

# Connecting What We Know and What We Do Through Problem-Based Learning

by Claire H. Major



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**T**he way we think about teaching and learning in higher education is changing. Our rhetoric illustrates this fact; we make assertions that undergraduate education is undergoing a paradigm shift, that the “learning revolution” has begun. Contributing to this change in perception is the cognitive research about the nature of learning. We know that students construct their own knowledge, that they benefit from working together, and that they do not all learn in the same way.

New powerful pedagogies, such as project-based learning, inquiry-based learning, case-based learning, research-based learning, situation-based learning, context-based learning, and problem-based learning (PBL), indicate that our techniques have, in fact, changed. Our actions are keeping pace with our words.

## Definition and History

PBL is an approach to learning in which problems serve as a stimulus for students to gain course concepts and content as well as metacognitive skills. Generally PBL problems are ill-structured, based on real situations, and have more than one “right” answer. In the PBL environment, students confront a problem *before* they receive all of the information necessary to solve it. Students work in teams to define the nature of the problem, to identify what additional resources they need, and to find viable solutions. Faculty members act as facilitators by asking questions and monitoring group processes as students actively pursue viable solutions. Faculty members also guide students to resources. Students must generally reapply the new knowledge to the original problem and communicate the results of their findings. Among the anticipated outcomes of PBL are

enhanced critical-thinking and problem-solving skills, research skills, communication skills, and content knowledge.

PBL has appeared in a variety of settings and has had many different applications. It has served as a framework for programs and curricula, as a guiding concept for entire courses, and as an instructional strategy in specific courses. PBL emerged as a curricular framework in medical institutions in the 1960s, in answer to criticisms of the inapplicability of memorization during the “information explosion,” the fragmentation of the curriculum, and the lack of prepared graduates. The first institution to implement PBL was McMaster University in Canada, which designed the curriculum of its newly created medical school around PBL. Soon Maastricht University in The Netherlands and University of Newcastle in Australia developed programs in their new medical schools on the basis of the McMaster model. Some medical schools, such as University of New Mexico, developed parallel PBL tracks for small groups of students. Other medical schools redesigned traditional curricula to follow an adapted version of the PBL model: Harvard University is one example. Howard Barrows of the Southern Illinois University School of Medicine is among the leaders of PBL in the medical school setting, continuing his groundbreaking work in the field.

After its emergence in medical schools, many professional schools adopted PBL, responding positively to medical school findings about outcomes such as increased faculty member and student satisfaction and increased retention of content. The professions also recognized the need to improve critical-thinking and problem-solving skills among their students. In addition, PBL, with its focus on “real world”

problems, seemed a suitable strategy for the professions, which had to produce competent practitioners. Leaders in professional school programs include Donald Woods in engineering at McMaster and Wim Gijsselaers in business at Maastricht.

With recent charges to improve the quality of undergraduate education, PBL has continued to spread into the general undergraduate curriculum. The 1998 Boyer Report "Reinventing Undergraduate Education: A Blueprint for America's Research Universities," published by the Carnegie Foundation for the Advancement of Teaching, articulates these charges and recommends inquiry-based learning as a vehicle for improvement. Some colleges and universities are adopting such approaches.

One of the first institutions to use a problem-based approach in undergraduate education was Aalborg University, founded in 1974 in Denmark. Aalborg modeled its curriculum on project-based learning, which is a combination of PBL and project work. PBL represents about half of student activity, and one project usually takes an entire semester. Maastricht University also uses PBL across the undergraduate curriculum. PBL spread from Maastricht's medical school, and the faculty, including the arts and cultures and general sciences, fully incorporate it. Unlike Aalborg, however, Maastricht students analyze relatively short problems during group sessions.

