STUDENTS' READINESS, COMPETENCIES AND SKILLS IN USING ONLINE LEARNING IN PRESERVING STUDENTS' CRITICAL THINKING

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FACULTY OF SCIENCE AND NATURAL RESOURCES
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DECLARATION

I hereby declare that the material in this thesis is my own except for quotations, excerpts, equations, summaries and references, which have been duly acknowledge.

05th JANUARY 2015

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CERTIFICATION

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ABSTRACT

Problem-Based Learning (PBL) is a learning approach, designed where students as a focus of learning. Normally, PBL conducted face-to-face, however with recent rapid development of technology enables PBL to be implemented through online (PBL online). This study is done based on two main objectives: (i) to seek whether the previous or prior PBL online strategy can preserve Physics students' critical thinking, and (ii) to recommend what is the best PBL online practices in order to preserve physics students' critical thinking. PBL online was implemented into twenty five (25) second year students of Physics with Electronics at University Malaysia Sabah for twenty eight (28) weeks, corresponding to two semester study in two different Physics courses (i.e., Thermodynamics Physics and Statistical Physics). Watson Glaser Critical Thinking Appraisal (WGCTA) (1980) test was used as a main instrument to study the level of students' critical thinking skills, there are five criteria of WGCTA to evaluate critical thinking: (i) making an inference; (ii) making an assumption; (iii) deduction; (iv) making an interpretation; and (v) evaluation argument. Findings also supported by survey questionnaire to study on students' background and their level of computer usage in learning and readiness on learning via online learning. This study design as a quantitative methodology and described as one-group pretest-posttest design employ in quasi-experimental which design without control group. Results of Mann-Whitney U test and Independent Sample t-Test showed no significance difference in overall for critical thinking but as results was further analysis, it is identified that statistically significant difference for *making an inference* and *making an interpretation* on first phase of implementation while only *making an inference* was statistically significant difference on second phase. This finding was believed result from the nature of the subjects of PBL being implemented. Moreover, results also show the students' critical thinking being preserved nay there is a positive improvement. Students' perceptions and readiness towards PBL and PBL online were positive but proper strategy is needed for better results. Recommendation on best PBL online practices implement in sciences courses also proposed.

ABSTRAK

(Kesediaan, Kecekapan dan Kemahiran Pelajar dalam Menggunakan Pembelajaran Berasaskan Talian dalam Mengekalkan Kemahiran Berfikir Secara Kritis)

Pembelajaran berteraskan masalah (Problem-based learning (PBL)) adalah satu pendekatan pembelajaran yang direkabentuk, di mana pelajar adalah sebagai fokus pembelajaran. Kebiasaannya PBL, dilaksanakan secara bersemuka namun dengan perkembangan rancak teknologi terkini menjadikan PBL mula dilaksanakan secara atas talian (PBL online). Kajian ini dilakukan dengan berteraskan dua objektif utama iaitu: (i) ingin melihat sejauhmana strategi PBL atas talian terdahulu boleh mengekalkan pemikiran kritis dalam kalangan pelajar Fizik serta (ii) mengusulkan praktis PBL secara atas talian yang terbaik untuk mengekalkan pemikiran kritis dalam kalangan pelajar Sains Fizik. PBL atas talian dilaksanakan keatas dua puluh lima (25) orang pelajar tahun kedua Program Fizik dengan Elektronik di Universiti Malaysia Sabah selama dua puluh lapan (28) minggu, bersamaan dua semester pengajian dalam dua subjek kursus Fizik yang berlainan (i.e., Fizik Termodinamik dan Fizik Statistik). Instrumen utama yang digunakan sebagai alat pengukur tahap pemikiran kritis dalam kajian ini adalah ujian Watson Glaser Critical Thinking Appraisal (WGCTA) (1980), terdapat lima kriteria dalam WGCTA untuk mengukur pemikiran kritis: (i) making inference; (ii) making an assumption; (iii) deduction; (iv) making an interpretation; dan (v) evaluation argument. Dapatan kajian ini juga disokong oleh instrument kajian soal selidik bagi mengetahui latar belakang pelajar dan tahap penggunaan komputer dalam proses pembelajaran mereka serta tahap kesediaan terhadap pembelajaran berasaskan dalam talian. Kajian ini direka sebagai kaedah kuantitatif dan diterangkan sebagai rekaan kajian one-group pretest-posttest digunakan dalam rekaan kajian kuasi dimana kajian ini tidak terdapat kumpulan kawalan. Dapatan daripada ujian Mann-Whitney U dan ujian Independent Sample t menunjukkan tidak terdapat perbezaan yang signifikan dalam keseluruhan pemikiran kritis namun apabila keputusan diuji lebih dalam, ditunjukkan terdapatnya perbezaan signifikan dalam making an inference dan making an interpretation pada fasa pertama perlaksanaan PBL manakala hanya making an inference sahaja yang menunjukkan perbezaan signifikan pada fasa kedua perlaksanaan PBL. Dapatan ini dipercayai berpunca daripada sifat subjek dimana PBL dilaksanakan. Selain daripada itu, data juga menunjukkan bahawa pemikiran kritis pelajar dapat dikekalkan malahan terdapat peningkatan yang positif. Persepsi dan kesediaan pelajar terhadap PBL dan PBL talian juga menunjukkan dapatan positif daripada pelajar namun strategi sesuai diperlukan bagi mendapatkan keputusan lebih baik. Usul terhadap praktis pembelajaran PBL atas talian yang sesuai dilaksanakan dalam dalam kursus-kursus Sains turut dicadangkan di dalam kajian ini.

