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Physics students' acceptance of pbl online in terms Of learning outcomes

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ABSTRACT: *The objective of this paper is to explore students' acceptance in terms of learning outcome towards problem-based learning online (PBL online) that was used in a physics course. A cohort of physics students (N=30) from the School of Science and Technology of Universiti Malaysia Sabah were involved in this study during Semester II, Session 2008/2009 academic year. The student had experienced the PBL learning activities via online learning environment by using the Learning Management System (LMS) provided by the university. The LMS acts as the main medium to support their full learning process including their assessment throughout the semester. Three main themes focused in this study as learning outcome were: students' knowledge, skills and application of knowledge and skills; communication; and independent learning. Data were collected using a well established survey of five points of Likert scale from strongly disagree to strongly agree level that filled by students after they finished with the intervention. The findings came up with a very positive feedback where all of the statements showed significant different (with p*<0.05 for the binomial test, based on Z approximation, and also for the Independent sample t-test) where students were strongly agree with the PBL online's learning outcome. Thus, the outcome reflects that student were really engaged and managed to apply all particular skills measured that been created from PBL online***.**

Keywords: *Problem-Based Learning; Online learning; Learning outcome*

I. INTRODUCTION

Problem-based learning (PBL) is a pedagogical approach to science education that focuses on helping students develop self-directed learning skills (Barrows & Tamblyn, 1980; Boud & Felleti, 1991). It was originally developed in a medical school in 1969 at McMaster University (Rideout & Carpio, 2001), but has since spread to other subjects [e.g., engineering (Awang & Ramly, 2008), Nursing (Baker, 2000), Physics (Dublin Institute of Technology, 2005; Sulaiman, 2004), Biology (Juremi, 2003) and Geography (King, 2008)]. It derives from the idea that education, knowledge and learning is a process in which the learner actively constructs new knowledge on the basis of current knowledge. Unlike traditional teaching practices in higher education, where the emphasis is on the transmission of factual knowledge, the courses consist of a set of problems that are carefully sequenced to ensure the students are taken through the curriculum. The students encounter these problem-solving situations in small groups guided by a tutor who facilitates the learning process by asking questions and monitoring the problem-solving process. The ability to solve problems is more than just accumulating knowledge and rules; it is the development of flexible, cognitive strategies that help analyse unanticipated, ill-structured situations to produce meaningful solutions. Even though many of today's complex issues are within the dominion of student understanding, the skills needed to tackle these problems are often missing from our pedagogical approaches.

Research at the School of Physics at the Dublin Institute of Technology in September 2001 pointed to positive feedback from the students engaged in PBL: having fun learning, learning from each other; not falling behind as everyone is constantly learning; more effective learning as it enables students to remember better; students having to interact; and real-life problems seen as more interesting and challenging. PBL is not just about problem solving, and it is important to distinguish between PBL and learning via problem-solving learning. In physics, the use of problem-solving learning is well established, and in this method the students are first presented with the material, in the form of a lecture, and are then given problems to solve. These problems are typically narrow in focus, test a restricted set of learning outcomes, and usually do not assess other key skills. When learning in this way, students do not get the opportunity to evaluate their knowledge or understanding, to explore different approaches, or to link their learning with their own needs as learners. They have limited control over the pace or style of learning and this method tends to promote surface learning (Woods, 1994). Surface learners concentrate on rote memorisation (Araz & Sungur, 2007); this often arises from the use of didactic 'spoon-feeding', which does not encourage students to adopt a deep approach learning (Kember, 2000; Kit Fong, O'Toole, & Keppell, 2007). Deep learners, in contrast, use their own terminology to attach meaning to new knowledge (Rideout & Carpio, 2001). In PBL, the students determine their learning issues, and develop their own unique approach to solving the problem. The members of the group learn to structure their efforts and delegate tasks. Peer teaching and organisational skills are critical components of the process. Students learn to analyse their own and their fellow group members' learning processes and, unlike problem-solving learning, must engage with the complexity and ambiguities of real life problems. PBL is thus well suited to the development of key skills, such as the ability to work in a group, problem-solving, critiquing, improving personal learning, self-directed learning, and communication.

