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Design a Framework of On-line Problem-Based Learning

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Abstract: - PBL is the bridge to connected learner with real world and is the trigger setting for high level thinking skill. On-line technology is supporting our learning in many ways. There is a need to design a framework of on-line PBL. The purpose of this study was to design a framework of on-line problem-based learning. Based on literature review, a theory framework was identified. An implementation of this framework was conducted to verify the feasibility. In the framework of on-line PBL, the results of the evaluation conducted in this study suggest that the feasibility is exits.

Key-word: On-line Technology, PBL, Education

1 Introduction

Problem-based learning (PBL) has its origins in the medical school when most major pioneering work has been conducted with programs in medicine since the last few decades. PBL in medicine is viewed as part of curricular renewal which generally calls for less lecture-based instruction and more emphasis on independent learning and problem-solving.

In the medical and allied health context, PBL at its most fundamental level is an instructional method characterized by the use of patient problems as an impetus for students to learn problem-solving skills and acquire knowledge about clinical sciences. The PBL strategy involves several stages which include (1) encountering the problem; (2) problem-solving with clinical reasoning skills and identifying learning needs in an interactive process; (3) self-study; (4) applying newly gained knowledge to the problem; and (5) summarizing what has been learned (Barrows, 1985). Finally, the PBL process concludes with students' evaluating the information resources they used and then analyzing how they might have better managed the patient problem.

The 'problem' in PBL can be used to denote any situation that may stimulate thinking in the learner, in contrast to the passive transmission of knowledge of the conventional lecture. The 'problem' provides an opportunity for students to become actively involved in the discussion of issues for new learning, with appropriate feedback and corrective assistance from teachers. The PBL strategy is student-centered, wherein learning sessions are carried out in small groups which help to foster teamwork and promote communication skills. The teacher's role is to facilitate the problem-solving process, to guide, probe, and support the students' initiatives, not to lecture, direct or provide solutions.

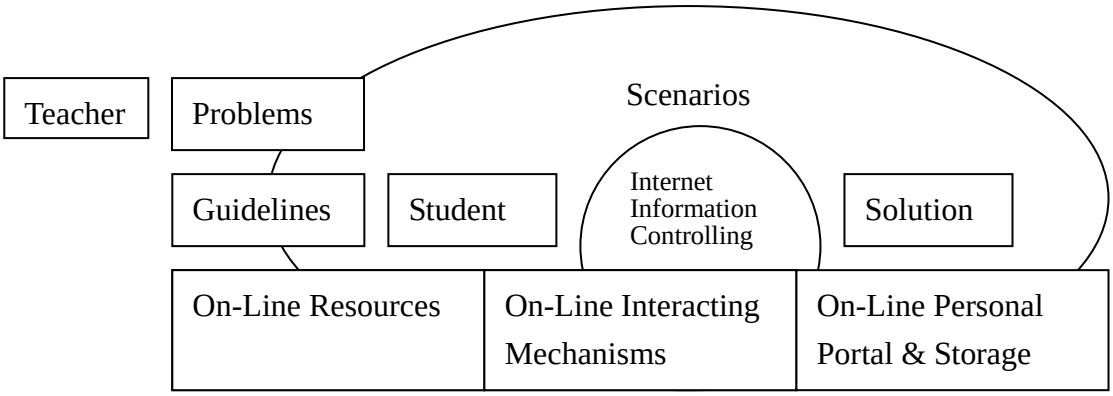

Figure 1. Theory framework of on-line PBL

What distinguishes PBL from other problem-centered methods, such as the case method, is that in PBL, the problem is presented first, before the students have learned the basic concepts, not after. This helps to promote relevance and interest for subsequent learning when students have a purpose for the acquisition of knowledge and concepts required for solving the 'problem'. The strength of this approach is that students acquire personally meaningful knowledge that is learnt in a relevant (problem-based) context, and also come to a personal understanding of how to acquire knowledge to resolve a situation.

The implications of adopting PBL on teachers and students are many folds. The initial implementation may not be an easy task, especially trying to persuade academic staff to accept the challenge of developing well-written and realistic problem for the PBL curriculum when they are blissfully happy with the traditional knowledge transmission mode. This change in role from a safe transmitter of knowledge to a facilitator of learning can be difficult and quite traumatic to the teacher, as well as the students.

Playing a critical part in PBL, students too have to learn to take on a new role. They have to accept responsibility for their own learning by identifying the gaps in their knowledge, determining their learning needs, and collaborating in the search for information so that they can share it with each other in the next session. Students should be reminded from time to time of not lapsing into their usual, passive mode of looking up to their teachers to be fed with on-the-spot answers as in conventional teaching.

