Distributed Problem-Based Learning at Southern Illinois University School of Medicine

Terri Cameron, Howard S. Barrows, Steven M. Crooks

Southern Illinois University School of Medicine Problem Based Learning Initiative

Abstract: SIU School of Medicine piloted a Distributed Problem-Based Learning (DPBL) project in Spring 1999 to support the authentic PBL method used in the curriculum. The pilot included face-to-face (FTF) tutor group sessions augmented by DPBL in which the group participated from distributed sites.

The pilot provided a list of observations including: the changes in the role of the facilitator, the feeling by students that information presented during DPBL was more likely to be more well thought-out and articulated than in face-to-face sessions, the value of being able to review session transcripts and whiteboards from any time and place, and the feeling that all students could respond to queries.

Technological issues include Internet Service Provider (ISP) responsibility, collaborative software functionality, presentation of the problem in a way that supports free inquiry, submission of resources to the web site, and data collection.

Future plans include platform-independent software, a database for collection of data as information is entered on the whiteboard, a database that presents the problem in a more intuitive, responsive manner, and a web page that allows resource submission by group members.

Keywords: computer-mediated communication, groupware, problem-based learning

Introduction

Problem-based learning is a, student-centered learning method that provides students with problem-solving, self-directed learning and collaborative learning skills. It is a student-centered learning approach with the teacher in the role of facilitator of learning, working with a small group of students. It has become an increasingly popular method of learning in many professional fields as well as in secondary education and undergraduate university education. Despite this popularity over the past ten or more years, there did not appear to be a collaborative software program that allowed problem-based learning to take full advantage of distributed learning so that students could be geographically dispersed, yet still take advantage of authentic problem-based learning methodology.

A pilot program was developed at Southern Illinois University School of Medicine with two objectives: 1) to identify hardware and software that would permit problem-based learning to occur in its natural context, and 2) to identify what, if any, new skills would be required of the tutor to accomplish effective distance problem-based learning (DPBL). SIUSOM has become sophisticated in the identification of skills necessary for training of tutors for face-to-face, non-distributed small group learning, but it was not clear whether there would be a set of unique skills needed for computer-mediated or distributed problem-based learning.

To support problem-based learning as a distant or distributed learning method using computers and avoiding expensive technology, the following requirements need to be satisfied:

1. An authentic, ill-structured problem needs to be presented to the students in a way that supports hypothesis-based inquiry where students acquire only the information they request about the problem as they request it.
2. Students should be able to communicate synchronously with faciliatory guidance by a tutor during their discussions about the problem as it is presented and analyzed.
3. A whiteboard should be visible at all times, where studentsí hypotheses, problem information gained through inquiry, and learning issues can be recorded as they develop and can be edited as their discussions continue. This board also needs to support diagrams and student-generated graphics.
4. The information and references students find during their self-directed learning that they will use in their subsequent problem discussions with the group should be communicated to all members asynchronously as they work individually, in dyads, or in larger groups.

In identifying hardware and software, the project was initially restricted to technology that would be available to most potential PBL students; e.g., a computer (not necessarily high-end), modem, and printer. Although video and audio features were felt to be of emerging influence, these technologies had not reached their full potential for group learning via modem connection to servers and the Internet.

With these criteria in mind, the goal of the project was to pilot a successful DPBL process that would not subvert problem-based learning methodology to the functionality of hardware and software. The success of such a project would greatly enhance student and faculty educational programs and would allow students and faculty distributed all over the country and globe to participate in PBL group activities. Participants would be able to learn while still at their regular employment or educational activity without having to reallocate time, relocate geographically or compromise an income or off-site educational experience to participate.

At Southern Illinois University School of Medicine, DPBL would benefit the existing Problem-Based Learning Curriculum in the first two years of the undergraduate medical program, a network of remote clerkship activities, the Physician Assistant program

cosponsored by Southern Illinois University and the School of Medicine, and other potential interprofessional educational programs. DPBL would also facilitate educational programs among the various SIU campuses and Family Practice satellites.

