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Riding the Active Learning Wave: Using Problem-Based Learning as a Catalyst for Creating Faculty-Librarian Partnerships

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Riding the Active Learning Wave: Problem-Based Learning as a Catalyst for Creating Faculty-Librarian Instructional Partnerships

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Abstract

With higher education shifting its emphasis from teaching to learning and inputs to outcomes, active learning techniques are gaining prominence. Research has shown that students learn better when they actively engage the course content, rather than passively absorb lecture material. However, many faculty are unsure of how to take advantage of these new techniques to improve the learning outcomes for their students. For one active learning technique, problem-based learning, librarians are well positioned to facilitate its adoption into course curriculum. In order to effect a high-quality problem-based learning experience, a true collaboration of efforts needs to take place between the subject faculty and librarian. In such a synergistic system, information skills are integrated directly into course content, while an engaging active learning experience for students is facilitated. This article describes the background and history of problem-based learning, explaining why information skills are an integral part of the technique. The authors then detail the experiences of librarians at Purdue University, both in forming collaborations with subject faculty, and in the development of problem-based learning instructional modules.

Introduction

Librarians face a constant struggle to convince students and subject faculty that information skills are important and needed by students. Recently, the editorial board of our campus newspaper provided an example of the typical thinking of undergraduate students. After running an article that found Purdue University's collections' size ranking at the bottom of the Big Ten, they wrote an editorial that opined, "To this we say: so what? When was the last time you went to the library to do research for a class project?" (Wakefield, et al. 2002). Their argument was that everything is available on the Internet, so we shouldn't worry about the libraries. At the same time, subject faculty complain that student papers continue to decline in quality, mainly due to an over-reliance on inappropriate Internet resources.

With the advances in search engine technology and the increased technology skills of undergraduates, it is easy to find "something" on the Internet to answer most any question. As Macklin (2002) posits, students believe they already possess information skills, when in fact, they may be functionally information illiterate (Majka 2001). That is, students can ostensibly find answers to simple information needs, but are unable to explore deeper concepts or determine if their answers are rigorous. Since students feel successful in answering simple questions, they don't believe they need information literacy instruction, and are consequently unmotivated to learn.

Conversely, faculty believe students have more skills than they actually do. Frequently one hears that student laziness is the root of the problem, rather than a lack of information skills. Faculty see that students have the information technology skills to use search engines, but are unaware of the subtle difference between information literacy competencies and information technology competencies.

One of the keys to developing effective information literacy instructional opportunities is to convince both students and faculty that there is a real need to teach those skills. The authors have made inroads into doing just that by using the problem-based learning (PBL) methodology as a hook to form collaborations with subject faculty and to engage students in the sciences at Purdue University. Since the problem-based learning exercises move a course's content forward, and aren't just add-on information exercises, there needs to be strong involvement from both subject faculty and librarians in the creation, integration, and evaluation of the exercises.

Background

Problem-based learning originally gained popularity in the context of medical education. Under the leadership of Howard Barrows, McMaster University incorporated problem-based learning as part of their medical curriculum in 1969 (Neufeld et al. 1989). Mercer University was the first U.S. school to adopt a PBL curriculum in the early 80s, and Harvard University School of Medicine converted completely to a problem-based learning curriculum in the late 80s (Donner and Bickley 1993). Overall, problem-based learning curricula have created positive outcomes, as the learning process was found to be more enjoyable for both students and teachers, and student performance was at least as good as for students in a traditional curriculum (Albanese and Mitchell 1993).

Active-learning techniques have been gaining steam for the past ten years or so in the rest of the higher education system. The Boyer Commission Report on Reinventing Undergraduate Education contains "Ten Ways to Change Undergraduate Education," the first two of which extol research-based and inquiry-based learning over the current dominant model of direct transmission of knowledge from instructor to student (Boyer Commission 1998). The report credited the University of Delaware for developing problem-based learning activities for their introductory science courses. The University of Delaware has incorporated problem-based learning into undergraduate science education since 1992, and in 2000 included PBL activities in over 150 courses, reaching over 4,000 students (Duch, Groh, and Allen 2001).

What is problem-based learning? In short, it is a teaching technique wherein the learning takes place in the context of solving real-world problems. The students are given a scenario based on a hot topic or current dilemma, perhaps taken from the news. The scenario implicitly requires an understanding of some concepts from the course's curriculum, but the overall structure is deliberately open ended and ambiguous, allowing students to explore the particular aspects of the topic that most interest them.