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CHAPTER 1

INTRODUCTION

1.1 Introduction to the Study

Criticism about Malaysian graduates lack of scientific and technical knowledge, thinking skills (i.e., creative thinking, critical thinking), competency based and communication skills been a keen issues nowadays (The Star Online, 2013; White, 2013). Complaint from industrial employer about Malaysian graduates rose up and this indirectly contributed in persistency concern of unemployment among Malaysian graduates each year (Lim, 2011:1) and the number of unemployment among Malaysian graduates also in critical state (Lai, 2011). Rapid globalization recent year also contributed to the highly demand among employers on recruiting new employees. Employers required new employees not only skilled in communication, soft skills but also know how to applied and perform well on what they learn and understand from universities or institutions in world of work (Johnson, Archibald and Tenenbaum, 2010).

This brought to the attention of education systems focally in Malaysia. Independent learning, problem-solving, reasoning, lifelong learning and critical thinking is some important cognitive skills given attention and be partially from main aspirations of Malaysian education system and Malaysian students (Preliminary Report Malaysia Education Blueprint 2013-2025, 2012). Problem-Based Learning (PBL) experienced positive development and can be seen as a trustful teaching method to improve students' thinking abilities, problem solving skills and proficiencies not only in medic, teacher and engineering education teaching even in Physics itself (Selçuk and Çaliskan, 2010; Ahmad and Siti, 2009; Hari, 2008; Ward and Lee, 2002). So far, compatibility between PBL (i.e., PBL online) process and critical thinking characteristics indeed suggests to positively increased and promoted either on soft skills or focally on critical thinking (Rosalind, Tehereh and

Wilma, 2013; Elizabeth and Zulida, 2012; Faridah, Norlaila, Rozmel and Maryam, 2011; Fauziah, 2011a; Şendağ and Odabaşi, 2009).

Furthermore, previous studies show that PBL being practices by students in long-term retention contributed to preserving on students' critical thinking skill (Choy and O'Grady, 2012; Sarah and Lana, 2011; Strobel and van Barneveld, 2009). So, increasing on students' critical thinking after being intervened with integrated PBL online for two (2) semesters of term was expected within this study. Hence, this study was formed as a result for alternative solution of this criticism. Moreover, the deficiencies of literature review about effectiveness of problem-based learning (PBL) (i.e., PBL online) on Physics (i.e., Science courses) (Masek and Yamin, 2011; Fauziah, 2011a) encouraged the formation of this study.

Thus, to achieve the objectives of this study, integrated PBL online was performed on cohort of twenty five (25) students (i.e., 16 females and 9 males) from second year of Physics with Electronics at University Malaysia Sabah. Implementation of PBL online was done on two (2) different subjects of Physics with Electronics course, Thermodynamics Physics (SF20503) and Statistical Physics (SF20403) which enrolled on two different semesters consecutively. PBL online was implemented to students using Facebook as platform and led by a lecturer who had been in experienced on PBL in Physics course for ten (10) years.

To measure the dependent variable of this study, Watson Glaser Critical Thinking Appraisal 1980 test which being adapted to context of Malaysia by Fauziah (2011a) was used. Meanwhile, quantitative and qualitative data also collected by using survey questionnaire before and after of the study to study on students' perception and readiness towards PBL online. All data and findings were analyzed by using Statistical Package for the Social Sciences (SPSS) version 20.

1.2 Problem Statements

Excellent academic grade no longer seen as a major element for employers on looking for new works instead they demanded for candidates with soft skills, good social skills and experienced. This phenomenon drive government to review their objective for education to produce graduates with those elements required by market, this results on variety of learning methods and approach have been introduced and implement either at the level of primary school, secondary school or higher education. Learning approach based on student centered learning is now gaining attention in this country as it is proved to foster and develop on students soft skills and Problem-Based Learning (PBL) is one of the learning activities which can be seen less complicated, low cost and appropriate to introduced and implement focally on higher education learning. Therefore, this study is the alternatives to study and prove the effect of PBL online on fostering and developing students' critical thinking skills. Apart from that, this research also study on students' readiness and perceptions towards PBL and online learning.