There has been reluctance to introduce PBL into physics courses due to a view that students require a sound body of knowledge and mathematical skills before they are equipped to engage with this type of approach (McDermott & Redish, 1999). It has been revealed that first year students tend to rely more on lecture notes than students in later years, and that first year students tend to be assessment driven (Dublin Institute of Technology, 2005). However, it has been reported in the School of Physics in Ireland that PBL can be introduced successfully into first year, if it is facilitated correctly and the tutors are aware that the students are only in the early stages of developing as self-directed learners (Dublin Institute of Technology, 2005).

Different from the PBL norm, traditional learning is the learning styles that been widely used in Malaysia (Ahmad, 1998). The learning activity follows typical traditional face-to-face classroom approach, where students are given lecture notes to read and study. At the end of each topic, students are given tutorial questions or homework they have to answer and send to lecture or tutor as usual. No further learning activities would be done other than these teaching and learning activity.

Integrating PBL in Online Environment

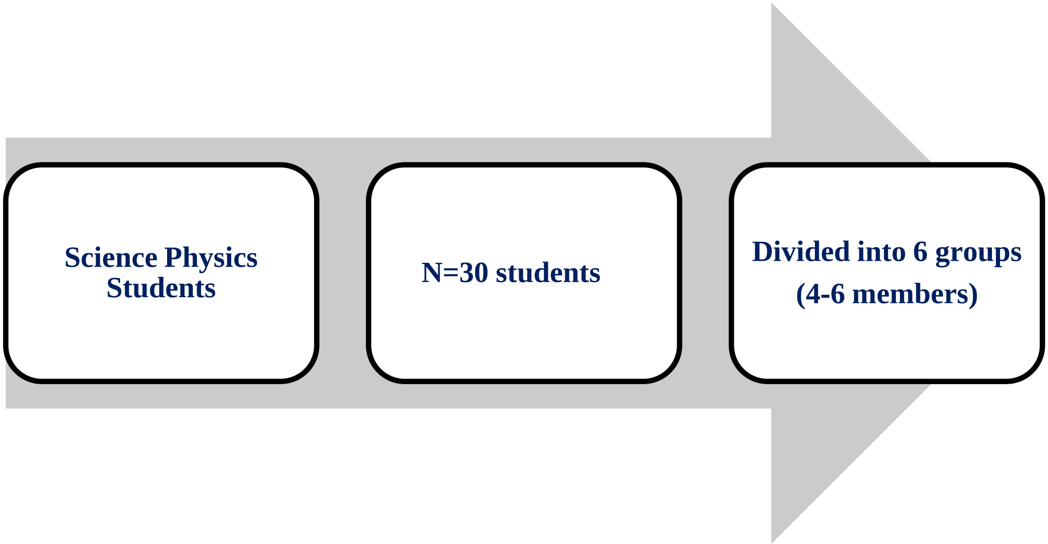
Nowadays teaching and learning are experiencing a dramatic change through the blending of information learning technologies into the learning process. Online learning is the collection of teaching – and information packages – in further education which is available at any time and any place and is delivered to learners by electronic means. The learner has limited physical contact with lecturer or other learners where all classroom based activities are interspersed with occasional computer delivered or facilitated assignments (Abdalla & Ibrahim, 2005, July). Certain factors such as the Internet connection, the capacity of connection bandwidth, student support services, course material, interaction between peers and lecturers are need to get extra attention in order to make the online learning is a success.

