

Success Factors of Problem based Learning for IT Courses: Measurements on PBL Characteristics, PBL Assessments and PBL Practices

^{1,2}Haslina Mohd, ^{1,2}Norida Muhd Darus, ^{1,2}Mohamed Ali Saip,
^{1,2}Fauziah Baharom, ^{1,2}Nurnasran Puteh, ^{1,2}Mohamed Zabidin Husin,
^{1,2}Zaharin Marzuki and ^{1,2}Azman Yasin

¹School of Computing, Universiti Utara Malaysia, Chauglun, Malaysia

²Human-Centered Computing Research Lab., Universiti Utara Malaysia (UUM),
06010 Sintok, Kedah, Malaysia

Abstract: Recently, a shifting from lecture-based teaching methods in for IT undergraduate courses to a more student-centered learning is called as Problem-Based Learning (PBL). A problem-based learning approach is one of the applicable solutions to strengthen IT student capabilities in critical thinking, problem solving, soft skill such as communication, leadership and team-work skills. Educational Institutions can produce students with the ability of critical thinking, creative and innovative through soft skill. This soft skill is crucial in preparing IT students with honorable values which later may contribute to the success of Malaysian Vision 2020 to increase skilled worker with soft skill ability. To date, there is a lack of statistical evidence to show IT student's perception of IT courses related to PBL characteristics, PBL assessment and PBL practices. Therefore, this study aims to identify the PBL success factors of IT courses. The survey technique was applied in this study. The self-administered questionnaires were distributed to 119 IT students who had experienced in PBL. The results of reliability test showed the Cronbach's alpha value for the questionnaire is 0.983. The findings from a descriptive analysis of the PBL characteristics, PBL assessment, PBL practices and PBL perception show that the critical success factors of IT courses that highlighted by the respondents with the mean value of 4 are self-assessment (one of the sub-factor of PBL assessment), Roles of facilitator (one of the sub-factor of PBL Characteristics) constructivism and group activity (two sub-factors of PBL practices). These findings may contribute the IT educators in improving their PBL implementation for IT courses and also to the PBL researchers in improving the existing PBL models.

Key words: Problem Based Learning (PBL), IT courses, problem solving, soft skill, critical success factors of PBL, assessment

INTRODUCTION

Malaysia institutions can play their roles in producing IT graduates with soft skills, abilities such as critical thinking, creative and innovative. The soft skills are crucial in preparing IT graduates with noble values which later may contribute to the success of Malaysian Vision 2020, especially to increase productivity and advancing the national economy.

Recently, a shifting from lecture-based teaching methods in for IT undergraduate courses to a more student-centered learning is called as Problem-Based Learning (PBL). The PBL is defined as a constructivist pedagogic approach that inspires learners to apply critical thinking and problem solving skills along with the content knowledge in solving real life problems and issues (Hendry *et al.*, 1999; Bajwa and Mulcahy, 2012).

Therefore, a problem-based learning approach is one of the applicable solutions to strengthen IT student capabilities in critical thinking, problem solving, soft skill such as communication, leadership and team-work skills.

In addition, the applicability of PBL in teaching IT courses are considered a good teaching method. Unfortunately, there is a lack of statistical evidences that has proven the existing PBL practices can lead to the successfulness of the future IT graduates to gain the required soft skills. Therefore, success factors of the PBL implementation need to be identified to ensure that future IT graduates have all the required soft skills as stated earlier. In fact, PBL has been applied globally in various educational levels (Chan, 2014; Sahin, 2007). Generally, the PBL can be applied in any content area but it may look very different across subjects, especially on the

implementation factors that may influence its effectiveness. In order to ensure effective PBL practice, the high capabilities factors that may influence the PBL practices must be identified such PBL characteristics and PBL assessment. The aim of implementing PBL in any course can be simplified as assessing a student in terms of critical thinking, high motivation, problem solving, self-directed, self-reflective and high decision-making ability. In order to achieve this mission, it is crucial to evaluate and develop the PBL program (Bruner, 1966). Until now, lack of study that observing the PBL characteristics and PBL assessment that may influence the PBL practices in teaching IT courses. In addition, a comprehensive PBL model that relates both factors with PBL practices in IT courses have not yet been found in the literatures. Therefore, it is vital to conduct a study to measures the roles of PBL characteristics and PBL assessment that might influence the PBL practices in teaching IT courses.

Further, such statistical evidences can assist decision makers in enhancing the PBL teaching and learning strategy for IT courses. In addition, this study may trigger the opportunity for PBL researchers in enhancing the existing PBL characteristics and PBL assessment to ensure the best PBL practices can be adopted in teaching IT courses.

Thus, this study aims to determine PBL success factors that might influence the PBL implementation in teaching the IT courses. The identified factors may contribute to the PBL constructive framework in which the constructivist theory is the foundation theory in this study. This theory promotes active in which learners construct new ideas or concepts based upon their current or pass knowledge (Cohen *et al.*, 2000).

