Problem Based Learning (PBL) for Malaysia Teacher Education: Design, Implementation, and Evaluation

Mohamad Termizi Borhan

Department of Development and Planning
Aalborg University, Denmark

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Aalborg University, Denmark.

SUMMARY

This research involved developing, implementing and evaluating Problem Based Learning (PBL) designs in the context of Malaysian teacher education. As a relatively new teaching and learning approach in the Malaysian higher education landscape, the student-centered learning such as the PBL has posed challenges since the approach was too different from the demands and constraints of contextual needs, i.e Malaysian teacher education. With regards to this challenge, the proposed PBL designs have been adjusted to suit the Malaysian teacher education.

Putting forward the above issues, the researcher has adopted Design Based Research (DBR) as the research methodology due to its principles that strive to make learning research more contextually relevant. In particular, the method addresses the needs and norms of a local context, which has led to research findings that are scientifically trustworthy and useful in practical sense.

DBR emphasises synergistic relationship between researching, designing and engineering the PBL design in an effort to understand learning in a complex environment. Since the method concerns learning and cognition, its inherent activities of research and design involve (1) collaborating with local practitioners, (2) developing and implementing the PBL design, (3) striving to refine and improve the PBL design through iteration and adjustment and (4) seeking to document the impact of the PBL design implementation on students' learning and students' learning environment. Instead of strictly following a set of ideas, the DBR allows the researcher to systematically adjust and iterate the PBL design as the research progresses especially during the implementation phase. This practice of embedded research within practical activities has led to (1) having the PBL design itself as a study, (2) better informed core issues in education, and (3) achievement of higher external validity.

To achieve such PBL designs, the research was divided into three design phases: *Compiling initial findings for the PBL design*, *Developing the PBL design for Malaysia setting* and *Implementing the PBL design in Malaysia setting*. The first design phase aimed to shed light on the impact of PBL on student learning, and the potentials and

constraints of PBL implementation. Evidence Such information were gathered from theoretical, practical and contextual perspectives. Accordingly, research findings on the impacts of PBL on students' learning were favourable and the key potentials and constraints were identified. These collective initial findings have served as one of the three elements for PBL design development in the second design phase (i.e., *Developing the PBL design for Malaysia setting*). Another two elements involve in this PBL design development phase are; PBL curriculum elements and course analysis. A number of PBL curriculum elements were analysed to ensure that they were aligned, while the intended course for the PBL design implementation was analysed to ensure that the learning outcomes were addressed in the PBL design. Following the results from the second design phase, the course content was transformed into three PBL problems (PBL1: *Constructivism*, PBL2: *Alternative Conception* and PBL3: *21st Century Learning*). Each of these PBL problems emphasise on both knowledge and skills acquisition among the students. The PBL toolkit was also developed for all the PBL problems such as lesson plan, PBL scenario, student written reflection and assessment.

Subsequently, the PBL design was brought into practice in the third design phase (i.e., *Implementing the PBL design in Malaysia setting*). The aim of this phase is to implement the PBL design in Malaysian teacher education context and to ascertain the impact of the PBL design implementation on students' learning and on students' learning environment. Different numbers of weeks are required for the students to deal with the three PBL problems. Likewise, each PBL problem has different number of PBL learning cycles for the students to complete. To obtain the empirical data on the impact of the PBL design implementation on students' learning and students' learning environment, observation, students' written reflection, interview and questionnaire were used. Data analysis approach such as inductive analysis and descriptive statistics were use to qualitative and quantitative data respectively.

The findings of this research have indicated that the students were aware of the knowledge and the variety of skills they acquired, developed and improved throughout the course. The PBL activities that required the students to be actively involved in the learning process were linked to the knowledge and skills they acquired. The group learning activities–which included brainstorming, discussing, arguing, presenting and locating resources–have served as an opportunity for them to validate arguments, and

exchange and expand ideas–all of which have resulted in better resolutions of the tasks. The students also remarked their favour towards PBL: they felt comfortable sharing information and asking for help from the other group members. In managing the information, the students pointed out that their ability to find, reach and analyse information has improved, thus, they have learned a lot during the activities.