This paper will evaluate the students' perceptions from two different approaches that been delivered fully through online learning. Although research indicated that the use of PBL in several context and other disciplines is engaging, and enabling students to develop a number of cognitive skills (e.g., Albanese & Mitchell, 1993) until now, little research has been done about to seek the diverse of students' perception about PBL online learning. With respect to improvement of education in higher education especially the science students and the enhancement of the students' engagement, it is important to know how far this particular approach can be enhanced and what the students' acceptance on PBL online learning is. Educators and researchers need to look more on these situations to better understand the advantages and disadvantages, particularly when it comes from students' awareness and interest. Hence the purpose of this paper is to explore the students' acceptance, and it is also will differentiate whether if there is any avoidance or neglecting off PBL online learning approach. This is critical to better know the real situation happen during PBL online learning session.

II. METHODOLOGY

The study was conducted throughout Semester II during the 2008/2009 academic year at the University Malaysia Sabah (UMS), Malaysia. Thirty science physics students from Physics With Electronic Programme at the School of Science and Technology (SST) were involved. The samples pursued all the PBL learning activities (i.e., collaborative learning, independent learning, self-directed learning, and reflective learning) in an online learning environment (i.e., learning management system, LMS) which acted as the main medium to support the full learning process throughout the semester. The students then divided into six small groups which contain 4-6 students. The flow of group sample shows in Figure 1.

Figure 1: ***Group Sample for the Study***



The intervention was conducted within 16 weeks. During this intervention, all the teaching and learning assessment being delivered using the learning management system (LMS) organised by Educational Technology and Multimedia Unit (ETMU) at the Universiti Malaysia Sabah. The researcher prepared the LMS followed the PBL criteria to fulfilled the learning and teaching activities via online.

The learning activities started with problems. After they encounter with the problem, they have to find their own information, knowledge and sources in order to find the appropriate solution. They can either find the solution via Internet, interview lectures or tutors, from text books, observation or any other methods in sequence to find adequate information to solve their problems. The students in PBL group also have to access to the LMS to do their chat room at least once in a week and monitored by a facilitator. In this chat room they will argue, share thoughts and most probably constructed their own thinking regarding to the particular problems. They also be able to enter the forum room to post any inquiries or any ideas asynchronously. Additionally some linkages, sources and lecture note also uploaded by the facilitator for them just to ensure the students did not lose their ways in sequence to find the suitable solution and just to give them the correct path in searching their resource. They had been given two weeks for each problem to solve before passing up, and there were five problems need to be solved throughout the semester. This LMS system was using Moodle2007 course management systems. Jayasundara et al. (2007) suggested that the PBL online service and implementation rate of system perhaps more improve and even better if it is incorporated with existing course management systems such as Moodle2007 and Blackborad2007.

In this study the intention was to investigate students' acceptance on PBL online learning. The data were collected through a well developed survey which has $\alpha = 0.83$ Cronbach's Alpha. The survey was filled one week after their finish with the intervention.

III. FINDINGS

The results are shown in Table 1. It indicates that there are statistically significant differences in perceived learning outcomes for students' in general who participated in the in PBL approach (analyse using the binomial test, based on Z approximation, all the asymp. sig. 2 tailed for all statements indicates that $p^* < 0.05$). Analysis using the One-Sample t-Test for test value = 3 also indicated that the majority of the students agreed their learning outcomes were enhanced by their participation in the PBL approach in terms of Knowledge, *Skills and the Application of Knowledge & Skills; Communication;* and *Independent Learning* categories of the PBL approach.

Table 2 Comparison of physics students' perceptions of PBL online (i.e.: learning outcomes (knowledge, skills & application of knowledge & skills; communication; and independent learning)