The criteria of the respondents for this study are IT students who had attended the PBL courses at least one semester. In this study, the respondents are employed among students of undergraduate programs, particularly Bachelor of Information Technology (BIT), Bachelor of Multimedia (BMM) and Bachelor of Education (IT Majoring) (B.EduIT) in University Utara Malaysia. Three courses are identified that applying PBL in teaching and learning process: system analysis and design, component-based software development, IT project 1 and 2. Based on a comprehensive literature review, the PBL success factors are identified which consists of three basic theories of PBL:1) PBL characteristics which are measured by self-directed learning, self-reflective and facilitator assessment,) PBL course assessment, composed of peer assessment and self-assessment and PBL practices which consists of constructivism, group formation, group activity, knowledge sharing and task

assignment. The factors are then being measured based on student's perception of the PBL implementation of IT courses. The student's perception factor is important to measure the PBL effectiveness of the identified factors.

MATERIALS AND METHODS

This study collects data through a survey (survey research design) based on study by Lavrakas (2008), Das *et al.* (2002) and Nunnally (1978). In preliminary study phase, a comprehensive literature review was carried out to gather information related to this study. The factors of PBL core characteristics, PBL assessment, PBL practices and student perception are identified and investigated. Next, a proposed model for this study was constructed to visualize the relation between each factor. Then, a list of hypotheses was formulated. The questionnaire was developed based on the factors. A pilot study was conducted to validate the questionnaire. The questionnaire was validated by 117 respondents. From the study, the value of Cronbach's alpha value of the questionnaire was 0.983 which is reliable because it is greater than the threshold value 0.611. This implicates that the questionnaire is good at asking what it should ask. Later, the questionnaire was refined based on the result of the pilot study. Once refined, the sample was selected in fulfilling the scope of this study. Data for the study is collected manually from the respondents using a set of questionnaires. The last phase was validation phase. The collected data were analyzed by statistical technique using SPSS Ver.16. The correlations among the factors were tested using pearson's correlation coefficient. The proposed model once again been validated and improved. The outcome from this survey revealed the student's perspectives towards PBL implementation in IT courses. The results of the correlation and hypothesis testing were presented in the previous study. This study only presented the results of a descriptive analysis of the mean values for each observed factor or also called as PBL success factors. The aim is to identify the most significant success factors of the PBL implementation of IT courses.

RESULTS AND DISCUSSION

This study discusses on the results of sampling adequacy, reliability test and descriptive analysis of the mean value for each observed factor in this study: self-directed learning, self-reflective, teaching skill, roles of facilitator, student centered, constructism, group formation, group activity, knowledge sharing, task assignment, facilitator assessment, peer assessment, self-assessment.

Sample adequacy: The sample in this study is considered adequate because the value of KMO is larger than 0.6. Particularly, Table 1 shows that the KMO value is 0.774.

Reliability and validity of the measurement items: The reliability of the measurement items was tested using Cronbach's alpha and the validity of the measurement items is tested using factor analysis. The values for cronbach's alpha which are larger than 0.6 are considered acceptable. Table 2 shown the Cronbach's alpha values for all factors are reliable and acceptable. The cronbach's alpha value for the questionnaire is 0.983.

Table 3 shows the results of a descriptive analysis of the mean values for each observed factors. The mean values are based on the measurement of Likert scales 1-5 (1 strongly disagree, 2-disagree, 3-natural, 4-agree, 5-strongly agree).

Based on Table 3, the results showed that the top four factors with the mean values of 4.0 are the self-assessment, roles of facilitator, constructism and group activity, followed by peer assessment, knowledge sharing, teaching skill, self-reflective and pbl perception (mean value = 3.9), then facilitator assessment, self-directed learning, task assignment, student-centered (mean value = 3.8) and finally group formation (mean value = 3.3).

Units: The finding of the study shows that Self assessment, role of facilitator, constructism and group activity (Mean value = 4) are the most important factors that may contribute to the success factors of the PBL implementation of IT courses. The first factor is Self-Assessment (SA). The respondents agree that (mean value = 4) they had spent a lot of time on the self-directed learning. They were also agree that PBL may improve their learning skill in class and also motivates them to use additional learning resources.

The second factor, Roles of Facilitator (ROF) are to facilitate discussion groups and also to ensure all group members are participating in the discussion. Hence, may trigger a lot of ideas in solving a given problem, increase communication, critical thinking, self-confidence and relationship among group members. The respondents agree that (mean value = 4), the facilitators of IT courses motivates students to do the best in the task given to them. In addition, the facilitators were also given helpful feedback to in improving their tasks.