The above findings have spoken directly about (1) the methodology, (2) the PBL design and (3) the teaching and learning activities and materials. Application of DBR as the research methodology increases the relevance of the PBL design for the Malaysian teacher education since it value and consider multiple elements that influence learning. Therefore, initiating the new learning practice such as PBL is possible in a context that is entrenched with traditional learning practice, i.e Malaysian teacher education. The research has demonstrated that DBR is a feasible means to reconciliate the distance between PBL and the present learning environment adaopted in Malaysian teacher education.

SAMMENDRAG

Denne forskningsrapport omhandler udvikling, implementering og evaluering af Problembaseret Læring (PBL) designs i en malaysisk læreruddannelsessammenhæng. Den studenter-centrerede læring som f.eks. PBL er en relativt ny undervisnings- og læringstilgang på videregående uddannelser i Malaysia og det gav nogle særlige udfordringer, da dens tilgang var for forskellig fra de krav, begrænsninger og behov der er i den malaysiske læreruddannelse og kontekst. Under hensyntagen til denne udfordring er de foreslåede PBL designs justeret til at passe til den malaysiske læreruddannelse.

Under hensyn til ovennævnte forhold har forfatteren valgt Design Based Research (DBR) som metodologi, da principperne bag DBR stræber efter at gøre læring mere kontekstrelevant. Metoden tager højde for behov og normer i en lokal kontekst, hvilket har ført til forskningsresultater, der både er videnskabeligt pålidelige og praktisk anvendelige.

DBR lægger vægt på synergien mellem at forske, designe og konstruere PBL design i et forsøg på at forstå læring i et komplekst miljø. Da metoden vedrører læring og kognition, involverer dets iboende forsknings- og designaktiviteter (1) samarbejde med lokale praktikere (2) udvikling og implementering af et PBL-design (3) forsøg på at forfine og forbedre et PBL-design gennem gentagelse og justering og (4) søge efter at dokumentere den indflydelse implementeringen af et PBL-design har både på de studerendes læring og læringsmiljø. I stedet for stramt at følge et sæt af ideer, giver DBR forskeren mulighed for systematisk at justere og ny gentagelse af PBL-designet efterhånden som forskningen skrider frem. Praksissen med indlejret forskning inden for praktiske aktiviteter har ført til (1) at PBL bliver til et studie i sig selv (2) bedre forståelse af grundlæggende forhold inden for uddannelsessystemet (3) opnåelse af højere ekstern validitet.

For at opnå sådanne PBL designs, blev forskningen opdelt i tre designfaser: *Indsamling af de første resultater til PBL designet, Udvikling af PBL design til en malaysisk sammenhæng* og *Implementering af PBL designet i en malaysisk sammenhæng*. Den første designfase stræbte efter at få indblik i hvilken evidens der er for den indflydelse PBL har på de studerendes læring, samt potentialer og begrænsninger i implementering af

PBL. Evidensen blev indsamlet ud fra teoretiske, praktiske og kontekstuelle perspektiver. Som følge heraf var forskningsresultater om PBLs indvirkning på de studerendes læring nyttige, og de vigtigste potentialer såvel som begrænsninger blev identificeret. Denne samling af første resultater har ligget til grund for ét af de tre elementer i PBL-designets udvikling i den anden designfase (dvs. udvikling af PBL design til en malaysisk ramme). To andre elementer der indgår i denne PBL-designudviklingsfase er: PBL-curriculumfaktorer og kursusanalyse. Et antal PBL curriculumfaktorer blev analyseret for at sikre at de var alignet, mens den planlagte retning for PBL-designet blev analyseret for at sikre, at læringsresultaterne blev adresseret i PBL-designet. Ved at følge resultaterne fra den anden designfase, blev kursuselementerne transformeret til tre PBL problemer (PBL 1: *Konstruktivisme,* PBL2: *Alternativ opfattelse* og PBL 3: *21. århundredes læring).* Derudover blev læringsresultater, der lægger vægt på udvikling af både viden og færdigheder, adresseret, en PBL værktøjskasse, der fungerer som både undervisnings- og læringsmateriale for såvel facilitatorer som studerende, blev udviklet, gruppebedømmelser blev konstrueret og formodninger om læringsprocessen (PBL læringscyklus) blev fremlagt.

