EXPLORING LEVEL OF STUDENTS' GENERATED QUESTIONS THROUGH A PROBLEM BASED LEARNING APPROACH

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ABSTRACT

Problem Based Learning (PBL) is believed be able to promote higher order thinking, better problem solving skills and analytical thinking towards biology learning.This study employed problem-based learning in a Pre-University biology class (N=80) in a private college in Malaysia. The important aspect of the research is to elicit students' natural inquiry by collecting their questions addressing problem scenario and categorization of those questions. As part of their syllabus, the problem is based on topics Inheritance and Genetic Technology which arouse their interest to learn thru PBL. The purpose of the study was to investigate (a) the individually generated questions and group generated questions based on Bloom's taxonomy, (b) the comparisons of types of questions that students asked individually and collaboratively based on Bloom's taxonomy, and (c) explore students' reflection in learning through the PBL approach which has guided them in knowledge construction. Data sources included field notes, students' written documents working in groups, and individually. The results suggest that the students' were able to generate questions of higher order thinking when working collaboratively especially in higher order thinking domain. The independent t test resulted significant difference when questions generated as individual and group generated with significant difference (t: 2.437) p=0.015 (knowledge) with a mean difference 0.101 and (t:-3.219) p=0.000 (analysis) with a mean difference -0.128; therefore both value is $p<0.05$, hence both these domains showed the significant difference. Feedback and reflection responses from this study clearly illustrate that PBL allows students to develop their soft skills through active participation in the learning process. This study is believed to provide biology teachers with new instructional tools to face the challenges of teaching genetics and bioethics in a manner that is content-rich, research and standards-based, and relevant to students' daily lives. Implications of the findings for instructional practice are discussed.

MENEROKAI TAHAP SOALAN PELAJAR YANG DIHASILKAN MELALUI PENDEKATAN PEMBELAJARAN BERASASKAN MASALAH

ABSTRAK

Pembelajaran berasaskan masalah (PBM) berupaya meningkatkan pemikiran aras tinggi, kaedah penyelesaian masalah serta menerapkan sifat analitikal terhadap pembelajaran Biologi. Kajian ini dijalankan ke atas pelajar Pra Universiti (N=80) di sebuah kolej swasta. Aspek utama kajian adalah untuk mencungkil sifat inkuiri naturalistik yang terdapat dalam pelajar melalui PBM. Lantaran, soalan yang dihasilkan oleh pelajar- pelajar yang berkaitan dengan senario masalah yang dikemukan akan diperoleh dan diklasifikasikan mengikut Taxonomi Bloom. Senario ini dihasilkan bersesuaian dengan sukatan pelajaran dan dimurnikan untuk topik Pewarisan dan Teknologi Gen untuk menarik minat pelajar untuk mengikuti PBM. Kajian ini dijalankan untuk mengkaji: (a) jenis dan kategori soalan individu dan berkumpulan mengikut Taxonomi Bloom, (b) perbezaan kategori soalan individu dan berkumpulan mengikut Taxonomi Bloom, (c) refleksi pelajar yang mengikuti PBM sebagai kaedah pengajaran yang akan membina pengetahuan subjek. Data- data yang dikumpulkan dalam kajian termasuk nota-nota ringkas, hasil catatan pelajar secara individu dan semasa berkumpulan. Kajian ini mencadangkan bahawa pelajar dapat menghasilkan soalan-soalan yang berpemikiran aras tinggi semasa berkumpulan berlandaskan aras tinggi Taxonomi Bloom. Ujian T sampel bebas menunjukkan perbezaan signifikan untuk domain Pengetahuan dan Analsis mengikut Taxonomi Bloom yang terbukti dengan nilai (t: 2.437) p=0.015(domain pengetahuan) dengan perbezaan min 0.101 serta nilai (t:-3.219) p=0.000 domain analisis) dengan perbezaan min -0.128; maka kedua-dua nilai $p<0.05$, mencadangkan bahawa ada peningkatan pemikiran aras tinggi semasa berkumpulan berlandaskan soalan-soalan dalam domain ini. Respons serta refleksi daripada pelajar menjelaskan bahawa PBM membantu pelajar membina kemahiran insaniah melalui penglibatan aktif dalam pembelajaran. Kajian ini diharap membuka wahana baru untuk pendidik dengan kaedah pengajaran inovatif untuk membuka minda mereka dengan cabaran pengajaran topik biologi seperti genetik serta bio-etika yang mempunyai kandungan yang padat serta relevan dengan kehidupan pelajar. Implikasi kajian dibincangkan menitikberatkan kaedah pengajaran dan pembelajaran.