In a nutshell, the PBL strategy is characterized by the following features:

1 The problem is the starting part.
2 The problem is a 'real problem' that the students may have to deal with.
3 Knowledge that students should acquire is organized around problems, not disciplines.
4 Students, as a group and individually, assume the major responsibility for their own instruction and learning.
5 Much of the learning occurs within the context of small groups rather than lectures.

An aphorism attributed to the Chinese has helped to summarize this PBL concept very succinctly: 'Give me a fish and I eat today. Teach me to fish and I will eat for a lifetime'[1-3].

2 Research Problem

PBL is the bridge to connected learner with real world and is the trigger setting for high level thinking skill. There is a need to design a framework of on-line PBL.

The purpose of this study was to design a framework of on-line problem-based learning. Based on literature review, a theory framework was identified. An implementation of this framework was conducted to verify the feasibility.

3 Theory Framework

Problem-based learning (PBL) is an active learning strategy in which students are engaged in real world problems. It is characterized by several distinct features that may be identified and utilized when designing curriculum: (1.) the strategy relies on problems; the problems do not test skills, but they assist in the development of the skills themselves; (2.) the problems are truly ill-structured: there is not meant to be one solution, and as new information is gathered in a reiterative process, perception of the problem, and thus the solution, changes; (3.) the students solve the problems while the teachers are coaches and facilitators; (4.) the students are only given guidelines for how to approach problems; there is no one formula for student approaches to the problem; (5.) the assessment, which is authentic and performance based, is a seamless part and end of the instruction[4, 5].

When using PBL, instructors must plan for three inevitable stages: Stage 1: Encountering and Defining the Problem; Stage 2: Accessing, Evaluating and Utilizing Information; Stage 3: Synthesizing and Performing[6].

There can, however, be problems in the actual

implementation of PBL. The most common problem stems from the cultural change that is required to implement PBL.

University students accustomed to the more traditional model of teaching, which features the professor as a "sage on the stage" and disseminator of knowledge, may experience culture shock of a sort as they work in groups to conduct research and find solutions to real-life problems[7, 8]. Instructors may also experience major adjustments as they learn to construct problems that assist students to learn appropriate skills and knowledge. Professors using PBL must learn to facilitate instead of lead[5]

It has been argued that PBL techniques help students develop the skills necessary to succeed in their learning careers. Students in PBL courses are challenged to "learn to learn" so that they can achieve their highest potential in their chosen professions. In helping to teach each other, students achieve a high level of understanding of the course's concepts[9]

4. Research Findings

In this section, research findings would be presented in four sub-sections.

4.1 The Procedure of On-line Problem Based Learning

Provide learners an individual account to access on-line learning platform and group learners into a team with small amount of members. Learners would get access on-line learning environment individually and would discover concepts and information through interacting with teacher, peers, and industry experts. They are responsible to make decisions for their own solution. Learning would be lasted when they observe, apply and refine through practice the thinking processes used by real-world practitioners. The real-world problem would be the source motivation of problem solving.

Teachers would provide rich information environments with activities for learning by incorporating opportunities for collaborative work, problem solving, authentic tasks and shared knowledge and responsibility. They act as a guide to encourage learners to become a solution-explorer and enhance learners' motivation throughout the learning process. Teacher would follow two guiding forces in generating problems. First, the problems must raise the concepts and principles relevant to the content domain; secondly, the problem must be real. Then, presenting problem becomes the next mission. The goal of presenting problem is to make learner owning the problem.

There are six sub-tasks of this on-line problem based learning design. Those are problem-identifying, recognizing, planning, alternating, constructing, and evaluating.