Efterfølgende blev PBL designet bragt i anvendelse i den tredje design fase (dvs. implementering af PBL-designet i malaysisk sammenhæng). Formålet med denne fase var at implementere PBL-designet i den malaysiske læreruddannelse og sikre PBL-designets indflydelse på de studerendes læring og deres læringsmiljø. De studerende har forskelligt antal uger til at arbejde med de tre PBL problemer. Ligeledes har hvert PBL-problem et forskelligt antal PBL-læringscyklusser, som de studerende skal gennemføre. For at få empiriske data om, hvordan implementeringen af PBL-designet havde indflydelse på de studerendes læring og deres læringsmiljø, blev der brugt observation, skriftlige refleksioner fra de studerende, interview og spørgeskema. Dataanalyseteknik, så som induktiv analytisk tilgang og deskriptive statistikker blev brugt til såvel kvalitative som kvantitative data.

Resultaterne af forskningen viser, at de studerende var bevidste om den viden og de forskellige færdigheder de havde opnået, udviklet og forbedret gennem kurset. PBL-aktiviteterne, som krævede, at de studerende var aktivt involveret i læringsprocessen, var forbundet med den viden og de færdigheder, de opnåede. Gruppelæringsaktiviteter, som involverede brainstorming, diskussioner, argumentering, præsentation og lokalisering af

resurser, har givet dem en mulighed for at validere argumenter og for at udveksle og udvide deres ideer. Alt dette har resulteret i bedre opgaveløsninger. De studerende gav også udtryk for velvilje over for PBL: de var tilpasse med at dele deres information og bede om hjælp fra andre gruppemedlemmer. I deres behandling af informationen påpegede de studerende, at deres evne til at finde, forstå og analysere information var forbedret, og at de dermed havde lært en masse igennem aktiviteterne.

De ovennævnte resultater har direkte nævnt (1) metodologien (2) PBL-design og (3) undervisnings- og læringsaktiviteter og materialer. Anvendelse af DBR som forskningsmetodologi øger således relevansen af PBL-designet for den malaysiske læreruddannelse.

RUMUSAN

Penyelidikan ini melibatkan pembangunan, perlaksanaan dan penilaian rekabentuk Pembelajaran Berasaskan Masalah (PBM) dalam konteks pendidikan guru Malaysia. Sebagai pendekatan pembelajaran dan pengajaran yang relatifnya baru dalam landskap pendidikan tinggi Malaysia, pembelajaran berpusatkan pelajar seperti PBM telah memberi cabaran kerana pendekatan ini terlalu berbeza daripada kehendak dan kekangan dalam keperluan kontekstual (i.e., pendidikan guru Malaysia). Rentetan dari cabaran ini, rekabentuk PBM yang telah dicadangkan adalah diselaraskan untuk disesuaikan dengan konteks pendidikan guru Malaysia.

Untuk mengetengahkan isu-isu di atas, penyelidik telah menerima pakai Penyelidikan Berasaskan Rekabentuk (PBR) sebagai metodologi kerana prinsipnya yang berusaha untuk membuat penyelidikan pembelajaran yang lebih relevan dalam konteks. Secara khususnya, metod ini mengutarakan keperluan dan norma konteks tempatan, yang telah membawa kepada dapatan penyelidikan yang boleh dipercayai secara saintifik dan berguna dari segi praktikal.