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LIST OF ABBREVIATIONS

PBL	Problem Based Learning
SPM	Sijil Pelajaran Malaysia
MOHE	Ministry of Higher Education
BT	Bloom's Taxonomy
UPSI	Universiti Pendidikan Sultan Idris
UKM	Universiti Kebangsaan Malaysia
IMU	International Medical University
HOTS	Higher Order Thinking Skill
LOTS	Lower Order Thinking Skill
HD	Huntington Disease
PBM	Pembelajaran Berasaskan Masalah
FILA	Facts, Ideas, Learning Issues, Action
T&L	Teaching and Learning
SPSS	Statistical Package for Social Research
SDL	Self-Directed Learning
ZPD	Zone of Proximal Development

CHAPTER 1

INTRODUCTION

1.1 Introduction

Malaysia is developing country and the nation is embarking to attain a competitive society inline with the Vision 2020. In the quest of building a scientific and progressive society, the Malaysian Government has taken measures to enhance the potential of Malaysian education and moving the nation as knowledge society. In a scientific society, the entity of an individual is important to the contribution of the society shift. This paradigm shift is important to the nation's growth in term of intellectual and academicians who are versatile and multi-disciplinary. The significance of this shift will draw the global attention towards our country and uphold our country's education policy. This will support the mission of Ministry of Higher Education (MOHE) which states, to develop and put in place a higher

education environment that encourages the growth of premier knowledge centre and individuals who are competent and innovative with high moral values to meet national and international needs (AIM:MOHE, 2009).

A teacher's role is ever challenging in equipping the body of knowledge as per our National Education Philosophy. A teacher also acts as a facilitator and guides easy path for task designated for students. Therefore a teacher's key role also includes in teaching a concept or a skill easily in a learning processes. Teacher equips the student with different concept and knowledge by drawing their attention with various method of teaching, thus the creativity of the teacher will boost the learner's characteristic to be more holistic and passionate about learning.

Generally, learning is actively constructed from prior knowledge and students must construct new knowledge from prior knowledge. As emphasized by the constructivism learning theory by Piaget, all new learning depends on the learner's prior knowledge and current state of understanding (Bybee, 2002). In another research by (Pepper, 2009) mentioned in her article that student's knowledge construction process incudes students deciding on the information and skills they need to investigate issues while building on their current knowledge to synthesize then integrate new information.

Therefore a teacher is suggested to emphasize on these characteristics during a learning process; thinking skill, mastery study, ICT skill, study skill, conceptual learning, self-directed learning, resourceful and responsible in the students. All these

key points will enable in producing a competent student whom are ready to face the challenging of the world in our current era and in near future (AIM: MOHE 2009).

1.2 Background of Research

The world today is dominated by web technology that has grown to touch people of all ages and lifestyles. It is undeniable that web technology to date has fascinated the younger generation in more ways than one to utilize and benefit from using internet as a source of entertainment despite its potential use as a priceless resource centre for knowledge acquiring. Understanding the current scenario it is necessary to divert and channel students' interest and skills in using the various method of teaching that makes the learning process creative and interesting in order to create an active learner classroom because deep conceptual learning requires interactive engagement.

Biology is taught in almost all schools in Malaysia with a specified curriculum and syllabus. It is a field of science that is growing rapidly. The advancement in technology enables topics in Biology to be taught interactively and with features that may well attract and motivate students to focus in depth of its concepts and contents. However, all the information and loads of facts available on the internet may not be useful to students to grasp and comprehend unless it is carefully directed and guided by an instructor or facilitator.

Problem Based Learning (PBL) caters for this need as its teaching and learning approach integrates student centered learning with the usages of exciting

virtual technologies. Massive information and knowledge obtained from the web is made worthy to students through PBL approach. PBL is a purpose driven learning style that is characterised by flexibility and diversity in the sense that it can be implemented in variety of ways in different subjects and disciplines in diverse contexts' reported by Savin – Baden (2001).

According to Suzilawati Shamsuddin (2007) PBL approach is an excellent strategy in teaching Biology according to the constructivism theory. This approach focuses on problem as an eliciting mechanism in learning process. In the PBL process, students will enhance the level of confidence and work cooperatively in solving the matter addressed and will attain self-directed learning skill.