1.3 Research Aim and Objectives

The core of this study is the use of Problem-Based Learning (PBL) online in Physics courses and effect on students' critical thinking skills. Tons of literature review regarding PBL online, however the study on concerning the implementation of PBL and implication on Physics students focally on critical thinking skills is very rare (Masek and Yamin, 2011; Fauziah, 2011a).

Regardless, the main aim of this study was to seek whether the previous PBL online strategy can preserve students' critical thinking. This potentially could be achieving supported by two (2) objectives:

1) To discover how physics students' critical thinking skill after intervened with the PBL online:

   Critical thinking requires the use of self-correction and monitoring as well as reflectivity also involves scrutinizing, differentiating and appraising as well as reflecting on information to make judgments that will inform clinical

decision. Researcher has been wondering why not all students which sit and study in same place and environment have same level of critical thinking? Critical thinking can be developed with frequent practice and this research will explore more about the critical factors in preserving students' critical thinking.

2) To come up with some recommendations on what is the best problem based learning practice in preserving critical thinking in problem-based learning physics class:

Mentioned in Savery (2006) study by Boud and Feleti stated PBL generally known today evolved from innovative health sciences curricula in North America over a decades, and rapidly becoming an ineffective and inhuman way to prepare medical students, given the explosion in medical information and new technology. So, one of the objectives of this study is to recommend what is the best problem-based learning practices particularly through online learning in preserving Physics students' critical thinking.

Two (2) main research questions was involved in this study is:

1) What is science physics students' critical thinking skills after intervened with PBL online practices?, and;

2) What is the best PBL (i.e., PBL online) practices recommendation in order to preserve science physics students' critical thinking in the future?

1.4 Summary of Research

This of study will discuss intensively on how PBL online was done (Research Methodology) to achieve objectives and aim of this study, this will cover from instruments used during the study and procedure and process of study done. This study also revealed the result and discussed the findings (Research Results and Findings) by analyzing data from WCGTA (1980) tests and survey questionnaires and transcribes interview with students. All findings also are being discussed based on research questions by comparing (i.e., agrees (corroborates), extends, refines and conflict) findings with existing theory from previous literature review and o conclude this study, suggestions and recommendations for future learning are included (Research Discussions and Conclusions).

1.5 Framework Schedule of Study

Table 1.1 shows framework schedule of this study within two years, early stage of study provided for preparing on research instruments (i.e., critical thinking test and survey questionnaire). During this period, planned on PBL practices were scheduled.

Table 1.1: Framework schedule of study

YEAR	MAC	APRIL	MEI	JUN	JULY	AUG	SEPT	OCT	NOV	DEC
2012	Preparing intervention for both phase						Phase 1 start	Intervention Phase 1		
							← Intervention Phase 1→			

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC
2013	Phase 1 end *Sem break Transcribing Data & Analysing Data	Phase 2 start	Intervention phase 2			Phase 2 End and Analysing Data						
		←Intervention Phase 2→				←----------Prepare thesis----------→						

1.6 Definition of Terms

Problem-based learning

Problem-based learning or shorten in this study as PBL was one of student-centered learning element being practices in Malaysia higher education systems since 1980s. PBL designed as problem-centered learning emphasis on individual and group task.

Problem-based learning online

Problem-based learning online or shorten as PBL online in this study was the applied of PBL practices within students by using online learning as main medium of delivery. Any electronic tools available within students such as computers, smart phone and camera were used for deliver the process of PBL.

Online learning

Learning processes such education activities and training was delivery by electronic tools. Electronic tools such as computers, smart phone and camera was used to deliver these processes.

Preserving

Preserving is condition of students' being able to maintain their achievement on critical thinking skill after being intervene with PBL online.

Critical thinking skill

Critical thinking is one of quadruple thinking and considered vital in higher education of Malaysia for last decades. Critical thinking skill in this study is the ability of students to *determine the truth and falsity of the statement from data provided (inference)*, ability to *recognize assumpations are clearly stated (recognition of assumption)*, ablility to *decide whether conclusions follow the information provided (deduction)*, ability to *consider evidence provided and determines whether generalizations on the data warranted (interpretation)* and ability to *distinguish between strong and relevant argument (evaluations of arguments)* (Watson & Glaser, 1994b) as mentioned in Gadzella, Hogan, Masten, Stacks, Stephens and Zascavage (2005).

