

PROBLEM-BASED LEARNING (PBL) VERSUS CONTENT-BASED LEARNING (CBL) IN THE WEB-BASED ENVIRONMENT:AN ANALYSIS OF MALAY STUDENTS' PERFORMANCE IN THE LEARNING PROCESS

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ABSTRACT. *This article reports on the study that explored the differences in Malay students' performance regarding the learning process provided by the Problem based learning (PBL) approach compared with that of the Content-Based Learning (CBL) approach in the Web-based environment. Both treatments contained the same subject, which is ZCT 104-Modern Physics. A group of 134 Malay students was given two types of treatment. Sixty-seven of the students were treated with PBL and the rest with CBL treatment. At the end of the treatment both groups were given a post-test to see their performance in the learning process. Analysis using the paired-sample t-test with the confidence level of $p,0.05$ revealed that reveals that the group that went through PBL recorded higher marks significantly compared to the CBL.*

KEYWORDS. *Problem-based learning, content-based learning*

INTRODUCTION

The emergence of the Web technology has led to an enormous shift in the way education is being delivered (Naisbitt, 1994; Min Shi et al., 2006; Upadhay, 2006). Educators are well aware of the potential of the Web technology and have adopted it to create new learning environments (Hanafi et al., 2002), thus yielding a huge repertoire of educational Web sites. However, most of the available educational Web pages are designed based on the Content-Based Learning (CBL) approach that elicits cognitive processes only on information retrieval while the emphasis remains on rote learning (Mioduser et al., 2000). The design is essentially highly structured, from the perspective of teacher/expert, it is also linear and rational, part to whole organization. Besides, it is also teaching as transmitting, learning as receiving and last but not least structured environment. All of the steps are not suitable to the current pedagogical approaches (IMSA, 2002).

One of the current accepted pedagogical approaches to learning is the constructivist-based learning environment wherein the learning is student centered, requiring students' active involvement in the construction of knowledge, hence assuming responsibility for their own learning (Jonassen, 1999). The learning happens in the collaborative environment and the teacher acts as a facilitator. The teacher does not deliver the course contents but guide the students in the process of discovery, inquiry, and analysis (Albanese and Mitchel, 1993)

One of the constructivist approaches to learning is the Problem-Based Learning (PBL). PBL is a total approach of education and it is a well-known alternative approach to traditional disciplinary-based professional educational programmes in higher education (Harper-Marinik, 2001). The emphasis of PBL regarded as essential for enhancing student learning are learning in context, elaboration of knowledge through social interaction, emphasis on meta-cognitive reasoning and self-directed learning (Boud & Feletti, 1991; Norman & Schmidt, 1992).

PBL, accordingly, begins with the introduction of an ill-structured problem to the students. The problem thus served as the organizing centre and the stimulus for learning and represented the vehicle that developed students' creative and high-order thinking skills. It is also mirrored real-world issues and had to be designed in the context of the learning that followed. It thus contrasted with the prevalent teaching strategies where a concept was first presented in the lecture format followed by the "end-of-chapter" problems (White, 1996)

The characteristics of the problem are the following:

- It is ill-structured in nature
- It is met with a "messy" solution
- It often changes with the addition of new information
- It is not solved easily nor does it adhere to a formula.
- It does not always result in the right position

A comparison of PBL with CBL approaches is shown in Figure 1. As indicated, PBL offers the solving of the authentic problem and this engages students in the learning of information that is similar to the way in which it will be recalled and employed in future situations. It also assesses the ways which demonstrate understanding and not results in mere acquisition.

