

Original

Integrating a Traditional Problem Based Learning Course with a Learning Management System

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Abstract: Background: This paper focuses on the additional time and effort associated with placing a problem based learning (PBL) case within a learning management system (LMS) and reporting on both student LMS utilization and course satisfaction data. Methods: The study involved 13 PBL students who volunteered to participate in one of two 9 week long PBL courses (6 or 7 students in each course). The LMS selected for utilization in this experiment was Moodle version #1.9.5. A questionnaire assessed the students' attitudes about the hybrid PBL-LMS system. Time-effort data, collected prospectively, were divided into faculty tasks that: occur during a typical PBL case; involved preparing and presenting several lectures as part of an expert resource session(s); and were associated solely with the LMS creating and posting process. Results: The total time in each course was 119.5 hours and the LMS related tasks involved 25.5 hours or 21.3% of the total course time. While opinions will vary on this issue, this extra time is probably outweighed by the advantages a LMS offers. For example, by placing a PBL course inside a LMS tracking and comparing the performance of multiple simultaneous PBL groups and tutors for consistency can be readily accomplished. Conclusions: A majority of the students (72.7%) agreed that the various materials contained on the website (e.g. videos and supplemental materials) were very helpful and 54.5% agreed that all future PBL courses should have a web-based component.

Key words: Problem Based Learning (PBL), Learning Management System (LMS), hybrid PBL-LMS, time-effort.

There have been several descriptive articles published about the many ways that online web-based software can be used to assist the PBL process.^{1~9)} An area of concern is in the development of patient care skills, which are not effectively dealt with in the PBL pedagogy thus allowing some students to embark on their clinical clerkships without adequate preparation to deliver clinical care.¹⁰⁾ Faced with a “not ready to enter clinic” student, clinical faculty familiar with a lecture and textbook based curriculum would typically refer the student back to their lecture notes or to a specific chapter in a textbook and the pre-clinical lab to close the gap. However, in

PBL, the faculty cannot be certain where the foundation content was provided and what resources were used in each group of PBL students, thus making remediation more difficult.

The solution to these knowledge gaps is not to switch back to a lecture based curriculum since students who were taught with a lecture-based-curriculum also had knowledge gaps and lecture based learning does not adequately engage the student in their own learning. An alternative method used in a PBL curriculum when knowledge gaps are identified, is to provide targeted learning resources sessions, usually by having content

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Table 1 Pros and Cons of a combining a LMS with a PBL case.

Central Repository	<p>Pro:</p> <ol style="list-style-type: none"> 1. All learning need reports come into a central web-based LMS repository. 2. The submitted learning need reports can be the basis of a private Wikipedia-like site that contains the accumulated knowledge of a student or class of students as they progress across their curriculum. 3. If the repository is searchable, faculty can refer students to it for remediation when knowledge gaps are identified in their clinical years. <p>Con:</p> <ol style="list-style-type: none"> 1. If the Internet is down or the software develops problems, access is problematic. 2. Management of such a large database of information is time consuming.
File Sharing	<p>Pro:</p> <ol style="list-style-type: none"> 1. If the LMS has a file management module, a student's work can be placed into a folder available for viewing by any approved student (or faculty) in the group. 2. PBL sharing of work product (i.e. learning needs) is enhanced. <p>Con:</p> <ol style="list-style-type: none"> 1. None
Sorting and cataloging by faculty	<p>Pro:</p> <ol style="list-style-type: none"> 1. This would be available from the Central Repository thus eliminating the faculty need to set up their own individual systems of cataloging and tracking individual student reports sent via email. <p>Con:</p> <ol style="list-style-type: none"> 1. Faculty would be relying on the efficiency of the management of the Central Repository in order to manage the assignments of the students.
Grading and Student Notification	<p>Pro:</p> <ol style="list-style-type: none"> 1. All learning need assignments can be graded using a numeric (e.g. 0-100) scale and written comments entered on the quality of the assignment. 2. Once graded the student will automatically receive an email notifying them of the grade. 3. The grade is automatically entered into a grade book that performs a running tabulation all student grades. <p>Con:</p> <ol style="list-style-type: none"> 1. Security could be an issue unless secure Intranet system is used to host the grading and notification to students of grades.
Parallel group monitoring for consistency and calibration	<p>Pro:</p> <ol style="list-style-type: none"> 1. Monitoring of multiple, simultaneous PBL groups can occur (up to 15 groups per case). 2. One PBL case manager can review/monitor the various learning need reports (LNRs) and grades incoming from all groups for consistency and equity across the board. <p>Con:</p> <ol style="list-style-type: none"> 1. Monitoring takes time and effort. 2. If inconsistencies are identified faculty remediation and recalibration would be needed.
Cut and Paste Prevention	<p>Pro:</p> <ol style="list-style-type: none"> 1. By cataloging each student's Learning Need, plagiarism programs can be run to detect "cut and paste" submissions without proper attribution to the original source. <p>Con:</p> <ol style="list-style-type: none"> 1. Additional tasks would need to be assigned to the Central Repository PBL Case Manager.
Online resource materials.	<p>Pro:</p> <ol style="list-style-type: none"> 1. Creating and placing critical topic lecture presentations online can be done relatively easily. 2. Students can review the materials as needed rather than at the end of the semester. 3. Faculty could track which students actually view this content and the frequency. <p>Con:</p> <ol style="list-style-type: none"> 1. It takes time to create the lectures, record them in a streaming video format and create links to the lectures inside the LMS website.