This paper presents SIUSOMís progress in developing distance or distributed learning methodology for problem-based learning with a technology that minimizes the degree to which the face-to-face problem-based learning method has to adapt to the requirements of the supportive technology itself. An initial pilot using this approach with medical students experienced with problem-based learning in an undergraduate medical education problem-based learning curriculum is described, including positive outcomes, negative findings, and observations, as well as plans for the future.

Background

As stated above, it was necessary for the collaborative software used in this project to meet four needs: 1) presentation of an ill-structured problem (stimulus) that provides information in response to questions on history, physical examination and laboratory values only as that information is requested; 2) synchronous discussion of the problem; 3) recording of case information, hypotheses, and learning issues; and 4) access to information acquired by students during self-directed learning.

In the early stages of this project, several distributed problem-based learning sites were evaluated:

- Swedenís Uppsala Universityís Department of Neutron Research: Use of *FirstClass* as a tool for distributed problem-based learning for teaching energy issues in collaborative learning in groups of seven-to-eight students appeared to significantly alter the problem-based learning process by the asynchronous nature of the group interactions. In addition, the whiteboard was accessed from a separate web page under the control of the tutor, which could make the process more teacher-centered than student-centered.
- Ohio State Universityís "MBA without walls": Use of *Lotus Domino* (previously Lotus Notes) for DPBL did not permit synchronous, free exchange of communication, and the whiteboard was not present.
- Tidewater Community College in Virginia Beach, Virginia: Use of Inter-Relay-Chat (IRC) to script data for retrieval and comment by learners as a tool for DPBL was limited by the mechanics for setting up the group of computers and the lack of the ability to edit the whiteboard.
- The Netherlandsí University of Maastricht: Use of *Polaris (Problem Oriented Learning and Retrieval Information System)*, allows for asynchronous discussion between group members and the tutor and provides a database in which students report on their progress with their learning issues, and peers and tutors provide asynchronous feedback.

In all of the above projects, the authentic problem-based learning process had been significantly altered to accommodate the computer hardware or software, which was a situation SIUSOM wished to avoid.

Selection of software

Following the evaluation phase, *First Class,* which seemed to have the greatest potential for providing all of the necessary features (problem presentation, chat area, whiteboard, resource submission) was purchased on a six-month trial basis. As the software was evaluated in a full test environment, it became obvious that the lack of synchronous whiteboard collaboration would negatively affect the PBL process. One person had to control the whiteboard feature, and changes to the board had to be sent to the group, necessitating the closure and re-opening of windows to view the changes. In addition, presentation of the problem was extremely cumbersome.

Netscapeís *Conference* was also briefly tested, but, while it appeared to have the necessary components, connectivity and functionality issues could not be resolved at the time of the test.

Habanero, developed at the University of Illinois, appeared to have all of the necessary features for authentic DPBL, including a shared browser, which would have provided an optimal patient presentation tool, but required massive amounts of memory and disk space to function. There was no indication from the developers that *Habanero* will be optimized in the near future.

When these attempts to use existing software failed, Instructional Technology faculty at the Edwardsville campus of Southern Illinois University were asked for assistance in finding a software that met the needs of the project.

Their search for the right software package to support DPBL began with a look at some of the more popular courseware products, including *WebCT*, *LearningSpace*, and *FirstClass*. It soon became evident, however, that these products were designed to support a more traditional model of instruction, comprising several features that are irrelevant to PBL (e.g., on-line timed examinations and automated grading). Furthermore, these products were designed to support a communication structure that emphasizes asynchronous communication as the primary means of collaboration. While synchronous communication tools (essential to PBL) are often available, they are not prominent features in the interface design of these products. For DPBL, the software needs an interface featuring synchronous collaboration as the primary instructional process with secondary emphasis placed on asynchronous collaboration. The fact that most courseware is template-based and not easily customized for specific instructional purposes made it imperative that other software be sought.