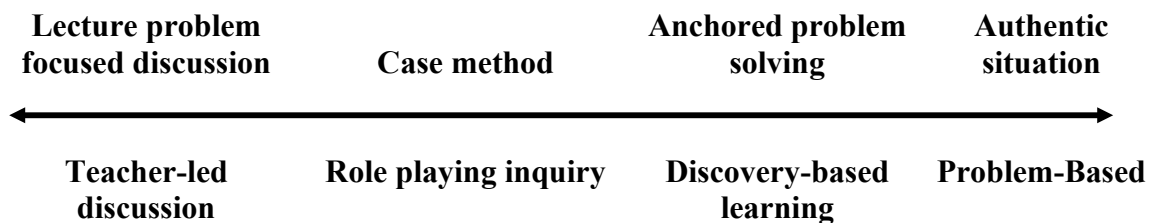


Figure 1. Comparison of Problem-Based Learning with Content Based Learning.

Effective Web-based learning environments incorporate necessary problem-solving tools, as in PBL. There has been tremendous interest to incorporate the constructivist PBL approach into the web-based environment (Corderoy & Copper, 2000). Dennen (2000) also revealed improvements in students' performance both in terms of process and product and attributed the enhancement to the task structuring and the combination of individual and group work which gave them control over their learning.

Although there has been enormous growth in the Web-based PBL approach, the efficacy of the approach in terms of the student learning process and the instructional practices is still not well understood, especially among the Malay students. This study, therefore, attempts to elucidate the learning processes provided through the PBL approach compared to the commonly

available CBL approach in relation to three domains, namely, the instructional design of the course materials, the delivery mechanisms and the learning effectiveness.

On the other hand, Content-Based Learning (CBL) is instructional for students to contemplate and study using the traditional way of learning. The methodology is widely used even until now. CBL is one of the behaviorist's hybrids of practical theory (Wikipedia, 2007). Behaviorism (also called learning perspective) is a philosophy of psychology based on the proposition that all things which organisms do — including acting, thinking and feeling—can and should be regarded as behaviors. The school of psychology maintains that behaviors as such can be described scientifically without recourse either to internal physiological events or to hypothetical constructs such as the mind (Skinner, 1985). Behaviorism comprises the position that all theories should have observational correlates but that there is no philosophical difference between publicly observable processes (such as actions) and privately observable processes (such as thinking and feeling) (Watson, 1970). The CBL instructional were following this method where the student will be given the notes and the contemplate process will be running as usual, and in the end of the learning process they will be given a test. In this process of learning the students do not have any kind of discussion and their notification of learning is only based on whatever they have from the web page.

THE WEB INSTRUCTIONAL DESIGN

To elicit the differences of the performance between the commonly available CBL and the experimental PBL, two types of Web pages with different instructional designs were developed and put online.

The CBL Web Pages

The model consisted of the following sequences of learning approach design, which had been adapted from Dick & Carey (1990).

- **Introductory information:** The Students were required to browse through the introductory pages for information regarding the learning process involved and the role they should keep.
- **Lesson Objectives:** The lesson objectives were given before the presentation of the learning materials to guide the students in the learning process.
- **The content delivery:** The course content were broken down into smaller segments and the learning activities were structured from low-level to high and complex activities. The instructions were made simple as possible to facilitate the students learning process.
- **Provision of examples:** Self-evaluation was also incorporated via examples and the answers enabled the students to gauge their level of understanding and competency.

The CBL Website can be accessed at the URL address:

- a. [URL:http://pppjj.usm.my/Fizik/sjh_1/default.html](http://pppjj.usm.my/Fizik/sjh_1/default.html) (Lesson 1)
- b. [URL:http://pppjj.usm.my/Fizik/sjh_2/default.html](http://pppjj.usm.my/Fizik/sjh_2/default.html) (Lesson2)

The PBL Web Pages

The design of the PBL approach for this study was adapted from Harper-Marinick (2001), which consisted of the following sequences of learning.