experts host discussions or provide lectures on a specific topic. Unfortunately it is difficult to do these resources sessions on an ad hoc basis since usually more

thoughtful planning of content and a careful analysis of the knowledge gaps are needed. A third approach to closing the gap is to provide additional learning materials

(outside the PBL process) but inside an online learning management software (LMS) program. This would be akin to the previously mentioned expert resource sessions, but in this case the faculty content experts would select and place online materials (e.g. selected lectures) they consider critical to the key concepts being covered in a specific PBL case.

Displayed in Table 1 are the various issues related to the pros and cons of combining a LMS with a traditional PBL seminar approach. As is also true with PBL pedagogy, implementation and successful utilization of a LMS has its own barriers and problems. On the negative side, the improved efficiencies claimed by a LMS, have an up-front time and effort-based cost for the instructor as it is necessary to put course content on the LMS website. This effort is often underestimated by the LMS claims of saved instructor time. Several studies have described the way that LMS systems can enhance teaching, but no reports have yet quantified the time and effort needed to combine a LMS with a PBL course. In considering combining the two systems it is important to ask not whether a better test score will result but rather is the PBL process enhanced by combining it with a LMS and if so, in what ways? For example, if this combination gives the tutor more information about an individual student's performance on a particular PBL case and to acquire this information does not take substantially more time, it may be considered worthwhile and therefore a sound investment. In this paper we have attempted to answer two of these questions: how much time and effort is associated with managing a PBL course within a LMS; and, to report on student LMS utilization and course satisfaction.

Materials and Methods

Venue: This study was performed at the Showa University School of Dentistry in Tokyo Japan during the summer and fall of 2010.

Faculty: There were two faculty tutors (GTC and RM) involved in this study. Both tutors were experienced with PBL methodology. Both were also certified as PBL

instructors based on a successful completion of a series of four PBL training courses.¹⁰⁾

Students: There were 13 students who volunteered to participate in one of two 9 week long PBL groups (7 in OM group and 6 in SP group). Inclusion criteria involved: having earned a DDS degree or its equivalent; self-reported English language proficiency; and an interest in the topic of the course. Exclusion criteria were an inability to attend case discussions and/or failure to complete any required assignment. Each PBL group contained students who varied in experience from Associate Professors to dental interns. All students had prior experience with PBL as a method of learning either as a tutor or as a previous PBL student.

PBL Cases: There were a total of seven PBL cases utilized in this experiment with all except two cases being three sessions long. The enrolled PBL students were divided into 2 groups: (1) the special patient care case series (four PBL cases) or (2) the oral medicine case series (three PBL cases).

Learning Management System: The learning management system (LMS) selected for utilization in this experiment was Moodle version: 1.9.5+ (Build: 20090624) (www.moodle.com). The elements that can be included in the LMS course webpage is up to the choice of the faculty member who is the primary case manager.