According to an article written by Daniel (1992) the impartation of high order thinking skill (HOTS) is still vague in learning Biology whereby students are prone to omit facts without understanding in Biology concepts. Hence when teachers pose questions that test their critical thinking they are having difficulty. A book written by Allen (2001) mentioned that PBL have functional entity in allowing the development of HOTS among students and thus promoting the analytical mind. There is also a need to see if the group dynamics in learning brings a better elevation in HOTS among students which will be the main concern in this research. In PBL, students also experience materializing scientific information where there is "pursuit of meaningful questions through the use of the procedures that are thoughtfully generated and evaluated by those who are asking questions" and this is part and parcel of scientific inquiry (Palinscar *et. al.*, 1993).

Reflection can be define as a complex process of thinking in which students can reflect and comment critically about their strengths and weakness that allows them to highlight areas for development (Lin & Lucey, 2010). The students' reflection will also enhance their passion and understanding in science subjects such as Biology through their learning process. Students' feedback also offers insight about the likes and dislikes of PBL and how it can contribute to learning of sciences. This is further supported by local research (Baharom & Saad, 2009) whereby their research clearly proved that online feedback and reflection provided students an ideal platform for the expression of their student's thoughts and elicitation of ideas and whereby their sample being Asian students, they found it easier to express their thinking and analysis of situations.

1.3 Problem Statement

The teacher centered learning is still popular among many academic institution and nevertheless many students find this way is boring furthermore science subjects heavy with facts such as Biology (Escotet, 1995). Therefore, this study focused to show that the Teaching and Learning is diversified and can be channeled to knowledge acquiring and classroom discussions through PBL in Biology. It is aimed at helping students increase their cognitive gains. This is done by exploring the ability to generate questions and categorised based on Bloom's Taxonomy and improve their classroom interactivity generally during the PBL facilitation.

The current teaching and learning experience in colleges focusing Biology in Malaysia today are driven towards traditional, one-way learning pedagogical model. The students are passive recipients of science knowledge and the teacher as the provider of knowledge resultant of failure despite efforts and moves taken to diversify teaching approaches and create interactive learning classrooms by the Ministry of Higher Education (Ministry of Higher Education, 2007). This only allows room for minimal creativity and critical thinking on the part of the students. It has also been shown by study of DeHaan (2009) that passive learning setting does little to promote deep conceptual understanding. He also added that most college the instructors teach science primarily through lectures and textbooks that are dominated by facts and algorithmic processing rather than by concepts, principles, and evidence-based ways of thinking. This is despite ample evidence that many students gain little new knowledge from traditional lectures in learning science fundamental such as Biology.

The topics like Genetics and Inheritance are topics where students find difficulty to gauge in the Biology subject. According to academic experts of some private colleges in western countries that concludes that these chapters need an innovative method in teaching due to abundance of concepts and application knowledge heavily loaded in the content which was remarked from their general observations in teaching plans according to writers Koba & Tweed (2009) in their book *"Hard-to-teach biology concepts: a framework to deepen student understanding"*.

Furthermore Biology has been always been labeled as boring subject and many teacher still practice teacher centered teaching as in traditional approach

whereby teachers acts as the instructor of course and deliberating important points. This is supported by a researcher Williams *et.al.* (2003) who said students only the enjoyed practical in Biology and find that lectures are boring. He added another frequent reason for finding biology boring was when it was envisaged as repetitive or predictable. Perhaps the most obvious factor raised by students was the link between finding a subject boring and perceiving it as being difficult. Indeed, there is evidence that the perception of a subject as being difficult tends to result in the development of a general negative attitude to that subject. Therefore the PBL approach is suitable to bring up the actual potential the students and promote passion in learning subjects as Biology.

In other words, the current teaching practices in college have failed in terms of promoting deep understanding and instill HOTS within them. Students are not attracted by the many teaching courseware and interactive CD applications that are available in colleges today as they are not as fascinating and interactive as the material that is available in the web. Hence, is PBL is believed be able to promote higher order thinking, better problem solving skills and analytical thinking towards biology learning? Does PBL enable students to access and process information from the web for knowledge acquisition? Does PBL impacts their learning style in Biology? These were some of the questions underlying the main issues that initiated the reason why study was done.

1.4 Purpose of the Research

The purpose of the research was carried out was because for several reasons. Firstly the teacher will act as the instructor/ facilitator in giving information to students and they will be passive learner which contradicts with the National Education Philosophy (Rose Amnah *et.al.* 2004) as they will not be holistic learner in an integrated manner. The challenging topics in biology such as this chapter (Inheritance & Gene Technology) are complex and many students having difficulty to understand the content. Thus, the PBL offers active engagement in group work which will create an active learning environment in group work and group dynamics. Hence this deepens the understanding in these core chapters of Biology such Inheritance and Gene Technology (Nakhleh, 1992). The other reason was, that so far, students cognitive engagement have received few research interests, and therefore, there is a need for more research on this dimension within the context of the Malaysian private education system.