For example, in our local community, as in many others, the status of creationism vs. evolution in the school curriculum continues to be a hot topic. A possible scenario for an earth science class could be:

> *The local school board is considering the curriculum for 7th grade earth science. You have been asked to testify on the topic of the age of the Earth. How old is the Earth, how do we know, and what kind of accuracy do we know it with? Your testimony could influence what local students are taught in the coming years. What do you tell the board, and how will you back up your conclusions?*

For this exercise, the structured curricular aspect of the problem is for students to investigate dating methods, while the open-ended aspect is for them to choose the method they want to use. As the students talk to each other about the method they chose to investigate, peer learning of several methods occurs.

Once the students have been given the problem, they go through a structured process of problem solving. First, the students have to take ownership of the problem by transforming it into something they fully understand (with the facilitation of their instructor). They then need to determine their "learning issues." Students pool their own knowledge on the topic, and then figure out aspects they don't understand. They determine who will get the answers to those aspects of the problem, and how they will do so. They break up and do their research, and come back with information, synthesizing their new findings with their previous knowledge. They determine if the information has raised new learning issues, and, if so, iterate the research and synthesis stages of the problem solving. After the research is finished, the students write solutions to the problem, typically analyzing various potential alternatives, and advocating for their preferred solution. For further information, Duch, Groh, and Allen (2001), and Fogarty (1997) provide good practical introductory guides to the techniques and underlying concepts of problem-based learning. Macklin (2002) provides the framework for and an example of problem-based learning applied in an information literacy setting.

The Association of College and Research Libraries (2000) information literacy competency standards parallel the problem-solving process of problem-based learning. From the first standard "determining the nature and extent of the information needed," all the way to the fourth standard of using "information effectively to accomplish a specific purpose," solving problem scenarios requires proficiency in all the competency standards to be completed successfully. The medical library literature demonstrates the effect of information use by students in a PBL curriculum. Rankin (1996) reviewed the literature and found PBL students used the library more often, used a wider variety of resources, showed more independence in information gathering, asked more complex reference questions, and generally acquired information skills sooner than their peers in traditional education curricula. Schilling et al. (1995) and Minchow et al. (1993), for example, described how information literacy skills can be fully integrated into the PBL curricula. In their cases, librarians are also used as facilitators for student groups working on problems, on par with medical faculty in that role. Since the problem facilitator is not imparting their information to students, but rather facilitating the finding of answers by students for themselves, librarians were valued for their abilities to clarify problems and issues and to point students in the right direction to find their own answers. Indeed, these are techniques librarians use at the reference desk every day.

The background of the relationship between librarians, libraries, and PBL is well established in the medical library literature. As PBL becomes more interesting to the rest of higher education, librarians can take advantage of the obvious information tie-ins of the technique to become partners and leaders in its acceptance on their campus. For the past year through the LEADER project, Purdue University librarians have used problem-based learning techniques to open new doors for information literacy instruction, instruction that is perceived as both interesting and relevant to students and subject faculty.

The LEADER Project

LEADER (the **L**earner **E**n-**A**bled **D**igital **E**nvi**R**onment) is a three-year project funded by a grant from a private donor to the Purdue University Libraries. Its aim is to promote information literacy skills for students in science and technology fields, in the context in which students will need them in the course of their work after graduation. Similar to philosophy of Barrows and Tamblyn (1980), who asserted that merely acquiring knowledge provides no assurance of knowing when or how to apply it, LEADER is based on the premise that students will retain information skills better and be more productive workers if they learn those skills in the context of work-related problem scenarios.

In its final form LEADER will consist of online modules and a shared digital workspace for students and faculty engaging in problem-based learning exercises. By providing ready-made templates for class scenarios, we hope to make the project highly scalable across the campus. However, for this first year, the authors have been concentrating on PBL techniques to see how they work before moving on to an online component.

Forming Collaborations

Finding subject faculty to partner with has been the result of sustained, diverse efforts of the authors. Networking, participation in campus-wide activities, and enticing subject faculty with a free lunch all contributed to the recruitment of collaborators. But, ultimately, the key to recruiting faculty is to give them an image or concept they can remember and associate with positive outcomes for their students.

Networking is one way to identify faculty who may be interested in working on this kind of project. Students at the reference desk, faculty in the hallways and especially before and after their weekly seminars (when they have their cookies and are in a good mood), and course syllabi all give input on what kinds of assignments, topics, etc., undergraduates have. In identifying recruits, eligible faculty are not just those who have given research assignments, but also, and often more importantly, those who seem to care about student learning or are interested in innovation and new ideas. They might just need the proper spark of an idea to add information skills into their course's curriculum.