The next class of software considered was specifically designed to support synchronous communication. Two of the products (Ilincís *LearnLinc* and DataBeamís *Learning Server*) could be called virtual classrooms (Auerbach, 1999), since they are designed to

support a larger synchronous classroom-type environment on the Web. The other two products (Netopiaís *Timbuktu Pro*, and Microsoftís *NetMeeting*) are more appropriately termed conferencing software since they are designed to support small group synchronous discussions. While the virtual classrooms contained impressive synchronous communication tools, they, like the courseware products mentioned previously, contained several features that were irrelevant to PBL. In addition, these products required server-side software (and more extensive client-side software than the conferencing software) to support their use.

For the reasons specified above, it was determined that conferencing software in combination with a web page to support document sharing and asynchronous discussions was the most efficient and effective way to support DPBL. *NetMeeting* was chosen over *Timbuktu* because it was freely available from Microsoftís web site. The only immediately obvious disadvantage to *NetMeeting* was that it supported only the Windows environment. *Timbuktu* was tested as a companion product with *NetMeeting*, since the combination of the two products would accommodate a mix of Macintosh and Windows computers. Unfortunately, *Timbuktu* did not support the whiteboard feature essential to DPBL. *CU-SeeMe* was also considered as a possible Macintosh companion to *NetMeeting*, but was also lacked the whiteboard feature.

NetMeeting, in combination with a web page, combines synchronous chat, application sharing, and an electronic whiteboard (features of *NetMeeting*) with asynchronous discussions, document sharing, and chat archives (contained in the web page). All of these features together enable learners in geographically distributed locations to participate in the PBL experience.

First test of Microsoft *NetMeeting* with faculty and staff

The initial test was meant to evaluate the applicability of the software to the problem-based learning process. The test was conducted in a computer lab, using a LAN connection to the Internet for connection to a *NetMeeting* server on the Southern Illinois University at Edwardsville campus (85 miles away). Instructional Technology faculty from SIU-E provided technical assistance during the test, and provided written procedures for using Microsoftís *NetMeeting*. The whiteboard was set up exactly as it is set up in a face-to-face session, with the exception that it was on a computer screen, rather than a wall. The roles of reader and scribe were assigned just as they are in FTF sessions, and the process began with the reader providing the presentation of the problem. To accomplish this, the reader opened a Microsoft Word document containing the problem, and used the Windows cut and paste function to place the appropriate text in the *NetMeeting* chat window.

At the conclusion of the test, the following observations were noted:

1. Presentation of the problem by pasting text into the chat window was not appropriate. There were problems with truncations, and, for longer passages, it was necessary for the group to scroll back to the beginning and read the text.

Since all participants had different reading speeds, this created a problem with scrolling.

2. The chat window scrolling feature is controlled by addition of comments to the window. Group members could scroll the window at their individual paces, but the window returns to the bottom of the chat synchronously each time information was submitted to the chat.
3. Timing and patience were key factors to the success of the session. It was necessary for group members to have time to formulate responses and enter them before the rest of the group moved on. It was important to ensure that responses to a particular question began with the name or initials of the person who made the query so that the response could be linked to the query. When multiple parallel discussions began to develop, it was important for the tutor to facilitate the multiple discussions back to a group conversation related to the problem.

First test with students

Based on the observations noted from the first test, it was determined that the collaboration elements of *NetMeeting* should be evaluated as a means of presenting the patient problem. The readerís role was to open the problem in an MS Word document, then use *NetMeeting* to share the document with other members of the group. This facilitated the hypothesis-based inquiry process necessary for authentic PBL, and, initially, seemed to be a workable solution. Since the shared resource window takes precedence over other windows, it had to be set up so that it did not conflict with the other windows. Several different window configurations were tested to determine which configuration might be recommended to students.

Problem-based learning student volunteers were solicited, and a test was conducted, again, in a computer lab environment. This time, instead of connecting to an off-site *NetMeeting* server, one student in the lab hosted the meeting, and the other students connected to that computer using the IP address. Computer skills among the students varied widely, but the only skill level that appeared to affect the process was keyboarding skill. The test began with an introductory group discussion about what the test was meant to accomplish (distributed problem-based learning that did not negatively impact the authentic PBL group or learning processes), and observations from the first test of the software were discussed, along with recommendations for window configurations.