Streaming Video Recording Process: Recording of audio and video lecture content that can then be streamed is moderately easy to do. In this course we utilized a commercial video conferencing software vendor (www.ViVu.tv) that allowed recordings to be made which were automatically processed for streaming delivery and archived on a server. The educator receives an access link from ViVu usually in less than a few minutes, which can then be posted to the LMS course website. This software virtually eliminates any post-production time. In our experience once the recordings were made and the link loaded into the LMS, the students could log on and view the lecture at any future time. It is also possible for students to log on while the recording is being made and post-questions, which can be answered interactively, via

Table 2 Average faculty time/effort data.

	Time
Four PBL Specific Tasks	
1. Select 3 patient cases and edit each portion of the case (2 h per case)	6.0 hrs‡
2. Conduct 9 PBL sessions (2 h each)	18.0 hrs‡
3. Read and grade each of the 9 learning need report submitted (20 min each)	3.0 hrs‡
4. Write a final summary report on each student in the PBL class (20 min each)	7.0 hrs‡
Two Lecture Specific Tasks	
1. Create 8 supplemental PPT based lectures (6.5 h each)	52.0 hrs†
2. Delivery of 8 PPT based lectures (1.0 h each)	8.0 hrs†
Eleven LMS Specific Tasks	
1. Design course structure and set up website in LMS	2.0 hrs*
2. Write an introductory letter to students	0.5 hrs*
3. Write course description and objectives	1.0 hrs*
4. Write student assessment policy	0.5 hrs*
5. Create 9 linked file pages & upload each of the case parts (30 min per case)	1.5 hrs*
6. Create 9 linked file pages and upload recorded facts, ideas and LN assignments	1.0 hrs*
7. Create 9 learning need report upload pages (10 min each)	1.5 hrs*
8. Video recording and uploading of streaming links for 8 lectures (1.0 h each)	8.0 hrs*
9. Create PDF files for 8 PPT lecture and upload to course website (~10 min each on avg)	1.5 hrs*
10. Create and import 8 multiple choice quizzes for each lecture (60 min each)	8.0 hrs*
Total time for PBL, Lecture and LMS Specific Tasks	119.5 hrs

(‡ = tasks for PBL case; † = tasks for lecture content; * = tasks for LMS)

an instant message chatbar.

Student Likes and Dislikes Questionnaire: One outcome of this teaching experience involved collecting student opinions about the educational methods discussed in this article (e.g. creating and using an LMS based PBL course) via a 10 statement questionnaire. The questionnaire used a 7-point Likert scale with the following categories and points as indicated: (-3) strongly disagree, (-2) moderately disagree, (-1) slightly disagree, (0) Neutral opinion (1) slightly agree, (2) moderately agree and (3) strongly agree.

Faculty Time and Effort Tracking: The time required to set up the different components used in this course were tracked in 15 min increments by both tutors as they were carried out. These data were then averaged and summarized in Table 2.

Results

Demographics, Completions and Drop-outs: The mean age (± 1 s.d.) for the students in this study was 38.8 ± 7.8 years. There were 8 males and 5 females in the student groups. Of the remaining 13 students all students completed their assigned Learning Needs in their selected

PBL case series. There were 20 (17.1%) instances of students having conflicts that prevented them from attending a PBL session and getting a LN assignment. Of the potential 117 LNRs that could have been generated if all 13 students attended all sessions, 97 LNRs were actually turned in for evaluation.

Tutor's Time/Effort Data: The data in Table 2 can be divided into the four faculty tasks (‡) that normally occur during a PBL case; the two faculty tasks (†) that would normally involve an end of case resource session(s); and the ten faculty tasks (*) associated with the LMS. The total time associated with each of the 9 session course was 119.5 h. The subset of tasks needed for PBL cases involved a total of 34 h (28.5% of the total time expended by the faculty for the course). The time needed to create 8 h of lecture content and deliver it to the students involved 60 h (50.2%). The tasks associated with creating, uploading and managing the LMS equalled 25.5 h (21.3%).

Student Questionnaire: The student responses to 10 individual statements regarding the integration of a PBL course within a LMS are presented in Table 3. For reporting purposes the 7 point Likert scale results were

Table 3 Integrating Moodle and PBL (n = 11).