Getting involved in campus-wide activities also provides a self-selected group of motivated instructors to network with. For example, campus centers for teaching excellence are appearing at universities across the country. Purdue University has a professional development resource called the Center for Instructional Excellence (CIE). The CIE provides seminars, workshops, and evaluation services for instructors interested in improving their teaching. They share their own expertise as well as tapping expertise of faculty from across campus.

Once a year, CIE sponsors a two-day seminar and poster session called TLT (Technology and Learning for Tomorrow), where innovations in instruction and technology meet, and interested faculty from across campus can see what their peers have been doing. The authors presented a poster session at the 2001 TLT, which provided us with visibility at the campus level and made some connections with subject faculty. One of the authors (AM) has also been active in giving seminars and conducting faculty training through the CIE, and ended up co-founding a subgroup within the CIE called the PBL Initiative. The institutionalization of PBL increased its legitimacy as a viable instruction method, and positioned the Purdue University Libraries as leaders within the university community for this instructional technique.

In May of 2001, after having secured funding for the LEADER project, the authors assembled a list of potential science faculty participants from contacts made through CIE experiences and acquaintances who we knew were interested in undergraduate education. Since incorporating problem-based learning activities into existing curriculum is a time-consuming process, we wanted to give a focused presentation to prospective participants, where we laid out the requirements and the benefits of doing this. What better way of getting undivided attention than through a "free lunch?" Although the free lunch was certainly a draw for faculty, we were encouraged by the number who couldn't make the meeting but nevertheless declared their interest in the project. In all, we hosted eleven faculty for the lunch, and five other faculty expressed interest in working with the project.

At the lunch, we laid out our case for information literacy and problem-based learning. We explained how students gather and use information using novice algorithms, and that they really don't have the higher-level analysis skills needed to find, read, digest, and synthesize information, even though they have strong technology skills. This apparent duality of competence in information technology and incompetence in information literacy resonated with the faculty. We also had a subject faculty member speak to the group, one of their own that they could relate to, to reinforce this perception. We talked about the resistance of students to learning information skills, and the fact that problem-based learning can show where the students are lacking in their skills by having them try to solve a problem. If they fail, they need to revise and rethink until they succeed. This trial-by-fire approach to gaining information skills, and thus the key to lifelong learning, was very attractive to the faculty.

Since startup projects are inherently time intensive, we did not want to overextend ourselves and promise more than we could deliver. Thus, we limited ourselves to two pilot courses in the first academic year of the project, to try out our PBL-based information curriculum. The two projects involved different amounts of contact time, class size, and content, and we felt they would provide a good test of the flexibility of information-integrated PBL exercises. Above all else, in forming these partnerships one must be flexible and understand the needs of the subject faculty, articulate what services you can provide, and, together, come up with a plan for meeting the needs of the classroom.

In the first collaboration, after several instances of unsatisfactory writing projects from students in a required first-year survey course in Earth Science (EAS 109), the instructor decided not to give up on research assignments, but rather, to build information skills into that course and see if it would produce better outcomes for his students. The second course (SCI 460), Science and Society, was making a jump from a two-credit to a three-credit course and needed to upgrade the rigor of its assignments to include research projects. The instructor wanted ideas for possible assignments and to make sure students had skills to carry out these assignments. In both cases, the faculty believed a problem-based approach would be an effective way for students to acquire the information skills they needed for their semester projects. To give a better understanding of the details of the collaborations, we briefly describe them below.

The Collaborations: EAS 109

The Earth and Atmospheric Sciences department teaches a freshman survey course that all incoming majors must take. The typical class size is 80. This course requires a short term paper on some topic. The instructor was not happy with the results, finding that students seemed to believe the Internet would answer everything, uncritically citing sources like corporate web sites, short announcements and abstracts, personal web sites, and the like. Although journal articles were required and used, they were obviously not understood and usually not relevant.

In order to facilitate understanding of what the instructors wanted students to know, the authors distilled a list from the ACRL National Competency Standards performance indicators. From the lengthy list of identified skills that needed work, it was obvious a 50 minute one-shot orientation was not sufficient to address these issues and turn incoming students into skilled information seekers. The instructors agreed to dedicate some of their lab sessions for "information labs" so that enough time would be available to address all the issues. Furthermore, since the instructors wanted to strengthen students' presentation skills as well as their research and writing skills, they agreed that the subjects of the information labs would be good vehicles for student presentations to their peers. Having smaller groups (20 people per lab) also facilitated interactive experiences for the students (enabling them all to work in a computer lab), and for peer learning to occur.