PBR menekankan hubungan sinergi antara penyelidikan, mereka bentuk dan kejuruteraan rekabentuk PBM dalam usaha untuk memahami pembelajaran dalam suasana yang kompleks. Oleh kerana metod mengambil berat tentang pembelajaran dan kognisi , aktiviti yang sedia ada dalam penyelidikan dan reka bentuk melibatkan (1) bekerjasama dengan pengamal tempatan , (2) membangun dan melaksanakan reka bentuk PBM , (3) berusaha untuk memperbaiki dan menambah baik pembangunan PBM melalui iterasi dan penyesuaian dan (4) ingin mendokumentasikan kesan pelaksanaan reka bentuk PBM pada pembelajaran dan persekitaran pembelajaran pelajar. Selain dari mengikuti satu set idea-idea secara ketat, PBR membolehkan penyelidik untuk menyesuaikan PBM secara sistematik dan iterasi reka bentuk PBM semasa progres penyelidikan berlansung. Amalan penyelidikan ini dalam aktiviti praktikal telah membawa kepada (1) pengkajian rekabentuk PBM itu sendiri, (2) memberi maklumat tentang isu akar umbi pendidikan dan (3) pencapaian kesahihan luaran yang lebih tinggi.

Untuk mencapai reka bentuk PBM , kajian ini telah dibahagikan kepada tiga fasa reka bentuk: Mengumpul hasil penyelidikan awal untuk reka bentuk PBM, Membangunkan reka bentuk PBM bagi tetapan dalam Malaysia dan Melaksanakan reka bentuk PBL dalam suasana Malaysia. Fasa reka bentuk pertama bertujuan untuk memberi penerangan mengenai bukti kesan PBM kepada pembelajaran pelajar, dan potensi dan kekangan dalam pelaksanaan PBM . Bukti telah dikumpulkan dari perspektif teori , praktikal dan kontekstual. Oleh itu, hasil penyelidikan terhadap impak PBM kepada pembelajaran pelajar adalah menggalakkan dan potensi utama dan kekangan telah dikenal pasti. Penemuan awal kolektif dijadikan sebagai salah satu daripada tiga unsur pembangunan rekabentuk PBM dalam fasa reka bentuk kedua (i.e, membangunkan reka bentuk PBM bagi tetapan Malaysia). Dua lagi elemen melibatkan dalam fasa pembangunan reka bentuk PBM ini adalah; elemen kurikulum PBM dan analisis kursus. Beberapa elemen kurikulum PBM dianalisis untuk memastikan keselarian, manakala kursus yang dicadangkan untuk pelaksanaan reka bentuk PBM dianalisis bagi memastikan hasil pembelajaran diutarakan dalam reka bentuk PBM ini. Rentetan hasil daripada fasa rekabentuk kedua,kandungan kursus telah ditransformasikan menjadi tiga masalah PBM (PBM1: Konstruktivisme, PBM2: Konsepsi Alternatif dan PBM3: Pembelajaran Abad ke-21). Hasil pembelajaran yang menekankan pengetahuan dan kemahiran pembelajaran telah diutarakan, Kit PBM yang berfungsi sebagai bahan pengajaran dan pembelajaran untuk kedua-dua fasilitator dan pelajar telah dibangunkan, pentaksiran kumpulan telah dibina dan andaian proses pembelajaran (kitaran pembelajaran PBM) telah dibuat.

Selanjutnya, reka bentuk PBM telah dipratikkan dalam fasa reka bentuk ketiga (i.e, melaksanakan reka bentuk PBL dalam suasana Malaysia). Tujuan fasa ini adalah untuk melaksanakan reka bentuk PBM dalam konteks pendidikan guru Malaysia dan menentukan kesan pelaksanaan reka bentuk PBM terhadap pembelajaran dan persekitaran pembelajaran pelajar. Beberapa minggu diperuntukkan kepada pelajar untuk menangani tiga masalah PBM. Dengan itu, setiap masalah PBM juga mempunyai bilangan kitaran pembelajaran PBM yang berbeza kepada pelajar. Untuk mendapatkan data empirikal mengenai kesan pelaksanaan reka bentuk PBL pada pembelajaran dan persekitaran pembelajaran pelajar, kaedah pemerhatian, refleksi pelajar bertulis, temuduga dan soal selidik telah digunakan. Teknik analisis data seperti pendekatan induktif dan analisis statistik deskriptif telah digunakan untuk data kualitatif dan kuantitatif.