		Category (Observed Prop.)		Asymp. Sig. (2-tailed)	Mean (SD)	Test Value = 3	
		Group 1 <= 3	Group 2 > 3			t (df =29)	Sig. (2-tailed)
Knowledge, Skills and Application of Knowledge & Skills							
1	I was able to search for, and access, information from a variety of sources.	6 (0.20)	24 (0.80)	0.00*(a)	4.10 (0.78)	7.66	0.00*
2	I was able to recognize the relevance of what I learned to my own daily life.	4 (0.13)	26 (0.87)	0.00*(a)	3.90 (0.58)	8.52	0.00*
3	I was able to develop my problem-solving ability.	2 (0.07)	28 (0.93)	0.00*(a)	4.10 (0.69)	8.69	0.00*
4	I was able to identify the critical issues that were being discussed.	4 (0.13)	26 (0.87)	0.00*(a)	3.90 (0.45)	11.07	0.00*
5	I was able to learn many new knowledge.	4 (0.13)	26 (0.87)	0.00*(a)	4.00 (0.64)	8.52	0.00*
6	I was able to gain more advantages in knowledge facts.	5 (0.17)	25 (0.83)	0.00*(a)	3.90 (0.64)	7.77	0.00*
7	I was able to make connections between different facts.	5 (0.17)	25 (0.83)	0.00*(a)	4.00 (0.69)	7.88	0.00*
8	I was able to choose and apply my own strategy in problem-solving.	6 (0.20)	24 (0.80)	0.00*(a)	3.90 (0.78)	6.32	0.00*
9	I was able to think creatively when using problem-based learning.	3 (0.10)	27 (0.90)	0.00*(a)	4.05 (0.61)	9.34	0.00*
10	I was able to think critically.	5 (0.17)	25 (0.83)	0.00*(a)	3.86 (0.48)	9.86	0.00*
11	My comprehension improved.	6 (0.20)	24 (0.80)	0.00*(a)	3.86 (0.66)	7.13	0.00*
12	My ability to apply what I have learned improved.	5 (0.17)	25 (0.83)	0.00*(a)	3.86 (0.80)	5.87	0.00*
13	My ability to analyze data improved.	4 (0.13)	26 (0.87)	0.00*(a)	3.95 (0.72)	7.27	0.00*
14	I was able to apply my synthesis skill more deeply when using problem-based learning.	8 (0.27)	22 (0.73)	0.02*(a)	3.76 (0.69)	6.05	0.00*
15	My ability to evaluate findings improved.	4 (0.13)	26 (0.87)	0.00*(a)	3.90 (0.58)	8.52	0.00*
16	I was able to apply my technical maturity skill more deeply.	3 (0.10)	27 (0.90)	0.00*(a)	3.90 (0.64)	7.77	0.00*
17	I was able to retain what I had learned.	6 (0.20)	24 (0.80)	0.00*(a)	3.76 (0.58)	7.18	0.00*
Communication							
18	I was able to share my ideas clearly within my group during group.	4 (0.13)	26 (0.87)	0.00*(a)	3.81 (0.62)	7.12	0.00*
19	I was willing to consider the opinions of others, even though I did not fully agree with them.	3 (0.10)	27 (0.90)	0.00*(a)	4.00 (0.45)	12.04	0.00*
20	I was able to provide logical ideas to my group members, even though they sometimes did not fully agree with me.	1 (0.03)	29 (0.97)	0.00*(a)	4.19 (0.56)	11.55	0.00*
21	I was able to generate related ideas and information with the group members gradually.	4 (0.13)	26 (0.87)	0.00*(a)	3.86 (0.88)	5.32	0.00*