1.4.1 Research Objectives

Generally, the research evolves from the approach of PBL on student learning and student success in Biology. The following are the main objectives of this study:

1. To explore the categories of questions generated based on the Bloom's taxonomy, by students and group through the intervention of PBL.
2. To compare the mean differences in the types of questions generated between individual and group for categories based on Blooms taxonomy.

3. To explore the students' reflection of the Problem Based Learning approach.

1.4.2 Research Questions

Generally the researcher has attempted to answer the following questions in this study. These questions are:

1. What are the types of questions generated by individual students and students in groups learning through the PBL approach?
2. Is there any difference between individual and group generated questions based on categories of Bloom's Taxonomy after learning through the PBL approach?
3. How does PBL contribute to students' learning?

1.4.3 Hypothesis of the Research

This research will test on the following null hypothesis and following six sub-hypotheses as followed:

H_o: There is no significant difference between the group and individually generated questions based on categories of Bloom's Taxonomy after the facilitation in PBL.

H_o1: There is no significant difference between the group and individually generated category of questions (Knowledge) based on Bloom's Taxonomy after the facilitation in PBL.

H_o2: There is no significant difference between the group and individually generated category of questions (Comprehension) based on Bloom's Taxonomy after the facilitation in PBL.

H_o3: There is no significant difference between the group and individually generated category of questions (Application) based on Bloom's Taxonomy after the facilitation in PBL.

H_o4: There is no significant difference between the group and individually generated category of questions (Analysis) based on Bloom's Taxonomy after the facilitation in PBL.

H_o5: There is no significant difference between the group and individually generated category of questions (Synthesis) based on Bloom's Taxonomy after the facilitation in PBL.

H_o6: There is no significant difference between the group and individually generated category of questions (Evaluation) based on Bloom's Taxonomy after the facilitation in PBL.

1.5 Conceptual Framework

The PBL approach is main part in this study whereby this study is to explore the effects of PBL approach in enhancing the types of questions generated based on the Bloom's taxonomy questioning skill and students reflection on PBL approach. The constructivist theory by Vygostky formed the foundation of this concept. The framework of the study is shown in the Figure 1.1:

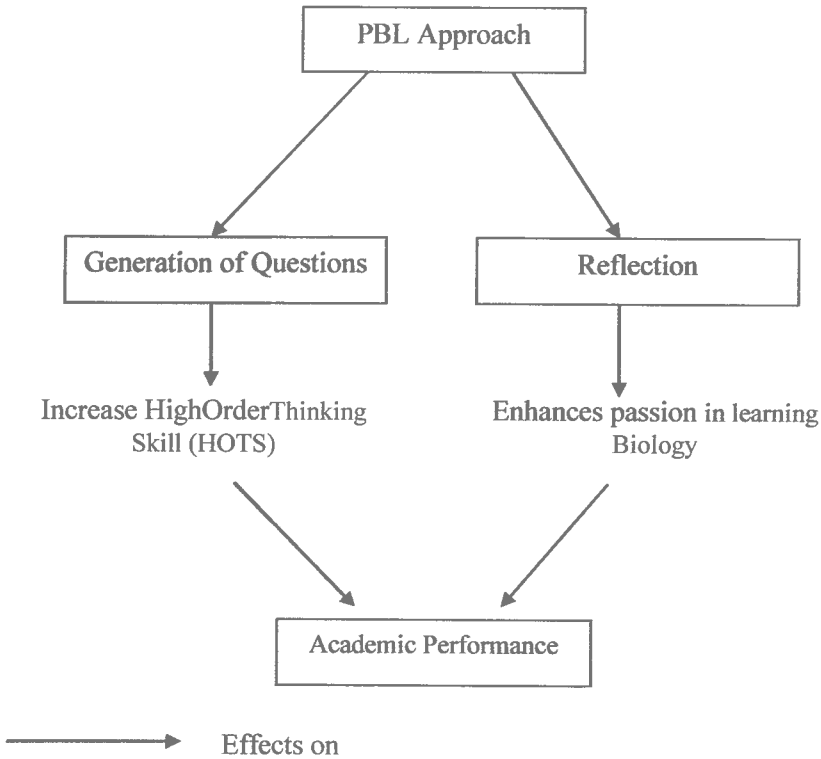

Figure 1.1. Conceptual framework of the study

Based on the conceptual framework, the PBL intervention will be the independent variable which effects on the types of questions generated based on the Bloom's taxonomy and self-reflection on PBL approach as the dependent variables. Therefore the PBL approach is studied on these variables thoroughly to see the effect after the intervention of PBL in a Biology classroom teaching and learning process.