Hasil kajian ini telah menunjukkan bahawa pelajar-pelajar menyedari pengetahuan dan kepelbagaian kemahiran yang telah mereka peroleh , membangun dan bertambah baik sepanjang kursus. Aktiviti PBM yang memerlukan pelajar untuk terlibat secara aktif dalam proses pembelajaran telah dikaitkan dengan pengetahuan dan kemahiran yang mereka perolehi. Aktiviti pembelajaran secara berkumpulan melibatkan sumbang saran , perbincangan, berhujah , penyampaian dan pencarian sumber telah digunakan sebagai suatu peluang bagi mereka untuk mengesahkan hujah, dan bertukar dan mengembangkan idea yang kesemuanya telah menjana resolusi yang lebih baik untuk tugasan. Pelajar juga telah menunjukkan kecenderungan terhadap PBM: mereka merasa selesa untuk berkongsi maklumat dan meminta bantuan daripada ahli-ahli kumpulan yang lain. Dalam menguruskan maklumat, pelajar menegaskan bahawa keupayaan mereka untuk mencari, mencapai dan menganalisa maklumat telah menjadi bertambah baik, justeru itu, mereka telah banyak belajar semasa aktiviti dijalankan.

Dapatan kajian di atas secara langsung diperkaitkan dengan (1) metodologi kajian, (2) reka bentuk PBM serta (3) aktiviti dan bahan pengajaran dan pembelajaran. Penggunaan PBR sebagai metodologi penyelidikan telah meningkatkan kesesuaian reka bentuk PBM dalam pendidikan guru Malaysia kerana ianya menilai dan mempertimbangkan pelbagai element yang mempengaruhi pembelaajaran. Maka, memulakan satu amalan pembelajaran yang baru seperti PBM adalah berpotensi walaupun konteks pendidikan guru Malaysia adalah berakar umbikan pembelajaran berpusatkan guru. Penyelidikan ini telah menunjukkan bahawa PBR adalah satu wadah yang berpotensi dalam usaha merapatkan jurang antara amalan pembelajaran semasa pendidikan guru Malaysia dan PBM.

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CHAPTER 1

INTRODUCTION

To meet the goal of educating pre-service and in-service school teachers for 21st century schools, teacher educators in higher education are demanded to employ an innovative forms of pedagogy that suits adult learners. Conventional pedagogy that entrenched in higher education is no longer sufficient to meet this current demand. Being at the frontline in preparing Malaysian school teachers, teacher educators continually seek better ways to strengthen their students' (pre-service and in-service school teachers) knowledge, skills and dispositions in order to be successful in diverse classrooms.

To meet such demand, Problem Based Learning (PBL) is one of the teaching and learning approach designed to foster active learning experience and inculcate skills and competencies among students. Accordingly, this research aims to develop, implement and evaluate a PBL design in the context of Malaysian teacher education. The first section of this chapter provides preliminary insights on the motivation and drivers for the shifting to active learning practice in higher education from policy perspective.

Since active learning is entrenched from constructivism philosophy, the second section comprehensively discusses the many aspects of PBL, from basic assumption of learning to interpreting the practice from constructivism point of view. The third section discusses PBL from models practices in specific institutions and learning principles that derived across variety of PBL models. The fourth section gives an overview of PBL implementation both in Malaysian higher education and in teacher education. Analysis of the interplay between those aforementioned issues, research questions and research objectives are formulated in the fifth part of this chapter.

1.1 Background

Concerns towards education systems that do not adequately prepare students for living and working have prompted reviews in education worldwide. Students' learning in higher

education is largely influenced by the way their teachers/lecturers teach. A long-standing criticism with regards to this issue is the approach of teaching and learning in higher education that disregards students' attainment of skills and competencies. Higher education specialists suggest that institutions should focus on inculcating generic skills (Murray-Harvey et al., 2004) and emphasize on the quality of the thinking process rather than accuracy of the students´ answers (Casey and Howson, 1993).