22	**I had the opportunity to play an important role as one of the main resource contributors during group discussion.**	**3 (0.10)**	**27 (0.90)**	**0.00*(a)**	**4.14 (0.80)**	**7.82**	**0.00***
23	**I was able to listen to different perspectives and points of view of my group members and keep an open mind about their views.**	**2 (0.07)**	**28 (0.93)**	**0.00*(a)**	**4.19 (0.50)**	**13.05**	**0.00***
24	**I improved in my ability to contribute useful ideas and knowledge in group discussion.**	**3 (0.10)**	**27 (0.90)**	**0.00*(a)**	**4.00 (0.83)**	**6.60**	**0.00***
Independent Learning							
25	**I was able to work more independently.**	**5 (0.17)**	**25 (0.83)**	**0.00*(a)**	**3.76 (0.91)**	**4.61**	**0.00***
26	**I was able to think of questions that helped me to drive the progress of problem-solving.**	**7 (0.23)**	**23 (0.77)**	**0.01*(a)**	**3.90 (0.64)**	**7.77**	**0.00**
27	**I did my fair share of work in my group.**	**9 (0.30)**	**21 (0.70)**	**0.04*(a)**	**3.62 (0.76)**	**4.44**	**0.00***
28	**I know what I am good at, and used my talents to the fullest.**	**7 (0.23)**	**23 (0.77)**	**0.01*(a)**	**3.86 (0.71)**	**6.62**	**0.00**
29	**I was able to learn new things during problem-solving.**	**3 (0.10)**	**27 (0.90)**	**0.00*(a)**	**4.14 (0.76)**	**8.28**	**0.00***
30	**I was able to demonstrate positive and responsible attitudes towards learning.**	**6 (0.20)**	**24 (0.80)**	**0.00*(a)**	**4.10 (0.78)**	**7.69**	**0.00***
31	**I was able to sustain my interest in solving a problem.**	**2 (0.07)**	**28 (0.93)**	**0.00*(a)**	**4.19 (0.72)**	**9.00**	**0.00***
32	**I was able to choose and apply my own strategy when learning.**	**4 (0.13)**	**26 (0.87)**	**0.00*(a)**	**4.05 (0.67)**	**8.59**	**0.00***
33	**The learning activities employed motivated me to learn more.**	**2 (0.07)**	**28 (0.93)**	**0.00*(a)**	**4.14 (0.60)**	**10.37**	**0.00***
34	**I was able to solve interesting and relevant physics problems.**	**3 (0.10)**	**27 (0.90)**	**0.00*(a)**	**4.05 (0.72)**	**7.99**	**0.00***
35	**I was involved actively in the learning activities with the group members.**	**7 (0.23)**	**23 (0.77)**	**0.01*(a)**	**3.86 (0.84)**	**5.57**	**0.00***
36	**I was able to locate my own sources of information.**	**5 (0.17)**	**25 (0.83)**	**0.00*(a)**	**4.05 (0.72)**	**7.99**	**0.00***
37	**I was able to apply much new knowledge in problem-solving process.**	**4 (0.13)**	**26 (0.87)**	**0.00*(a)**	**4.05 (0.81)**	**7.10**	**0.00***
38	**The learning activity was suitable for my level of knowledge.**	**3 (0.10)**	**27 (0.90)**	**0.00*(a)**	**3.95 (0.89)**	**5.86**	**0.00***
39	**The learning activities were fun.**	**3 (0.10)**	**27 (0.90)**	**0.00*(a)**	**4.33 (0.71)**	**10.27**	**0.00***

Note. (a) Based on Z Approximation.
*Statistically significant differences between PBL mean on Likert Scale with test value=3 (t-Test for One-Sample Test)
(N=30)
Observed Proportion (Test Prop.=0.50)

IV. DISCUSSIONS AND CONCLUSION

From this finding it is clearly shows that the learning activity embraced in PBL online did trained student to be more competence in communication and more independent, at least from the students' perceptions. Their skills also improved especially in handling their own learning activities and resource findings. This is similar with works with Carlisle and Ibbotson (2005) where students felt that a PBL approach helped to make the subject matter interesting to them and they believe can maintain knowledge for a longer period compare learning in traditional way. As Pastirik (2006) also suggests that PBL method is a widely adopted and effective approach to fostering autonomy and self-directed learning in students. The objective of this paper was to find out what is physics students' acceptance of PBL online in terms of learning outcomes under the three main themes which are: *students' knowledge, skills and application of knowledge and skills; communication; and independent learning*. In conclusion, apparently physics students had accepted the PBL online approach in a very positive way. They felt that their respective skills improved and they managed to study well in the PBL online environment. As a consequence these findings should be able to give a better description and ideas to educators, lectures and researchers on what are really happens from the students' perspective towards PBL online.

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