#	Statements	Disagree (either moderately or strongly)	Neutral (or slightly agree/ disagree)	Agree (either moderately or strongly)
1	I found it easy to use the course web-site.	0.0%	0.0%	100.0%
2	I believe the website and supplemental materials created for this course greatly enhanced the PBL learning process.	9.1%	45.5%	45.5%
3	Using this hybrid approach (lectures and quizzes plus PBL cases) was very helpful to my understanding of the key concepts taught in this course.	27.3%	54.5%	18.2%
4	I found the PBL session presentations of my fellow students very helpful to my understanding of the key concepts taught in this course.	0.0%	27.3%	72.7%
5	I found the supplementary lecture videos provided by the faculty expert very helpful to my understanding of the key concepts taught in this course.	0.0%	27.3%	72.7%
6	I found the supplementary PDF handouts from the lectures very helpful to my understanding of the key concepts taught in this course.	0.0%	27.3%	72.7%
7	I found the weekly quizzes very helpful to my understanding of the key concepts taught in this course.	0.0%	36.4%	63.6%
8	The biggest problem I had with this course was my spoken English language ability.	0.0%	18.2%	81.8%
9	I would have liked this course better if it were offered in Japanese language.	0.0%	27.3%	72.7%
10	Based on my experience in this course I believe that all PBL cases should use a hybrid format (meaning they will be hosted on a website that also provides supplemental expert lectures and other materials to support the key case concepts).	27.3%	18.2%	54.5%

collapsed into 3 categories of agree (either moderately or strongly), neutral (or slightly agree or disagree) or disagree (either moderately or strongly). We felt that providing the percentages for each category by statement was more informative than simple means and standard deviations as they point up some interesting findings. For example 54.5% felt neutral about the question as to whether using the hybrid approach was helpful to understanding the key concepts of the course and 45.5% were neutral about whether the website and supplemental materials greatly enhanced the PBL learning process. A majority of the students 72.7% agreed with the statements that the various materials contained on the website (e.g. videos and supplemental materials) were very helpful and 54.5% agreed that all future PBL courses should have a web-based component.

Discussion

This article provides data on the relative time and effort associated with running two 9-week hybrid PBL courses (one on oral medicine and one on special patient care). These courses were designed with multiple part PBL

cases for each. In addition both courses utilized a LMS, where all PBL case materials including video lectures, supplemental materials and work assignments were uploaded either by the faculty or the students. Overall the total faculty time and effort expending on this course was 119.5 h. These number does not include the time needed to register the students into the LMS system and provide passwords to the system. Unfortunately, there is no literature available against which we can compare our reported time and effort data. Some of the time and effort needed to create the lecture content could be considered time that would normally be expended for an end-of-case expert resource session(s), which is likely to vary greatly based on the experience of the faculty in previously teaching the course content material. The 6.5 h needed to create each of the lectures used in this course is certainly an underestimation of the time it takes to create a completely new lecture. However, in the case of this study, both faculty were experienced in their respective fields and had materials available that could be updated rather than generated from scratch. Moreover, the amount of time associated with lecture specific tasks in a

course would also vary greatly depending on how many supplemental lectures are provided. It could be argued that the lecture specific time-effort data is equivalent to time commonly allocated by faculty to participate in post-case resource sessions no matter the style of session and therefore it is not unique to the process of hosting a PBL course within an LMS. For some a resource session might involve meeting with the students in a group or individually, and answering questions ad lib without preparation. Whereas for others it may mean creating one or more entirely new presentations covering the key concepts that should have been covered in the case.

The key finding in this study was that an additional 25.5 h of instructor time (21.3% of total) was needed for course LMS website creation and management. This time was clearly an add-on of faculty effort associated only with using the LMS. This additional time would be mitigated or lessened if a school were conducting a PBL curriculum for an entire class because in this scenario, creating the LMS website and course materials would be done by one individual for one PBL group and it could then be replicated for each additional PBL group, thus dividing the time among multiple PBL tutors. Unaccounted for in this scenario is the time it takes to register the students on the LMS, issue passwords and usernames since in most instances this would be usually be done for the entire class by a staff individual in an administrative office of the school. It is important to note that the time required to set up this course website would not need to be redone annually if the same PBL were taught again in a subsequent year. It is important that this extra block of time is weighed against the inconvenience of having an email in-box based student work distribution system which must be managed piecemeal by the tutor throughout the course. The enhancements of being able to grade the students work as it comes in, record the grade and distribute the grade and any associated comments as quickly as the tutor desires is particularly appealing for the faculty. Similarly being able to compare and contrast all tutors' performances for an individual PBL case has definite benefits to ensure consistency of the curriculum

and identify training and performance issues for the faculty tutors.