The reader opened the problem in MS Word and shared the document. Students then spent a few moments configuring the windows so that the patient problem, whiteboard and chat area were all present. The scribe spent a few moments setting up the whiteboard, and the session began with the reader moving to the patient presentation section of the document. While this was not ideal, it did permit group inquiry into the problem and allowed all members to have simultaneous access to problem information.

Although an orientation session had been used to explain the process to the students, the same potential problems were observed in this test, particularly scrolling issues and multiple parallel conversations. However, students appeared to like the concept of

distributed problem-based learning, and it was felt that, by providing detailed instructions, appropriate training, and increased exposure to the process, *NetMeeting* could meet the needs of authentic DPBL.

As students were solicited for actual use of DPBL in the curriculum and preparations were made for use of the process in a more distributed environment, several additional issues were encountered, as delineated in the following paragraphs.

NetMeeting Server

Although *NetMeeting* is advertised as not requiring a dedicated server, its popularity has made it difficult to gain access to Microsoftís public web servers. In addition, if students did not remember to keep their names out of the directory, it was possible for other users to intrude. As additional small-scale tests were conducted by faculty and staff in preparing for use of *NetMeeting* in the curriculum, it was determined that a dedicated server would provide the most flexibility, reliability and security to the process.

In addition, this server could be configured to cause fewer problems with institutional security applications, such as firewalls, that often limit functionality of collaborative software when access is via modem from outside the network. Unfortunately, however, firewall problems continued to cause problems that had to be worked around. For instance, it was not possible for group members to "call" each other using *NetMeeting*. Instead, the server "hosted" the meeting, and students "joined the meeting." This was not detrimental to the process, but added additional administrative oversight and potential for a lack of connectivity; e.g., a staff member had to be available to set up the server to host a meeting each time a group wished to conduct a DPBL session.

Internet Service Provider (ISP) Issues

Although SIUSOM provides a limited amount of dial-in access for faculty, students and staff, there was no mechanism for dedicating lines to DPBL sessions. This made it highly possible that one or more of the group members would be unable to connect during scheduled group meetings. After investigation into the purchase of dedicated dial-in phone banks (with toll-free access lines) that would have allowed two groups of seven to have concurrent access to the SIUSOM Internet connection vs. purchase of ISP accounts from commercial vendors, it was determined that the commercial ISP accounts were more cost-effective at the current time.

After testing several ISPs to determine compatibility with *NetMeeting* and the institutional security systems, the process of developing an institutional billing account for multiple users was begun, and, after contacting multiple vendors, the only ISP willing to set up accounts on an institutional basis was AT&T WorldNet. Detailed procedures for installing the software and connecting to the dedicated server were developed, and compact disks of the software and account information were developed to facilitate installation on studentsí home computers and/or laptop computers.

The question left unanswered during this phase of the process is whether the institution should provide free access to online resources such as web-based curriculum information, collaborative learning projects, and e-mail, or whether students and faculty should be responsible for paying for their own Internet access which, in turn, gives them access to online educational resources. Since institutional resources were not available for this process, unit funds were used during the pilot phase, and the question will be debated again in preparation for full implementation of DPBL into the SIUSOM curriculum.

Pilot in the curriculum

Five students volunteered to participate in a group that would use DPBL as a component of the group process in an eight-week unit of the second-year PBL curriculum. An orientation session was held in which the detailed procedures were explained, and a computer lab-based trial of the process was demonstrated.

During the first week of the unit, the first case was begun in a face-to-face meeting so that introductions could be made and the group could begin to develop its relationships. The initial plan was to hold one FTF session and one DPBL session each week. However, student discomfort with the process during a fairly high-stakes time in the curriculum (last unit of the year, licensure exam preparation, anticipation of clerkships), resulted in a change to two face-to-face meetings per week, and one evening DPBL session. During two of the group sessions, the tutor participated from long-distance locations (intrastate and international).