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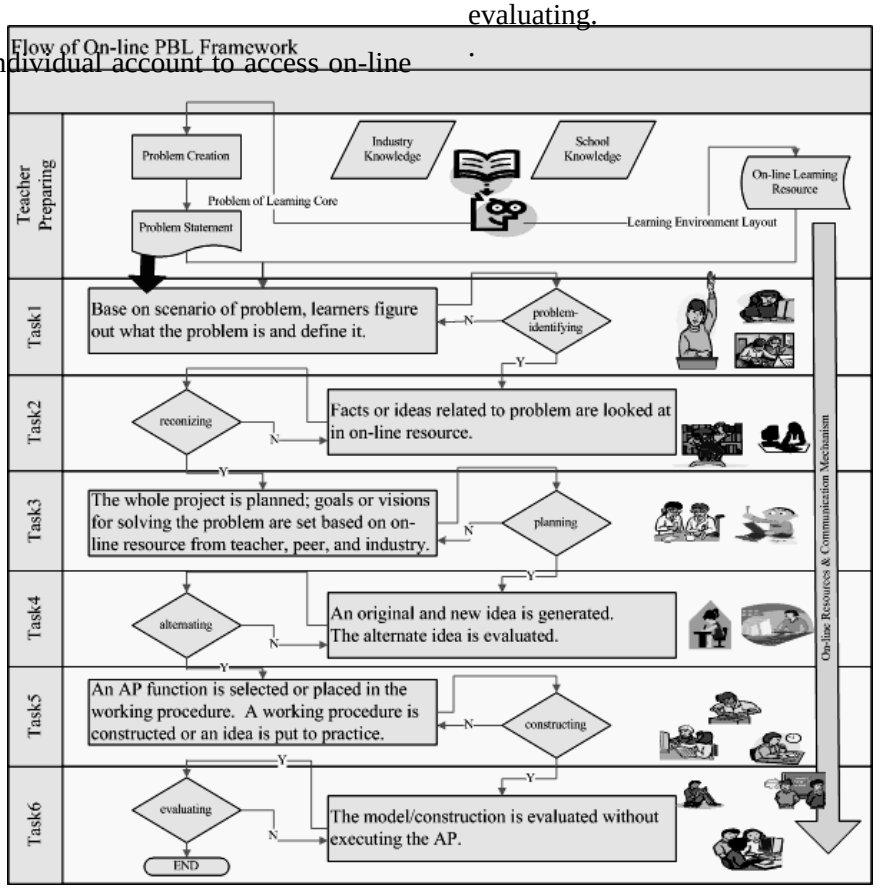

Figure 2. Flow-chart of on-line PBL Framework

4.2 The Strategies of Promoting Problem Based Learning

Teacher should apply some critical strategies in order to provide effective learning in adopting PBL as an instructional model:

1. Secure all learning activities to a larger task or problem.
2. Support students in developing independent responsibility of the overall problem or task;
3. Design the authentic task;
4. Prepare the learning environment to reflect the real world complexity;
5. Challenge individual students with developing their own process and solution;
6. Challenge the learner's thinking.
7. Provide learners with alternative views and contexts.
8. Provide learners a platform to reflecting learning process and content learned.
9. Reminding learners to join all learning activities.
10. Guide learners to search on-line learning resources

4.3 The Supporting Module of On-line Platform

There were eight modules jointed to establish the whole mechanism. They were described separately in the followings.

Assignment Module

Assignments can be specified with a due date and a maximum grade for raising a problem. Students can upload their assignments (any file format) to the server – they are date-stamped. Late assignments are allowed, but the amount of lateness is shown clearly to the teacher. Teacher feedback is appended to the assignment page for each student, and notification is mailed out. The teacher can choose to allow resubmission of assignments after grading (for re-grading)

Chat Module

It would allow smooth, synchronous text interaction for providing teachers and students on-line interacting for facing problems. It includes profile pictures in the chat window and supports URLs, smiles, embedded HTML, and images. All sessions are logged for later viewing, and these can also be made available to students

Choice Module

Like a poll. Can either be used to vote on something, or to get feedback from every student (e.g. problem consent). Teacher sees intuitive table view of who chose what and students can optionally be allowed to see an up-to-date graph of results

Forum Module (Storage Board)

Different types of forums were provided, such as teacher-only, course news, open-to-all, and one-thread-per-user. Discussions could be viewed nested, flat or threaded, oldest or newest first. Individual forums can be subscribed to by each person so that copies are forwarded via email, or the teacher can force subscription for all. It would be the core place for knowledge exchanging and problem resolving. The teacher can choose not to allow replies (e.g. for an announcements-only forum) for providing certain one-way information. Discussion threads can be easily moved between forums by the teacher for spreading information among groups. Ratings are possible in forums and these can be restricted to a range of dates.

Resource Module

Supports display of any electronic content, Word, PowerPoint, Flash, Video, Sounds etc as on-line problem solving resources. Files can be uploaded and managed on the server, or created on the fly using web forms (text or HTML). External content on the web can be linked to or seamlessly included within the course interface. External web applications can be linked in with data passed to them.

Workshop Module

Allows peer assessment of documents of solutions, and the teacher can manage and grade the assessment. It also supports a wide range of possible grading scales. Teacher can provide sample documents for students to practice grading so could see the criteria for evaluating solutions.