The third factor, constructivism is a philosophy based on the fundamental assumption that knowledge cannot exist outside our minds. Knowledge cannot be given from one mind to another. New knowledge is "constructed" or created from within individuals through experience. In higher education, Problem-Based Learning (PBL) is an accepted instructional method or strategy for structuring learner's experiences. The findings show that

Table 1: KMO and barlett's test

Tasts	Values
Kaiser Meyer Olkin measure of sampling adequacy	0.774
Barlett's test of sphericity	
Approx. χ^2	8703.853
df	3160.000
Sig.	0.000

Table 2: Results of cronbach's alpha values

Sub-factors	Factors	Cronbach's alpha values	No. of items
SDL	PBL characteristics	0.911	7
SR	PBL characteristics	0.912	10
TS	PBL practices	0.841	3
ROF	PBL characteristics	0.878	4
SC	PBL characteristics	0.850	4
C	PBL practices	0.869	4
GF	PBL practices	0.616	3
GA	PBL practices	0.928	8
KS	PBL practices	0.921	6
TA	PBL practices	0.822	6
FA	PBL assessment	0.912	6
PA	PBL assessment	0.898	4
SA	PBL assessment	0.844	3
All items		0.983	79

Table 3: Descriptive statistics of mean values

Variables	N	Mean		SD	Variance
		Statistic	SE		
SA	117	4.0940	0.06276	0.67891	0.461
ROF	117	4.0235	0.05596	0.60529	0.366
C	117	4.0197	0.05371	0.58091	0.337
GA	117	4.0110	0.05520	0.59707	0.356
PA	117	3.9850	0.05816	0.62912	0.396
KS	117	3.9402	0.05550	0.60031	0.360
TS	117	3.9312	0.06097	0.65947	0.435
SR	117	3.9200	0.04984	0.53915	0.291
PBLPEC	117	3.9144	0.05052	0.54646	0.299
FA	117	3.8942	0.05475	0.59220	0.351
SDL	117	3.8915	0.05513	0.59637	0.356
TA	117	3.8749	0.05619	0.60778	0.369
SC	117	3.8746	0.06330	0.68471	0.469
GF	117	3.3103	0.08150	0.88158	0.777
Valid N (listwise)	117				

the IT courses may develop their ability to work as a team member and also help them with their problem-solving skills, analytic skills and develop their academic interest of IT courses.

The fourth factors is the group activity, based on this study, the results show that, the PBL approaches may improve their IT skills, especially in problem solving skills, analysis, creativity and communication, efficiency in the teamwork activity and spirit, stimulating their learning activities and group discussion, especially in promoting open discussion of different opinion and facilitating the learning process (mean value = 4). These findings are supported by previous studies (Yuan *et al.*, 2011; Bates, 2000).

Instead of the above sub-factors, other sub-factors are peer assessment, knowledge sharing, teaching skill, self-reflective and PBL perception with the mean value of 3.9, then facilitator assessment, self-directed learning, task assignment, student-centered with the mean value of 3.8 and finally group formation with the mean value of 3.3.

CONCLUSION

The findings from this study shows that the most critical success factors of the PBL implementation of IT courses to the mean value of 4 are self-assessment (one of the sub-factor of PBL assessment), roles of facilitator (one of the sub-factor of PBL characteristics), constructivism, and group activity (two sub-factors of PBL practices).

IMPLEMENTATIONS

These findings may contribute to the IT educators in improving their PBL implementation for IT courses and also to the PBL researchers in improving the existing PBL models. For future improvement, the measurement of each PBL characteristic, PBL assessment, PBL practices and PBL perception can be refined by including more sub-factors that most probably may produce a very significant results of the critical success factors of the PBL implementation especially on IT courses. The study also can be replicated in other domain to ensure the robustness of the model.

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REFERENCES

- Bajwa, H. and E.P. Mulcahy, 2012. Redesigning teaching approaches for undergraduate engineering classrooms. Proceedings of the 2012 IEEE 2nd International Conference on Integrated STEM Education (ISEC), March 9, 2012, IEEE, Ewing, New Jersey, USA., ISBN:978-1-4673-1096-3, pp: 1-4.
- Bates, A.W., 2000. Managing Technology Change: Strategies for College and University Leaders. Jossey-Bass Publishers, San Francisco, Pages: 235.
- Bruner, J., 1966. Toward a Theory of Instruction. Harvard University Press, Cambridge, MA.
- Chan, S.K., 2014. The impacts of problem-based learning on student's academic achievement, motivation and self-regulated learning strategies: A perspective from a law subject. Ph.D Thesis, Chinese University of Hong Kong, Hong Kong.
- Cohen, L., L. Manion and K. Morrison, 2000. Research Methods in Education. 5th Edn., Routledge, London, England, ISBN:9780415195416, Pages: 446.
- Das, M., D.J.S. Mpofu, M.Y. Hasan and T.S. Stewart, 2002. Student perceptions of tutor skills in problem-based learning tutorials. *Med. Educ.*, 36: 272-278.
- Hendry, G.D., M. Frommer and R.A. Walker, 1999. Constructivism and problem-based learning. *J. Further Higher Educ.*, 23: 369-371.
- Lavrakas, P.J., 2008. Encyclopedia of Survey Research Methods. Sage Publications, Thousand Oaks, California, USA., ISBN:978-1-4129-1808-4, Pages: 1003.
- Nunnally, J.C., 1978. Psychometric Theory. 2nd Edn., McGraw-Hill, New York, USA., ISBN-13: 9780070474659, Pages: 701.
- Sahin, M., 2007. The importance of efficiency in active learning. *J. Turk. Sci. Educ.*, 4: 62-74.
- Yuan, H.B., B.A. Williams, L. Yin, M. Liu and J.B. Fang *et al.*, 2011. Nursing student's views on the effectiveness of problem-based learning. *Nurse Educ. Today*, 31: 577-581.