In the past, extensive cognitive science studies on the nature of learning have focused on having teaching moved towards learning (Barr and Tagg, 1995); this in turn, would encourage a student-centered approach to teaching and learning in higher education that will facilitate the production of university graduates who possess not only knowledge, but skills and competencies as well. Fostering such outcome challenges the higher education to develop, implement and evaluate teaching and learning approaches that are student-centred. To effectively address these issues in higher education, policies on higher education are steered to highlight the need to develop a more well-rounded university graduates. For example, the Bologna process in Europe has emphasized on student-centered learning, outcome based education and competencies to achieve such aims (Kolmos, 2010). To keep abreast, the Malaysia's higher education has introduced the outcome-based education (OBE) in the late 1990´s (Puteh, 2013).

OBE is a method of curriculum design and teaching and learning activities that focuses on what students can actually do after class. In OBE, the learning outcomes of the course does not only focus on students' possession of knowledge, but also on their development of appropriate skills and qualities upon graduation. This equal emphasis on both knowledge and skills has prompted university teachers to enquire: *What do we want our students to learn? Why do we want them to learn it? What is the best ways to help student to learn it? and how do we know that they have learnt it?*. Hence, the OBE emphasizes on active learning where students are expected to tackle many challenging tasks other than memorizing and reproducing what has been taught. To realize this aim across Malaysian public universities, the Malaysian Qualification Framework (MQF) was established at the end of 2007 (Pelan Strategik Pengajian Tinggi Negara, 2007). In line with its role as the reference for quality in Malaysian higher education, the MQF emphasizes on the following learning outcome domain:

i. Knowledge
ii. Practical skills
iii. Social skills and responsibilities
iv. Values, attitudes and professionalism
v. Communications, leaderships and team skills
vi. Problem solving and scientific skills
vii. Information managements and lifelong learning
viii. Managing and entrepreneurial skills

As a teacher educator who teaches in an educational university in Malaysia, the researcher has to include those learning outcome domains in the course to achieve the OBE aims. Regardless, the researcher's concern is not only on the policy change in higher education, but also on the development of Malaysian school policy and how it affects the ways pre-service and in-service teachers are being taught in teacher education institutions.

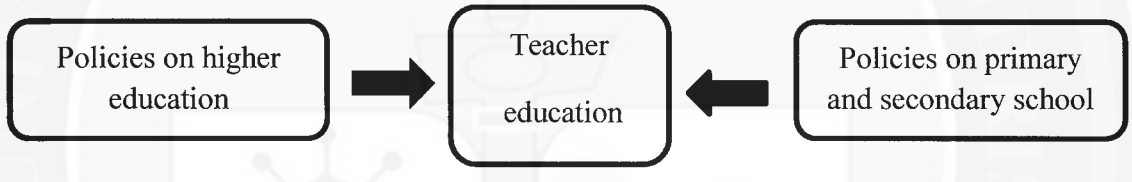

Figure 1: Teacher education is influenced by both policies on higher education and on primary and secondary school

As depicted in Figure 1, teacher education does not take place in a vacuum. Teacher education should correspond to the policy changes in higher education, as well as in primary and secondary school policy. Developments and changes in national policies and initiatives have implications on how teachers are being prepared. Furthermore, teachers need to stay abreast with the changes in local and national standards. Recent development with regards to school teachers and school children is the introduction of the School-Based Assessments (SBA) by the Malaysia´s Ministry of Education in 2011 (Panduan Pengurusan Pentaksiran Berasaskan Sekolah, 2012). The rationale of the SBA implementation is to:

i. Develop learners´ physical, emotional, spiritual and intellectual abilities
ii. Reduce exam-oriented learning among learners
iii. Evaluate learners´ learning progress

iv. Enhance teachers' integrity in assessing, recording and reporting of learners' learning.

SBA is a holistic, integrated and standard-referenced assessment approach that emphasizes on the development of cognitive and affective psychomotor of a school student. There are two categories in SBA: academic and non-academic. School teachers are given the responsibility to conduct and administer SBA by using instruments, rubrics and guidelines. In fact, they should plan, prepare the instruments and administer the assessment during the teaching and learning process (Panduan Pengurusan Pentaksiran Berasaskan Sekolah, 2012). In other words, school teachers need to assess their students in ways different from the ones they are used to. This however, raises the question; *do the in-service teachers or pre-service teachers have the ability to meet such demand?*