Journal Module

The teacher asks the student to reflect on a particular topic, and the student can edit and refine their answer over time. This is the personal problem solving recording spaces. It can only be reviewed by the owner and teacher.

Message Module

This module allows students or teachers to start two-way dialogues with another person.

For achieving the functions of each task, modules were grouped to form the on-line learning environment for supporting PBL activities. In the Table 2, modules were listed accordingly.

Table 2 On-line module group of each PBL task.

Tasks	Functions	On-line Module Used
problem-identifying	Identifying Formulating Specifying	Message Module Journal Module Forum Module (Storage Board) Chat Module Assignment Module Choice Module Resource Module
recognizing	Facts Resources	Resource Module Journal Module Chat Module Forum Module (Storage Board) Choice Module
planning	Whole project Programming Model building	Resource Module Journal Module Chat Module Forum Module (Storage Board) Choice Module
alternating	Generating Evaluating	Resource Module Journal Module Chat Module Forum Module (Storage Board) Choice Module
constructing	Programming Model building	Resource Module Journal Module Chat Module Forum Module (Storage Board) Choice Module
evaluating	Testing Model Debugging	Resource Module Journal Module Chat Module Forum Module (Storage Board) Choice Module Workshop Module

4.4 Result of Framework Implementation Evaluating

A field test of this framework was conducted to verify all the functions of each PBL task. Twenty senior university instructors and thirty-two students at university level invited to evaluating the on-line PBL platform.

Research tool were design based all six tasks and critical strategic items. Five points likert type scale was used to record the agreement level of each function. Value one to five was represented to highly not agree, not agree, neutral, agree and highly agree accordingly.

In table 3, the results of the evaluation procedure were recorded with the number, mean, and standard deviation for each PBL task. The range of means is from 3.13 to 4.11. The range of standard deviations is from 0.50 to 0.72.

Table 3 the N, Mean, Standard deviation, and Standard Error Mean of agreement of on-line PBL framework feasibility

PBL Task	N	Mean	Std. Deviation	Std. Error Mean
Identify	52	3,13	0.63	0.09
Recognize	52	4.10	0.50	0.07
Alternate	52	4.11	0.51	0.07
Plan	52	4.11	0.58	0.08
Construct	52	4.11	0.55	0.08
Evaluate	52	4.10	0.72	0.10

In table 4, the results of the evaluation procedure were recorded with the number, mean, and standard deviation for each PBL promoting stragegy. The range of means is from 4 to 4.2. The range of standard deviations is from 0.37 to 0.45.

Table 4 the N, Mean, Standard deviation, and Standard Error Mean of agreement of on-line PBL promoting strategies

Strategy of Promoting PBL	N	Mean	Std. Deviation	Std. Error Mean
Strategy 1	20	4.1	0.45	0.10
Strategy 2	20	4.2	0.41	0.09
Strategy 3	20	4.05	0.39	0.09
Strategy 4	20	4	0.46	0.10
Strategy 5	20	4	0.46	0.10
Strategy 6	20	4.05	0.39	0.09
Strategy 7	20	4.1	0.45	0.10
Strategy 8	20	4.1	0.45	0.10
Strategy 9	20	4.15	0.37	0.08
Strategy 10	20	4.2	0.41	0.09

In table 5, the mean values of both groups, teacher and student, were listed for comparison. There were twenty evaluators in teacher group and thirty-two evaluators in student group.

Table 5 the N, Mean, Standard deviation, and Standard Error Mean of agreement of on-line PBL framework feasibility by different evaluator group

Group Statistics					
	Evaluator	N	Mean	Std. Deviation	Std. Error Mean
Identify	teacher	20	4.10	0.50	0.11
	student	32	4.13	0.71	0.13
Recognize	teacher	20	4.10	0.41	0.09
	student	32	4.11	0.55	0.10
Alternate	teacher	20	4.07	0.37	0.08
	student	32	4.14	0.58	0.10
Plan	teacher	20	4.12	0.49	0.11
	student	32	4.10	0.64	0.11
Construct	teacher	20	4.05	0.45	0.10
	student	32	4.15	0.59	0.10
Evaluate	teacher	20	4.17	0.49	0.11
	student	32	4.22	0.84	0.15

For verify the feasibility of the on-line PBL framework and feasibility of conducting PBL promoting strategies, one-sample T tests were applied. The One-Sample T Test procedure tests whether the mean of a single variable differs from a specified constant.