Positive Outcomes

1. Students felt that they adapted to the new environment and that it seemed to simulate face-to-face interactions. Much of this had to do with the fact that the DPBL sessions were prefaced with several face-to-face interactions and that social occasions were scheduled over the course of the unit.

2. Students reported that they were more cognizant of their contributions to the discussion and tried to ensure their accuracy, since there was the thought that anything they added to the discussion was "in print" and could be checked later. They said that they tended to think more about expressing themselves and tended to be more thoughtful as they participated, often taking the time to clarify questions and concepts to ensure they were responding to the right question.

3. It was harder for students to "hide," since it was easy to scroll back and see who was not contributing and follow up with non-contributors.

4. The process became much less technical and/or intimidating over the course of the unit.

5. Students liked the hedonistic approach to PBL -- being able to participate in their pajamas and not have to worry about whether they had showered, whether they looked professional, etc.

6. Students liked being able to go back to the chat transcripts to look for additional learning issues or issues they wished to clarify and to check for learning issue coverage (comparison to whiteboard). They felt this added a new dimension to PBL.

7. Students liked the 24-hour a day availability of the whiteboard. Again, this added a new dimension to PBL and took away the stress of misplacing notes.

8. Although the opportunity did not arise in this unit, students thought that the opportunity to interact with other medical or health care profession students and/or faculty would be a great enhancement to their education.

9. Students felt confident that they would be able to participate in group sessions from out of town (this was tested on two occasions during the pilot).

10. Students noted that, while the tutor role is the same in online discussions, the manner in which that role is performed is changed -- questions are asked of a specific person, using names, and, at times when there were "lulls," it was the tutor who kept the discussion going. It was noted, however, that students are often unaware of the non-verbal tutor communication in face-to-face sessions and more used to casual vocal challenges.

Negative Findings

1. The problem presentation interface provided the greatest challenge. In addition to the scrolling problem (the reader controlled the scrolling), the interface was difficult to work with, and the reader had difficulty participating in the discussions. There was also an occasional problem with formatting that provided more information than had been requested. (This is at variance with inquiry-based evaluation of the patient problem.)
2. Due to limitations of *NetMeeting* (audio and/or video function between only two participants at a time) and firewall problems (audio and/or video from outside the firewall could not be received), all communication in the pilot was text-based. Although the text-based chat sessions were productive and resulted in good discussions, students believed that they would be more comfortable with audio and/or video communication.
3. The whiteboard had to be assigned to one person because of the scrolling factor. (Although this is usually the case in face-to-face sessions as well, there are times when students split the role of scribe so that one person is recording case information while another records learning issues, or a couple of students take on the task of assigned learning issues. This was not effective in DPBL due to the scrolling feature of the whiteboard.)

4. The scroll on the chat was also troublesome. While one member was reviewing past exchanges, the screen would suddenly return to the end when another group member contributed to the discussion.
5. Parallel conversations were difficult, and the tutor needed to step in on those occasions when the discussion appeared to be heading toward a free-for-all. This does not happen as often in face-to-faceóthe loudest or quickest person wins.

Observations

1. The process took on a life of its own and developed its own terminology (e.g., "typative" for "talkative").

2. Although a couple of students expressed some continuing discomfort with the process during feedback sessions, there is no evidence of that discomfort in the transcripts. There was the usual joking, silliness, and much evidence of a cohesive group process.

3. The procedures developed during the planning phase appropriately facilitated the adaptation of the technology to the process, and the issues noted during that process were also identified by students in the early group sessions:

    a) when responding to a particular person, that personís initials should be used as a preface.

    b) participants must be patient when it is obvious that someone is formulating and submitting a response (the respondent should also do one or both of two things: respond quickly with JAM (just a minute), or begin to answer, being sure to end each entry of two or three lines with an ellipsis (...) so that the rest of the group will know that more is coming.

    c) participants must give the reader time to go to each problem question before the next request for information is made; and try to hold off on important observations and comments if the reader is busy moving through questions, so that no one is left out of the process.

