

## Assessing Problem-Based Learning: A Case Study of a Medically Oriented Biophysics Problem-Based Learning Course

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**Abstract:** Problem based learning (PBL) has been introduced into the academic programs offered by the Faculty of Applied medical sciences October 6 University at the start of the academic year 2012. This paper examines students' Learning in a team-based PBL course of medical biophysics. Pre-course results indicate that there is difference in students' general understanding of medical biophysics concepts between those attending PBL and those following the traditional course. Succeeding in today's world requires college undergraduates to be able to think critically, solve complex problems, communicate clearly (using both verbal and written skills) and work effectively in teams. Problem-based learning (PBL) helps students develop their knowledge and understanding skills. Also Their intellectual skills in integrating the principles and concepts of medical biophysics. Students acquire professional and practical skills in practicing the leadership role and applying the principles of scientific research. Students in a PBL course are challenged to "learn to learn", working cooperatively in groups, seeking solutions to real world problems by asking and answering their own and their peers' questions. The effectiveness was evaluated by comparing the performances and the perceptions of the sample students (n=50) using the PBL and comparing the outcomes with those of the Content-Based Learning (CBL). The comparative post-test performance analysis conducted using a student t-test statistical analysis ( $p < 0.001$ ) revealed that the experimental PBL approach yielded better performances than the controlled CBL approach. The analysis also revealed that students exposed to the web-based PBL approach responded more positively with their knowledge enhancement compared to students unexposed to the web-based CBL approach.

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### 1. Introduction

Problem-Based Learning (PBL) is very active, interactive and collaborative based education. The students are learning from a real-world problem similar to one they might encounter as practitioner of the discipline [1,2]. Teaching content through skills is one of the primary distinguishing features of PBL with conventional method. In PBL, the students are more inductive. They will actively try to solve a real-world problem based on their experiences and skill. They will learn actively the content of subject during solving the problem. In contrast, the traditional method is just educating student in a class; where the lecturer giving lecture and the students are passively sitting on their chair and learn from the lecture. Then they try to solve the question given by the lecturer at the end of the topic [1,2]. In 2001 the School of Physics in the Dublin Institute of Technology set up the Physics Education Research Group (PERG) to carry out research to inform curriculum development, teaching and assessment practices. The group has engaged in a number of research projects aimed at obtaining a better understanding of how students

learn and how educators can help students learn and develop. [3]

Using PBL, students acquire life-long learning skills which include the ability to find and make use of the appropriate learning resources. PBL is also a curriculum development and instructional system that simultaneously develops both problems solving strategies and learning by placing students in the active role of problem solvers confronted with practical problems in the workplace [4]. A common way of measuring students' views, expectations, and beliefs about Physics and science is to use surveys [5]. Some of the most commonly found surveys in the literature are, the Views about Science Survey (VASS) [6], the Maryland Physics Expectations Survey (MPEX) [7], the Epistemological Beliefs Assessment Survey (EBAPS) [8] and the Colorado Learning Attitudes about Science Survey (CLASS) [9]. Teachers, parents and administrators are being faced with many changes in education. Many people are concerned that the high school graduates are not capable of making real-life decisions. One reason is the claim by Anderson et al (1992), Ezike (1985),

Stephen & Workman (1998) Zoller (1993) that eighty five percents of teachers' questions and methods do not provoke high-order thinking but recall or simple comprehension of materials of learning

## 2Materials & Methods:

The sample present study involved the first year undergraduate basic sciences students enrolled in October 6 University in collaboration with the Fontys University applied sciences. The course applied in the study is modern medical biophysics. From a total of 80 students enrolled in this course, 25 were selected for this study. The experimental design of the study involved a separation of the selected sample into two groups and these groups learn one case through two sessions. The data representation of the experimental design is given in Figure 1. The experimental design used was the rotational-group design proposed by Adams et al., [9]. This rotational

procedure enabled the elimination of uncertainty due to the variations of the sample. The measured dependent variables in this study were the scientific knowledge enhancement principle (The concept of the Laser beam, The characteristics of Laser beam, Application of the Laser beam, Principle action of Laser beam and Safety precaution of Laser beam). Competency, were found to indicate statistical differences ( $p < 0.001$ ) between the CBL and PBL the students.

## 3. Results and Discussion

Table 1 shows the comparative analysis between the means of the pre-test marks of the CBL and PBL approaches, there was difference ( $p < 0.05$ ) between the mean marks of the two approaches, implying that both groups CBL and PBL the students were homogeneous in terms of the background knowledge before the pre test.

**Table 1. Comparative analysis between the mean marks of the CBL and PBL(CBL; n=25) and experimental group (PBL; n=25)**

Variable	Groups	Mean+S.E	S.D	T-test	P-Value
Pre test Session (1)	(Control CBL (n=25))	6.32+0.55	2.7	9.6	0.5
	(Experimental PBL (n=25))	9.28+0.17	0.8		
Pre test Session (2)	(Control CBL (n=25))	6.16+0.6	0.770281334 3.05	1.3	0.01
	(Experimental PBL (n=25))	9.48+0.15	0.7		

The different statistical parameters including (Mean  $\pm$  S.E., P-value) with CBL and PBL, N.S=Not Significant, S.E=standard error, S.D: Standard Deviation, P :  $< 0.001$  highly significant :  $\leq 0.05$  significant, P :  $> 0.05$  non-significant.