- **Introductory information:** The students first required to open and browse through the introductory information pages that provided them with information and examples regarding the processes of online PBL and the role they should play to accomplish the learning tasks.
- **Presentation of loosely structured and real-world problems:** The problems served as the organizing center and context of learning. They were loosely structured and related to real work and every issues. They were also complex and encompassed the content objectives of the course.
- **Online collaboration:** The synchronous chat tool was used in small assigned groups of 3-4 where students analysed the given problems together. Based on their prior knowledge, they determined the information they already had and what information they were still required to possess and had to master, in order to solve the given problems. During the collaboration, they proposed hypotheses to the problems, generated learning issues that were required to solve them, prioritized the learning issues, and organized and effective plan of action. All these were done by assigning individuals to undertake the defined tasks.
- **Online resources:** Each student has his/her own responsibilities to do research and to investigate on the learning issues that were assigned to him/her. He/she was required to resort to the designed online resource for new information and, on an individual basis, had to attempt to find a solution, new information and concepts pertaining to the learning issues assigned to him/her.
- **Follow-up online collaboration:** The group of students reconvened to continue the on-line synchronous collaboration. Each student reported on the research undertaken, identifying the overlapping issues, reviewing both the information acquired as well the hypotheses arrived at in accordance to the new information gathered.
- **Solution to the problems:** The group collectively planned for the presentation of the solution to the problems, utilizing various tools that were available.

The PBL Web pages can be accessed at the following URL address:

- a. [URL:http://pppj.usm.my/Fizik/sjh_3/default.html](http://pppj.usm.my/Fizik/sjh_3/default.html) (Lesson 1)
- b. [URL:http://pppj.usm.my/Fizik/sjh_4/default.html](http://pppj.usm.my/Fizik/sjh_4/default.html) (Lesson 2)

METHODOLOGY

The sample of this study consist of 134 Malay students selected randomly from a total of 460 students registered for the course of Modern Physics (ZCT-104) offered by the School of Physics, Universiti Sains Malaysia (USM), Malaysia, during the second semester of the 2002/2003 academic session. Students were divided into two smaller separated groups of students, and each group was treated with the CBL and PBL approaches in two separate tutorials.

The duration for each tutorial treatment was one and a half hours. The topics presented in the treatment were Black Body Radiation, Radiation Spectrum, The Laws of the Stefan-Boltzman and Wien's Law, Rayleigh-Jeans's Theory and Planck's Law for Lesson 1 and 2 respectively.

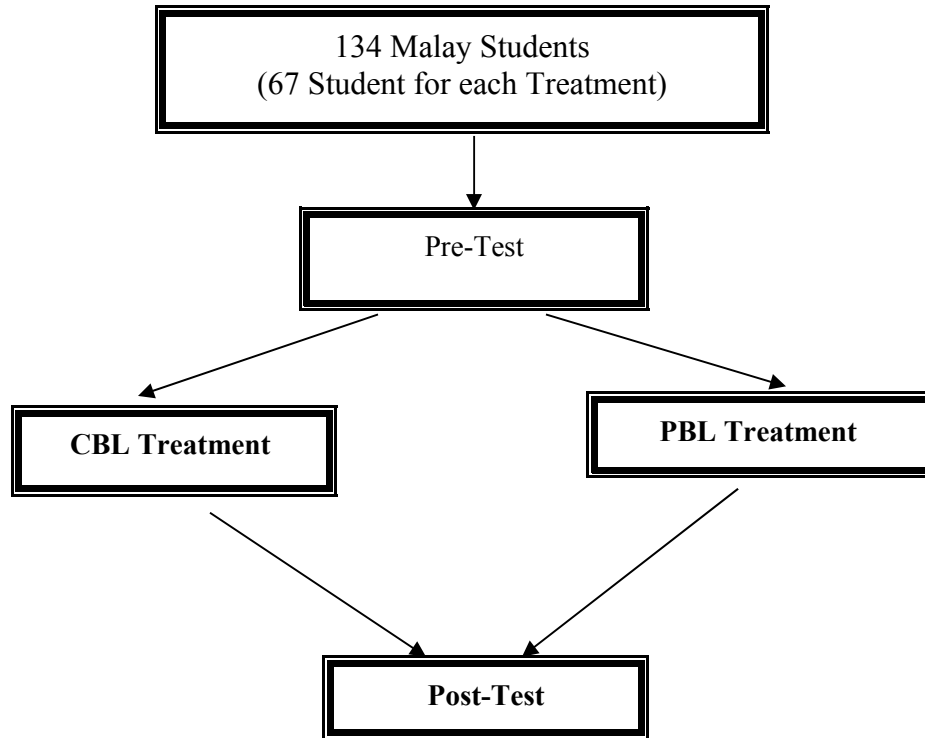


Figure 2. The Experimental Design.