CHAPTER 2

LITERATURE REVIEW

2.1 Educational Trends

Education is vital process of man to perform more efficient in life and lead to the development of nation (Hasyamuddin, Abdullah, Nor Ratna and Yahya, 2010; Rudner, 1977). Education system especially at school level and continuously applied on higher education system, conventional education system usually employed with students as passive learner and teachers as guidance (Hasyamuddin *et al.*, 2010:2). Thus, the transformation of educations was implement continuously from time to time on education structure to achieve the demand of producing "*good quality education*" (EFA Global Monitoring Report, 2005) and employability demand (Hasyamuddin *et al.*, 2010). In Malaysia generally, changes of the educational structure began in 1960s when the objectives of policy introduced by Tun Razak could not meet the demand on social, economic and political growth and development of mankind (Rahimah, 1998; Rudner, 1977).

The importance of science and technology in education are increasingly given attention as the changes of social and economic mankind in Malaysia. The interest resulted on establishment of schools and institutes root on technical and vocational, learning approach introduced in technical and vocational institutes provide students learning more with practical compared to theoretical which bring keen among people (Rahimah, 1998). Changes in learning approach also growing as introduction on opposite structure of teaching-learning process were increasingly implemented by higher education system in order to meet demand on employability of graduates (Hasyamuddin *et al.*, 2010).

2.2 Problem-Based Learning (PBL): Introduction

Problem-Based Learning (PBL) starts with long story since it first adopted at Faculty of Medicine in McMaster University in Canada (Hillen, Scherpbier and Wijnen, 2010) when they cored medical education from integrated basic and clinical sciences including introducing real life patients in class (Girl, Kumar and Ho, 2006). PBL is designed to improve and develop the wide range of skills such as teamwork, reasoning, and characteristics of lifelong learner (A guide for students by students: Problem-based learning at HYMS, 2012:7)

Meanwhile in Malaysia, PBL started in 1981 when it first implemented in Medical Department of University Sains Malaysia (Nurjahan, 2009). The adoption of PBL style in this study was a result from positive review of previous study which seen as a trustful alternative teaching method to improve students' soft skills such as thinking skills, language skills, problem solving skills, teamwork, use reasoning skills and proficiencies that made employers keen in hired employee among fresh graduates (Ward and Lee, 2002). PBL implementation is not only developed in medic and education fields but also intriguing researchers and educators from other fields such as law and economics, communications and language (William *et al.*, 2013), engineering (Echavaria, 2010) and sciences (i.e., Physics, Mathematics, Chemistry) (Selçuk, Çalişkan and Şahin, 2013; William, Woodward and Symons, 2010; Fatih and Hafize, 2009; Pepper, 2008) to introduce and expandable.

2.2.1 PBL: Abstract of Idea

Problem-Based Learning (PBL) is a recent phenomenon in Asian region, it is describe as teaching method based on opposite philosophical approach to teaching and learning (Bowe, Flynn, Howard and Daly, 2003) as one of elements for outcome-based education. PBL is a process of learning through experiences (Fang, Chiang, Tsai, Wang, Tsai and Chen, 2008a) and characterized as a collection of problems based from real world of ill-structured faced by professional (Schmidt, Loyens, Tamara and Paas, 2007; Burns and Hazell, 1999). Davis and Harden (1999) describe PBL as some learning approach that based on relationship between concepts or principle and examples of problems, which mentioned by Ahmad and

Siti (2009) and Tai and Yuen (2007) that it helped to introduce students on learn actively through solving the problem. PBL utilizes real world problem into class which introduced students to learn both content and critical thinking after struggling process with actual problem (Jafri, Mohd. Ariffin, Syed Ahmad Helmi, Mohd. Kamaruddin and Khairiyah, 2005).

PBL designed with emphasis on individual independence, communication and discussion skills among group members (Wang, Tsai, Chiang, Lai and Lin, 2008) which great alternative for students to be responsible on their learning and skills as PBL provide them an opportunity to take active in role of learning and teaching process (Samy, 2009). Hence, Samy also discusses that process of PBL not only developed and trained tutor on how to facilitate PBL but also developed and trained students to improve group effectiveness and learn on how to evaluate self and members learning.

Wang *et al*. (2008) stated that there are two different types of education, general education and professional education which root on two different truths but consolidated and possess by PBL which practices both but emphasize in two different phases. First phase of PBL was concerned on truth of general education which learners are *open* on any facts without concerning on accuracy while second phase was gradually directed from truth of professional education as learners are intended to *pursuit the fact* towards the solution, both of this process within PBL which consolidated and possess both thrust of two types of education.

With teacher centered learning approach which popular among traditional learning approach, students' thinking skill could not determine as there is no interactions neither among students nor within lecturer-students. Anyway, contrary with PBL practices, discussion among students and teacher-student could be heard and read so students' thinking could be determined (Samy, 2009).