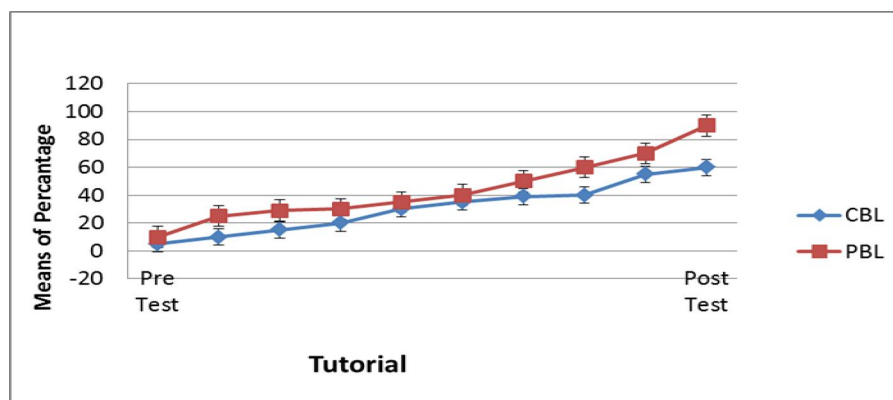
**Table 2. Comparative analysis between the mean marks of the post-tests for the CBL and PBL approaches for Lesson 1 and Lesson 2(CBL; n=25) and experimental group (PBL; n=25)**

Variable	Groups	Mean+S.E	S.D	T-test	P-Value
Post test Session (1)	(Control CBL (n=25))	5.9+0.6	3.1	4.9	0.01
	(Experimental PBL (n=25))	9.6+0.1	0.7		
Post test Session (2)	(Control CBL (n=25))	5.8+0.6	0.770281334 3.1	3.4	0.001
	(Experimental PBL (n=25))	9.7+0.1	0.5		

The different statistical parameters including (Mean  $\pm$  S.E., P-value) with CBL and PBL, N.S=Not Significant, S.E=standard error, S.D: Standard Deviation, P: $< 0.001$ , highly significant:  $\leq 0.05$ , significant, P:  $> 0.05$ , non-significant.

The comparative academic performance analysis was carried out between the means of the session 1,2 -test marks for the CBL and the PBL students (Table 1). In case of pre test in session 1, there was a no significant difference between the

mean marks of the CBL and PBL. However, significant difference was recorded between the two groups in session 2. These results are an indication that the PBL approaches yielded a better students' academic performance.



**Figure (1): Graph showing the enhancement of the mean marks between the pre-test and the post-test following the PBL and CBL treatments for Lesson 1**

The enhancement of the students' knowledge prior to and after the treatments between the CBL and PBL students is shown in Figure 1 for pre and post tests respectively. It is evident that both approaches produced a considerable enhancement in

terms of the knowledge constructed by the students. However, when the two approaches are compared, it is evident that the PBL approach yielded a superior learning enhancement.

**Table 3. Post-formative comparative analysis between control group (CBL; n=25) and experimental group (PBL; n=25) for Lesson 1**

Items	(Control CBL (n=25)) Mean±S.D	(Experimental PBL (n=25)) Mean±S.D	T-test	P-Value
The concept of the Laser beam	13.57 ± 8.54	20.22 ± 2.3	5.1	0.01
The characteristics of Laser beam	10.22 ± 3.2	22.65 ± 4.22	6.3	0.001
Application of the Laser beam	9.6 ± 6.3	15 ± 6.3	5.2	0.5
Principle action of Laser beam	7.37 ± 3.2	11 ± 4.46	6	0.001
Safety precaution of Laser beam	14 ± 9	22.3 ± 1.1	4	0.05

The students' evaluation analysis in terms of the knowledge enhancement was carried out by comparing between the CBL and the PBL approach. The results in Table 3 showed highly significant difference between the CBL and the PBL approaches. Nevertheless, it is interesting to note that all the items recorded higher mean values for the PBL approaches. Other studies like those of Seifer & Simmons (1997), Lacey (2001) and Orimogunje (2004) gave different

#### 4. Conclusion

The evaluation of the Problem-based Learning course (Bowe and Cowan, 2004)<sup>(3)</sup> highlighted the important and vital role the assessment strategy played in success of the course. The assessment strategy was seen by the students as supportive and helpful in terms of their development as members of a learning group. As the students developed their group and Communication skills the groups themselves worked better together thus improving and enhancing the learning. It also highlighted that fact that students need time to adapt to group learning and that this process can be supported through the use

views of the concept. Seifer & Simmons (1997), for example, sees problem –based learning as an appeal that enhances communication skills, encourages active participation and helps students become more self reliant learners. Being self reliant learners, the students determine what materials should be researched and how they will go about finding information from sources like the internet, interviews, reviewing recent publications and so on. of an appropriate assessment strategy. It was also evident from the evaluation that the rate of development of group skills was greatly improved when the current assessment strategy was introduced. This development was further improved when self and peer assessment was introduced.

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