To determine the students' performance regarding the two different learning processes they had undergone, a specially designed pre-test and post-test was developed. It consisted the main topics that will test the students' understanding regarding the topics thought. The pre-test and post-test was pilot tested on 35 students who did not take part in the final study. The aim was to see the validity of the questions and their acceptability when using them on the real sample of the research. The analysis on the Cronbach's alpha (α) noted as high as 0.776 for the pre and post test instrument. The comparative analysis was conducted by means of students using paired sample t-test.

RESULTS AND DISCUSSION

Table 1 shows that the CBL group of student noted 14.66% of pre-test while for the PBL group of students recorded 18.37% of pre-test mark. Even though there is a slight difference between the two groups, Table 2 shows that the difference did not describe the dissimilarity in significance at the level of confidence of $p > 0.05$. This indicates that the comparison for both groups after completing the learning process was valid.

Table 1. Paired Sample Statistics for Pre-Test of Both Treatments.

Treatment	Mean	N	Std. Deviation	Std. Error Mean
Pre-Test for CBL	14.66	67	15.074	1.842
Pre-Test for PBL	18.37	67	11.367	1.389

Table 2. Paired Sample Test for Pre-Test of Both Treatments.

Treatment	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre-Test for CBL - Pre-Test for PBL	-3.716	19.811	2.420	-8.549	1.116	-1.536	66	.129

Table 3. Paired Sample Statistics for Post-Test of Both Treatments.

Treatment	Mean	N	Std. Deviation	Std. Error Mean
Post-Test for CBL	57.49	67	25.350	3.097
Post-Test for PBL	73.24	67	9.399	1.148

Table 4. Paired Sample Test for Post-Test of Both Treatments.

Treatment	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Post-Test for CBL - Post-Test for PBL	-15.746	24.233	2.960	-21.657	-9.835	-5.319	66	.000

As for the post-test shown in Table 3, both groups recorded means of 57.49% and 73.24% respectively, indicating that there is significant difference for the level of confidence of $p > 0.05$. These results shows that PBL treatment have much more ability to increase the students' performance, differing from Mierson (1995) who said that one of the greatest satisfactions for teachers teaching PBL course who seeing students gain skills and self confidence. Talking and writing about science are something many students have not been required to do; explaining their ideas and using scientific terminology accurately require practice. From the results, many of the students got much better at this during the course.

CONCLUSION

This study revealed that between Problem-Based Learning (PBL) and Content-Based Learning (CBL) in the Web-Based Environment for Malay students' performance, there is a significant difference in performance and achievements. It is undeniable that PBL approach can increase the students' ability to interpret and answer the questions more accurately and in detail and proved the credibility of the students in using their critical and creativity thinking in their learning process. These were proven through the post-tests, where PBL noted higher achievement significantly compared to the CBL approach based on the web-based environment. Differing to Albanese and Mitchell (1993), as students pursue solutions to their subject problems, they assumed increased responsibility for their learning. These students use self-selected resources, such as journals, on-line searches, and other library resources (Vernon & Blake, 1993), text books, journals, and also discussions (Albanese & Mitchell, 1993) more often than traditional students. They also altered their views of instructor from a source of test answers to a possible resource to solving relevant problems (Aspy, et al., 1993). Together, these processes and learning skills help students become more competent in information-seeking skills in their learning process than the traditional students.

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