Like any other profession, teachers are urged to be more responsive and relevant to the on-going changes regarding schools and school students. In particular, the role of today's teachers is not limited to teaching and classroom matters; they are also carrying multiple roles like being a researcher, a curriculum planner, a team leader, a decision maker and the one that inculcates creativity, intellectuality, problem solving ability and critical thinking skills. For this reason, teachers need to equip themselves with necessary skills, attitudes and disposition to correspond with the ever-changing complexity of the school classrooms, such as diversity of students' backgrounds, inclusive classrooms and ongoing development of technologies (Dean, 1998 and Goodnough, 2006). Edmundson (1990) argued that a teacher education programme does not provide the foundations to help future and new teachers develop their skills and competencies relevant to their future professions as school teachers. He added:

> *New teachers will be unable to resist the powerful conservative effects of the schools and may themselves become the obstacles of change (p. 722).*

This statement implies that teachers need to be prepared for any change to take place in schools. Entailing issues of policy change, both in Malaysia's higher education and schools, have reflected on my role as a teacher educator who prepares teachers for both Malaysian primary and secondary schools. Hence, I queried:

i. How to implement OBE in my teaching and learning?

ii. How to prepare teachers (pre-service and in-service teachers) that correspond to current school demands?

iii. How to continually prepare teachers according to the current demands, and how to sustain the new pedagogical practice in teacher education?

A new approach in teaching and learning practice seemed to be an essential element in giving teachers the responsiveness they need to meet with new developments in school policies.

1.2 Conception of Learning and Constructivism

Early understanding of what constitutes learning was contributed by the behaviourist school of thought, who postulated learning as a change in observable behaviour caused by external stimuli in the environment (Skinner, 1974). Early behaviourist scientists such as Thorndike and Pavlov claimed that observable behaviour indicates that the learner has learned, and not what is going on in his cognitive structure. The research on learning remained flourished within behavioural tradition of psychology until 1960s (Shuell, 1986).

Between 1960s and 1970s, the psychology of learning began to change from a behaviouristic to cognitive orientations (Shuell, 1986) since there was a shift from environmental influences towards human factor to describe learning. This shift began with the development of cognitive psychology that placed great emphasis on learner's information processing as the central cause of learning. This is from the response of cognitive psychologists who claimed that not all learning is observable and there is more to learning than a change in behaviour. Cognitive psychology is concerned with various mental activities such as perception, thinking knowledge representation and memory. Hence, the cognitive psychologists posit learning as internal process, and the amount of learning depends on the processing capacity of the learner, the amount of effort expended during the learning process and the learner´s existing structure (Ausubel, 1974).

Learning, as Marton and Booth (1997) defined, is how learners perceive and understand the world, and about "meaning making". To describe meaning making, cognitive

psychologists have introduced "structure" such as schemata and heuristics to represent knowledge in memory (Palincsar, 1998). Therefore, knowledge is not imposed from outside but rather from inside the learners. The schemata undergoes assimilation or accommodation process as the learners are exposed to new understandings, experiences, actions and information. Change in schemata (either through assimilation or accommodation) reflects that learning has occurred. Learning (whether in cognitive, affective, interpersonal or psychomotor domains) involves a process of individual transformation and for this reason, people actively construct their knowledge (Biggs and Moore, 1993). An individual's construction of knowledge is true to that person but not necessarily to anyone else since learners produce knowledge based on their beliefs and experience in situations that differ from person to another (Cobb and Bowers, 1999). These were the basic assumption that gave rise to constructivism.

Constructivism stemmed from the burgeoning field of cognitive science particularly from Jean Piaget's work and the socio-historical work of Ley Vygotsky. According to Simpson (2002), constructivism is an epistemology or philosophical explanation about the nature of learning. It shares characteristics with social cognitive theory that assumes persons, behaviours, and environment interact in reciprocal fashions (Bandura, 1997). However, constructivism differs from conditioning theories that stress environmental influence on the learners; it also contrasts with the cognitive information processing theory that places the locus of learning within the mind, with little attention to the context in which it occurs (Schunk, 2009).

