMSA) and the instructional design model for ill-structured problem-solving by D. H. Jonassen (1997). The construction of this model is based on the theory of constructivism. The teaching and learning are student-centered whereby students are given the opportunity to carry out activities to build new knowledge based on existing knowledge which is one the fundamental characteristics of PBL. The module would be subjected to validity and reliability evaluation. Finally it will be distributed to educators to determine thier perception of the Biology teachers on Self-Directed Problem Based Learning Module for Form 4 Biology.

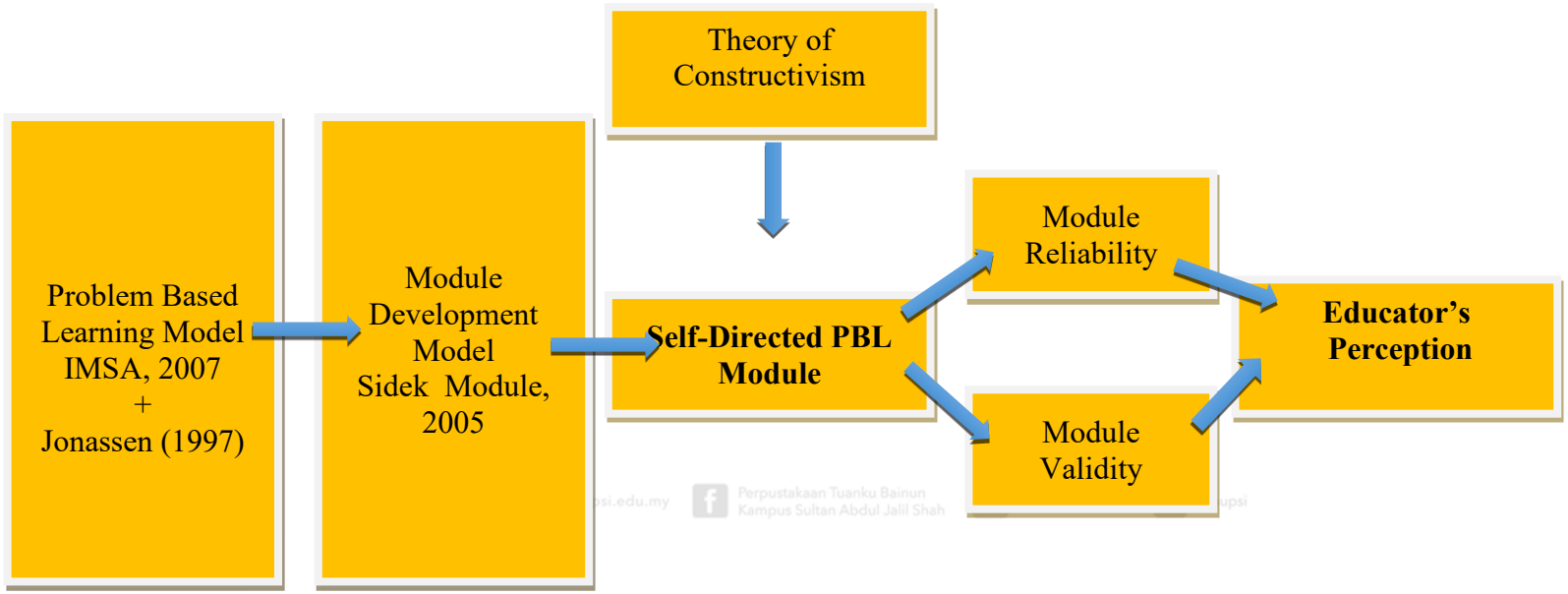


*Figure 1.1.* Conceptual Framework

## 1.7 Summary

The first chapter of this thesis opens with the background of the study and further describes the trend in education and need of industry while highlighting the issues revolving around PBL implementation. This is followed by objectives, research questions and significance of the study. The chapter concludes with the conceptualization of the study.