In table 6, the agreement level of each PBL task was significantly different with test value of three at .05 level. These illustrated that the feasibility of on-line PBL framework is supported by evaluators.

Table 6 the result of one-sample T test of each PBL task with neutral value of three

One-Sample Test						
	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
PBL Task					Lower	Upper
Identify	106.91	51.00	0.00	9.40	9.23	9.58
Recognize	75.39	51.00	0.00	5.21	5.07	5.35
Alternate	74.06	51.00	0.00	5.23	5.09	5.37
Plan	115.01	51.00	0.00	9.33	9.16	9.49
Construct	69.02	51.00	0.00	5.23	5.08	5.38

Evaluate	54.04	51.00	0.00	5.40	5.20	5.60

Table 7 the result of one-sample T test of each promoting strategy with neutral value of three

One-Sample Test

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Strategy 1	11	19	0.00	1.1	0.89	1.31
Strategy 2	13.08	19	0.00	1.2	1.01	1.39
Strategy 3	11.92	19	0.00	1.05	0.87	1.23
Strategy 4	9.75	19	0.00	1	0.79	1.21
Strategy 5	9.75	19	0.00	1	0.79	1.21
Strategy 6	11.92	19	0.00	1.05	0.87	1.23
Strategy 7	11	19	0.00	1.1	0.89	1.31
Strategy 8	11	19	0.00	1.1	0.89	1.31
Strategy 9	14.04	19	0.00	1.15	0.98	1.32
Strategy 10	13.08	19	0.00	1.2	1.01	1.39

Table 8 the result of independent T test of each PBL task by comparing means for both teacher and student groups

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Identify	Equal variances assumed	4.41	0.04	-0.03	50	0.97	-0.01	0.18	-0.37	0.36
	Equal variances not assumed			-0.04	49.16	0.97	-0.01	0.17	-0.35	0.33
Recognize	Equal variances assumed	1.98	0.17	-0.13	50	0.90	-0.02	0.14	-0.31	0.27
	Equal variances not assumed			-0.14	48.38	0.89	-0.02	0.13	-0.29	0.25
Alternate	Equal variances assumed	9.01	0.00	-0.90	50	0.37	-0.13	0.15	-0.42	0.16
	Equal variances not assumed			-1.00	49.98	0.32	-0.13	0.13	-0.40	0.13
Plan	Equal variances assumed	0.40	0.53	0.22	50	0.82	0.04	0.17	-0.30	0.38
	Equal variances not assumed			0.24	47.97	0.81	0.04	0.16	-0.28	0.36
Construct	Equal variances assumed	7.88	0.01	-1.38	50	0.17	-0.21	0.15	-0.52	0.10
	Equal variances not assumed			-1.47	48.08	0.15	-0.21	0.14	-0.50	0.08
Evaluate	Equal variances assumed	7.00	0.01	-0.42	50	0.67	-0.09	0.21	-0.50	0.33
	Equal variances not assumed			-0.47	49.83	0.64	-0.09	0.18	-0.46	0.28

In table 7, the agreement level of each PBL promoting strategy was significantly different with test value of three at .05 level. These illustrated that the feasibility of conducting PBL strategy is supported by evaluators, teacher group.

For probing the difference between both teacher and student evaluating the feasibility, independent samples T tests were applied. The Independent-Samples T Test procedure compares means for two groups of cases.

In table 8, there existed no significant difference between teacher and student groups for all six PBL task. These results provided the evidence that both evaluating group pointed out the same level of agreement.

5. Discussion/Conclusions

The results of the filed evaluation study showed that the framework of on-line PBL is feasible. In further details, the feasibility of the framework could be seen in all six problem solving tasks. The evaluators also agree with the feasibility of conducting promoting strategies on this platform. Proving teacher effectiveness and student achievement is crucial for the success of any school. Using an on-line PBL approach during learning procedures not only prepares learners to present this type of proof critically, it also gives them the opportunity to work collaboratively in situations true to the real world work environment. The designed framework would provide learner a six stages procedure to conduct problem solving for their own or their group. The structure of the on-line learning environment was likely to help students manage their time and remain on task. The frequent performance activities served as a way of causing students to be actively involved in the learning process throughout the entire PBL period, to facilitate transfer, and to stimulate the development of new, functional behaviors.

In the framework of on-line PBL, the results of the evaluation conducted in this study suggest that the feasibility is exits. It remains for further research to compare these mechanisms directly to better understand their possible differences in effectiveness.

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