1.6 Significance of the Study

This study is significant because it contributes to the teaching and learning of Biology among students today in a diversified approach that enables them to explore their level of question generating and thus enhance HOTS and reflection in PBL approach in line to gain knowledge and further enhance their understanding in topics related to Biology (Chin & Chia, 2004).

For the students', this experience will cause paradigm shift in the learning behaviour. As they progress in self directed learning, they will learn the knowledge as active learner. The students' engagement in learning will enhance their passion towards the subject .With much experience their conception on Biology as hard and boring subject may wash off over the process of PBL implementation. Students, by working through various challenges, acquire knowledge of problems and concepts through their own initiative, and gain greater respect for themselves and their fellow friends. Students can also engage in problem-based learning through a cooperative-learning approach, in which students work in groups that determine different solutions to the same problem. This adds the further benefits arising from cooperative effort, including interpersonal and communication skills. And students come to recognize that a problem may inspire more than one reasonable solution (Chin & Chia, 2004).

Teacher will benefit from this approach of PBL in classroom will arouse an opportunity to understand the problem-solving process and to foster their own problem-solving skills. This approach will bring effective professional development and examine essential elements of PBL that develop teachers' content knowledge and

subject-matter knowledge for teaching. It will also assist teachers in analyzing and changing their instructional practice. This was supported by a fellow researcher Rajendran (2000) whom said that teachers should be the mold the students into thinking leaders and therefore needs a comprehensive approach in preparing teachers to carry out such innovations in classroom.

Where else the policy makers can also enjoy the benefits of PBL approach to assist faculty in incorporating PBL into pre-service of teaching and in-service courses for teachers and professional developers in the design of effective professional development. Nevertheless this will enhance the standards of the nation's education level and graduate capabilities of the students.

1.7 Limitation of the Study

There are several limitations in this study that must be acknowledged. The study is limited to only total of 80 students consisting four classes from Pre-University level taught by the researcher who are taking Biology for the Cambridge A Level examinations. Therefore the results obtained in this study cannot be generalized. This study did not to contribute marks for the finals examination or for any internal assessments by the researcher as these students are graded fully by the external examinations board (Cambridge International Fellowship). Therefore some students may show less interest as their efforts are not awarded for any assessment.

Besides that, the study also requires the honest reporting of answers from students as the commitment to the study will affect the results of group intervention especially. Their prior knowledge is also quite poor in the chapters Inheritance and Gene Technology as these chapters are different in content level compared to their previous knowledge as students have completed Sijil Pelajaran Malaysia (SPM). Furthermore the students are expected to familiarize of syllabus that are not having local influence and therefore the requirements and learning outcomes differ from our country education system. The problem scenario for research is also not local essence as the students sitting for examinations based on UK syllabus, which is the Cambridge, A level however the names has been adapted and changed to enhance locality.

Another major limitation is time constraint. As this study had to be completed within the time frame of one semester, which is, about five months, the time allotted for data collection was only about two months. This short period of time for data collection had thus determined the size of the respondents which could not be too big a group. If more time was available, data could be collected from more groups of students taught by different lecturers. Besides that, qualitative studies needed in-depth reporting and this made it necessary to have more time.

However, despite these limitations, this study had already been conducted and the findings would serve as a catalyst for more representative and conclusive studies in the near future.

1.8 Operational Definition

1.8.1 Generation of Questions

Conceptual definition: Generation of questions are process by which students develop learning issues from a PBL scenario as questions that will be answered through a self directed learning. The generation of questions can be individually or group generated questions.

Operational Definition: In this study the level of generation of questions are assessed on categorizing the questions based on Bloom's taxonomy cognitive domain and followed by a descriptive analysis and statistical analysis.

1.8.2 Reflection

Conceptual definition: Reflection is the self-observation and reporting of conscious inner thoughts, desires and sensations. It is a conscious mental and usually purposive process relying on thinking, reasoning, and examining one's own thoughts, feelings, and, in more spiritual cases, one's soul. It can also be called contemplation of one's self, and is contrasted with extrospection, the observation of things external to one's self. Reflection also known as may be used synonymously with and in a similar way to human self-reflection. (Source: http://en.wikipedia.org/wiki/Introspection)

Operational definition: In this study reflection of students means the written responses of students who had undergone the intervention of PBL. Their written responses will be explored to learn the impacts of PBL on the learning process for a topic in Biology taught at a Pre University level. The reflections of students are answers for guided questions set by researcher and validated by experts.