The students generally favored the hybrid online-PBL method of teaching. This is consistent with prior research that shows hybrid online-PBL methods are well received by students and they appreciated being given supplemental course content that they could access online. It is interesting to note that when asked as to whether using the hybrid approach was helpful to understanding the key concepts of the course, the response was split with 45.5% agreeing positively, and the same percentage responding neutrally yet a majority of the students (72.7%) agreed with the statements that the various materials contained on the website (e.g. videos and supplemental materials) were very helpful. In response to another question, a majority (54.5%) agreed that all future PBL courses should have a web-based component. These inconsistencies in responses may be due to a variety of issues that were unique to our courses, which were delivered in the evenings to faculty who had already spent a full day teaching and were provided in a non-native language. These two distinctions may have made the PBL courses we provided difficult for some to keep up, yet as teachers it did not discourage their perception of the potential value of the components. Additional studies examining other populations of participants may better help to distinguish if there are inconsistencies in the responses of the students being surveyed.

In summary, the hosting of a PBL process inside a LMS offers several advantages and disadvantages. Our data suggest that it would require a moderate amount of additional instructor time to set up a LMS website, although this time would lessen as the LMS course website and specific cases are subsequently reused by additional classes each year. Most importantly the use of a LMS system to host content for a face-to-face PBL class and serve as a repository of learning need report uploads, would allow a designated case manager to monitor the multiple student groups and the assigned tutors for a specific case for consistency in content and

performance.

Consent section

Written informed consent was obtained from the participants for publication of this manuscript and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

References

- 1) Tichon JG: Problem-based learning: a case study in providing e-health education using the Internet. *J Telemed Telecare*, **8** (Suppl 3): 66–68, 2002
- 2) Kamin C, Deterding R, Lowry M: Student's perceptions of a virtual PBL experience. *Acad Med*, **77**: 1161–1162, 2002
- 3) Choi H: A problem-based learning trial on the Internet involving undergraduate nursing students. *J Nurs Educ*, **42**: 359–363, 2003
- 4) Docherty C, Hoy D, Topp H, Trinder K: Using E-learning techniques to support problem based learning within a clinical simulation laboratory. *Stud Health Technol Inform*, **107**: 65–68, 2004
- 5) Green CJ, van Gyn GH, Moehr JR, Lau FY, Coward PM: Introducing a technology-enabled problem-based learning approach into a health informatics curriculum. *Int J Med Inform*, **18**: 173–179, 2004
- 6) Strømsø HI, Grøttum P, Hofgaard Lycke K: Changes in student approaches to learning with the introduction of computer-supported problem-based learning. *Med Educ*, **38**: 390–398, 2004
- 7) Nathoo AN, Goldhoff P, Quattrochi JJ: Evaluation of an Interactive Case-based Online Network (ICON) in a problem based learning environment. *Adv Health Sci Educ Theory Pract*, **10**: 215–230, 2005
- 8) Schoenfeld-Tacher R, Bright JM, McConnell SL, Marley WS, Kogan LR: Web-based technology: its effects on small group “problem-based learning” interactions in a professional veterinary medical program. *J Vet Med Educ*, **32**: 86–92, 2005
- 9) Woltering V, Herrler A, Spitzer K, Spreckelsen C: Blended learning positively affects students' satisfaction and the role of the tutor in the problem-based learning process: results of a mixed-method evaluation. *Adv Health Sci Educ Theory Pract*, **14**: 725–738, 2005
- 10) Saunders TR, Dejbakhsh S: Problem-based learning in undergraduate dental education: faculty development at the University of Southern California School of Dentistry. *J Prosthodont*, **16**: 394–399, 2007