We finally settled on two information exercises, each of which took one three-hour lab period. In addition, in the lab following each information exercise, the students gave presentations of their problem solutions to the rest of their class. Since, especially in the geosciences where so much relevant government data is available, we needed to not dissuade students from using the Internet, but rather, to help them be more selective users. Thus, our first exercise dealt with Internet resources. We developed an Information Lab to guide students through the process of analyzing a problem, finding their information needs, searching, retrieving, analyzing, and evaluating.

For this lab, both subject faculty and librarians worked on writing problem statements appropriate in their complexity both for the students who would be working on them, and for the resources (the Internet) they would be using to solve their problem. Since students used their problems for their presentations, we developed five different problems, so students wouldn't get bored listening to the same presentation over and over. We did have two groups working on each project, though, so they could do some knowledgeable peer critiquing of final projects. Since this was an actual, graded lab, the librarians and subject faculty jointly determined the rubric for grading both in-class work and the presentations, making sure that appropriate skills were being assessed.

For the second lab, we gave the students more responsibility for selecting their own topics within one general problem scenario. After having seen a documentary on global warming, we asked them to brainstorm possible solutions to the problem. They were asked to role-play aides or lobbyists to the House Committee on Resources chair, who is responsible for environmental policy. Each group wanted to convince the class that their solution was the best possible way to have a positive effect on global warming -- assuring their boss would be re-elected, and thus their own job security. This time we had four groups of five working on their solutions. Students reinforced their problem definition and information evaluation skills from the previous class. In addition, they learned about subject indexes to the journal literature, and understood the added rigor of the journal literature. Since the journal literature is more difficult to understand than most Internet resources, we believed having larger groups would provide greater peer-support for students to be successful. Also, students weren't responsible for digesting as much raw information on their own, compared to what we expected from their Internet exercise. For their follow-up, presentation lab, the students gave panel presentations to each other, with each group member playing a role on the panel.

Overall, the students gave high-quality presentations, showing good progress in searching and evaluating resources and integrating their knowledge into a final product. The instructors gave us very positive feedback about the quality of the students' work on both the presentations and in their final papers.

The Collaborations: SCI 460

Science 460 is an interdisciplinary Science and Society class that examines the effect science and scientific discoveries can have on policy issues. As scientific breakthroughs allow society more and more control over its existence, moral choices increasingly have to be made. For example, stem cell research, cloning, surveillance and privacy, and our global climate all have been front page news in the past year. The format of the course consists of a series of guest lectures from faculty speaking about controversies in their fields. For this course, the instructor wanted students to engage the content and experience the controversies through their own research projects.

The authors, the instructor, and a past student of his class working on an independent study, created and tested problem statements to be used as models for class presentations the student groups would make during the last few weeks of the course. Over a period of a few months, our group met as a whole to discuss what newsworthy events had taken place that students might identify with, and how to translate those into problem scenarios that students could engage in. We also determined the information skills students would need to carry out their research projects, as in the collaboration above.

We decided to ask the students to role-play a scenario. For example, providing testimony to a Congressional hearing on energy issues; or giving advice to a new medical researcher interested in working on stem cells. The problems contained several potential roles, so each member of the group could find a part to play in the presentation, and they all explicitly required an understanding of both the scientific and philosophical issues involved in the problem. The students were responsible for the content of an entire class period in presenting their scenarios.

In addition to writing the student seminar problem scenarios, the authors facilitated two 1 1/4 hour class sessions devoted to the same information skills as the EAS 109 class. Using a case study of tidal energy, why (or if) one should support research in this area of alternative energy over other potential sources, the students surfed the web for resources during the first session, evaluating and getting peer feedback on their results. Then, for the same topic, they found the increased depth of information available in the journal literature in their second class session. Since we tried to reach the same student outcomes as in the EAS109 class in roughly one-third of the time, we had all the students working on the same problem, so they could quickly understand what their peers were presenting to the rest of the class, and the presenters didn't have to introduce their topic from scratch.

Conclusion

Through the LEADER project, librarians at Purdue University have leveraged the increasing popularity of active learning techniques into opportunities to facilitate the acquisition of information skills by undergraduate science majors. Faculty interested in finding new ways to teach students have latched on to the possibilities of problem-based learning, and we have successfully implemented PBL activities into two science courses. In the coming year, we will expand the project to test its scalability and extensibility to other subject areas and other librarians. We have recruited four more librarians to the project and have lined up instruction opportunities in physics, biology, agriculture, and veterinary medicine for the next academic year. Substantive collaborations with subject faculty have been necessary to create information problems that smoothly integrate into the course content and are accepted by students as valuable experiences.

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Previous Contents Next