Constructivism can be explained from three different perspectives of *exogenous, endogenous* and *dialectical* (Schunk, 2009). *Exogenous constructivism* emphasizes on the notion that knowledge acquisition is represented by a reconstruction of structure on the external world. This view implies a strong influence of external world in knowledge construction, which may include experience and teaching. In contrast, *endogenous constructivism* refers to the mental structure to explain knowledge acquisition whereby knowledge is developed through cognitive abstraction from previously acquired knowledge–not directly from environmental interactions as in exogenous constructivism. *Dialectical constructivism* highlights the interaction between persons and environments to explain knowledge construction. Construction of knowledge is neither merely from

external world, nor from the results of mental structure abstraction; rather, it is the result of mental interaction with the environment.

The basic premise of constructivism is that learning occurs by fitting new understanding and knowledge into old understanding and knowledge (Fry, Ketteridge and Marshall, 2009). This underlies many learning principles that has affected theories and research in learning and development (Schunk, 2009). A learning environment that reflects constructivism principles, as characterized by Brooks and Brooks (1999), is shown in Table 1:

Table 1: Principles of constructivism learning environments

• Posing problems of emerging relevance to students
• Structuring learning around primary concept
• Seeking and valuing students' point of view and opinions
• Adapting curriculum to address students' suppositions
• Assessing student learning in the context of teaching

Source: from Brooks and Brooks (1999), pg35-96

From curriculum perspectives, constructivism emphasizes an integrated curriculum whereby a topic is studied from multiple perspectives. From teaching perspectives, constructivism contradicts to the traditional delivery of instruction to learners. Rather, the lesson is structured in a way that engages learners to the teaching and learning process by active participation, which allows them to construct their own understanding. In a constructivism classroom, learners are taught to be self-directed and take active role in their learning by setting goals, monitoring and evaluating progress, and exploring interest (Bruning at al., 2004). As a result, constructivism learning environment gives students ownership of what they've learned and encourages higher retention, as the learners seek meaning for themselves and not the meaning constructed by their teachers (Hmelo and Evensen, 2000). A constructivism learning environment such as cooperative learning, peer tutoring and class discussion are designed in a way that allows students to play an active role (mentally, physically, socially and emotionally) during the learning process. PBL is also aligned with the constructivism framework that views learning and teaching as an active and meaningful inquiry by learners. Likewise, Savery and Duffy (1995) specifically described PBL from a constructivism framework:

i. *Learners construct their own knowledge* - Learners are encouraged and expected to think both critically and creatively with multi-directional interactions with the problem, their peers, the resources, and the instructor. Learning is no more a process of transmitting information from others to the learners themselves; rather, it's a process of immersing themselves into a problem situation, one that allows them to monitor their own understanding.

ii. *Problems as stimulus and organizer for learning* - All learnings arise from discussing the problem in class, generating hypotheses, identifying relevant facts related to the problem and identifying learning issues based on their analysis of the problem.

iii. *Knowledge is socially negotiated* - Social negotiation of meaning is an important part of the problem-solving team structure. Students' understanding of the content is constantly challenged and tested by others.

Learning through group work and collaboration explains for how individuals construct and transform their knowledge and conceptual understanding through communication among group members. The emphasis on collaborative learning in PBL reflects *dialectical constructivism* explanations for how individuals construct and transform knowledge and conceptual understanding through dialectical activity. This dialectical constructivism entrenched from Vygotsky´s theory of learning as social process. In particular, Vygotsky proposed that social interaction leads to knowledge construction in which communication serves as the main tool that promotes thinking, develops reasoning and supports activities like reading and writing (Vygotsky, 1978). Because knowledge is socially constructed, collaboration and exchange of ideas among group members lead to the inculcation of social and communication skills. Collaborative learning is valued, not only for the pragmatic value of supporting the development of team-work skills needed in professional practice (Maudsley & Strivens, 2000), but also in recognizing the view that learning is not an isolated, individual activity.

Accordingly, Malaysia´s National Higher Education Action Plan (2011) recommended that lecturers/university teachers in higher education institutions adopt student-centred learning approaches in their classrooms in order to achieve both the OBE aims and the quality of teaching and learning in higher education, in which the Problem Based