4. Students felt that one of the positive things about the early sessions was that several students answered questions asked of the group, rather than one person immediately responding, as in FTF. They said that, over time, they adapted to the online process and ended up liking the diversity of those initial answers, and felt that, while the immediate response of multiple students to a single question sometimes created confusion, it also added to the information shared and gave the discussion more options.

Future Plans

A major emphasis of the next phase of this project will be to find or develop platform-independent collaborative software that will allow participants in the group to use a combination of Macintosh and Windows-based computers connected to an NT server. Products such as *Convene*, *CourseInfo*, and *Web Course in a Box*, and *TeamWave* will be evaluated to determine their suitability for DPBL. None of these products has the immediate availability and cost-efficiency of *NetMeeting*, and all of them appear to be more complex, requiring a steeper learning curve.

Of equal importance is the development of a database that presents the requested patient data more easily and allows that patient data to be used in other computer-assisted instruction and assessment projects.

At the other end of the difficulty spectrum is the development of a web site that allows easy resource submission and access by group members. Such a tool would facilitate the sharing of information and allow group participants to study resource materials prior to group meetings. While creation of the web site is relatively easy, the challenge to date has been finding a method by which group members can post information without having to use file transfer protocol (FTP) processes. In the near future, the process of testing web sites promoted as "interactive" will begin to determine if any of these existing resources will meet the needs of the project.

It will also be necessary to determine how multiple PBL groups might be supported using the current constrained set-up (dedicated server hosts the session). Although it has not been thoroughly tested, it appears unlikely that multiple *NetMeeting* sessions could be hosted concurrently. This means that groups will either have to coordinate their schedules with the server, or that each group will require its own dedicated server. Additional effort will also be spent in attempting to work through the institutional security issues (firewall) so that it is not necessary for the server to host the session. Students or tutors with high-end computers could host the session, and the remaining members of the group could connect by joining the meeting.

Linkage to a database for automatic collection of data as items are entered on the whiteboard would also facilitate the process by alleviating the need for the group to formally document learning issues at the end of each unit.

The question of Internet access for students and faculty will remain an important issue. If commercial ISPs continue to be used, additional research into connectivity options will be necessary. Even ISPs that advertise "world-wide" connections have connectivity problems in some parts of the continent. The prevalence of international ISPs and inclusion of Internet software on computers creates an environment where these problems can be overcome when necessary, but not without configuration and cost issues that some group members might have difficulty resolving from a remote location.

At one point, future plans included a re-evaluation of Netscape *Conference* in light of the lessons learned with *NetMeeting*, particularly the need for a dedicated server located outside the institutional firewall. Unfortunately, Netscape appears to have abandoned this product.

Summary

Microsoft *NetMeeting* was used successfully at SIU School of Medicine to facilitate distributed Problem-Based Learning. Students who participated in the project provided valuable insights as to the positive outcomes, negative findings and observations they noted during the DPBL sessions. From a tutor standpoint, one of the greatest concerns in face-to-face sessions is the quiet student, and, during this project, it appears that this may be less of a problem in DPBL, because students are not intimidated by more assertive and talkative students.

While *NetMeeting* is not ideal, particularly due to its Windows platform dependency, when used in conjunction with a web page for inquiry-based problem presentation, it can facilitate DPBL without significantly altering the authentic PBL process.

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Authors' addresses

Terri Cameron (tcameron@siumed.edu)
Southern Illinois University School of Medicine, P O Box 9622, Springfield, IL 62794-9622 Tel. (217) 785-4969. Fax (217)524-0192.
Howard S. Barrows (hbarrows@siumed.edu)
Southern Illinois University School of Medicine, P O Box 9622, Springfield, IL 62794-9622 Tel. (217) 782-0795. Fax (217)524-0192.
Steven M. Crooks (scrooks@siue.edu)
Southern Illinois University at Edwardsville, Edwardsville, IL 62026-1125. Tel. (618) 650-3286.