In the United States, the University of Delaware offers PBL courses in sciences and social sciences, with funding from the National Science Foundation and the Pew Charitable Trusts. My institution, Samford University in Alabama, has recently begun an effort to implement PBL in the undergraduate curriculum and to research PBL in undergraduate education. The Samford PBL Initiative, supported by a grant from the Pew Charitable Trusts, involves redesigning core areas of its undergraduate curriculum. Five of Samford's eight schools are participating in the Initiative: arts and sciences, business, education, nursing, and pharmacy. Aalborg, Maastricht, Delaware, and Samford are examples of universities that bring together the concepts of teaching and learning through PBL.

## Core Concepts of PBL

With the spread of PBL into professional schools and undergraduate education, PBL continues to evolve. Different institutions, disciplines, and faculty members have taken the concepts of PBL from the medical school model and considered how the learning strategy and its underlying values and concepts might be used to accomplish other educational goals and objectives. Yet several essential PBL concepts are consistent across many programs. These concepts arise from what we know about learning and what must happen to enable it.

**Course and Curricular Design.** One of the most fundamental elements of PBL is course design. At the outset of the design process, faculty members consider the essential concepts of their courses, identify clear goals, and know what outcomes students should be able to demonstrate by the end of the course. According to Peter Ewell, students learn from direct experience, and learning occurs best in the context of a problem (*AAHE Bulletin*, December 1997). In PBL, content and ideas are situated in the context of "real world" practical or theoretical problems that students must solve. These problems allow students to grasp basic course concepts and practice higher-order thinking skills. Faculty members work to design problems that help students achieve desired outcomes. Faculty members also design assessment strategies that fit the methodology and that measure student achievement, while giving regular and prompt feedback. Assessment is part of teaching and learning — not ancillary to it.

PBL at the course level helps students achieve problem-solving and critical-thinking skills. Some PBL advocates, but not all, believe that PBL must be a part of a larger curricular design. In this way, PBL provides a continuity of experience from course to course. However, where traditional curricula cannot be reshaped (for whatever reason, whether financial, political, or other), PBL in combination with learning communities offers an interesting possibility for undergraduate education. These learning communities may allow a continuity of experience and may provide an interdisciplinary forum in which PBL can help students gain full educational benefits.

**Construction.** According to the theory of constructivism, students do not simply assimilate knowledge as it is presented. Rather, they act on a message to connect it to what they already know. This theory indicates that having students simply listen, transcribe, memorize, and repeat is not the best way to encourage learning. Students should be active participants in their learning — take ownership of the process — in order to construct knowledge. In a PBL classroom, students are encouraged to make connections. Unlike empty vessels ready and waiting to be filled with information, students use prior knowledge (from other courses or personal experience) when confronting problems. After taking stock of what they already know, students determine what additional information they will need, and they find and use appropriate outside resources. Because PBL is interdisciplinary in nature, students make connections between subjects. Through this process, students learn patterns of problem solving that they can transpose onto different situations. They develop mental models to make meaning out of new situations. This fact takes on increased significance because students are working on "real world" problems that they may encounter on the job. Thus, PBL can allow students to grasp the connection between the subject matter and life, between school and work.

**Collaboration.** While writing about constructivism in her article “Opening Windows on Learning” (League for Innovation in the Community College, Educational Testing Service, 1998), Pat Cross notes that students not only construct knowledge but do so in the context of social interaction. PBL encourages social interaction, or collaboration, between and among faculty and students. When designing PBL courses, faculty members are encouraged to work together since the nature of PBL promotes cross-disciplinary collaboration. PBL also encourages connection between faculty and staff members who might serve as resources.

PBL encourages collaboration between faculty members and students. As faculty members become facilitators (moving from “sage on the stage” to “guide on the side”) and as students become active participants in the learning process, their roles become more similar. They become co-learners instead of authoritative expert and empty vessel. Thus faculty members model the learning process for their students. In a PBL classroom, the instructor places considerable confidence in the student. The teacher should expect the student to bring certain knowledge and information to the classroom and to use existing knowledge to do the work. The faculty member trusts that the student is able to do the work and will do the work, and that learning will take place with or without the faculty member.

Cross further suggests that by teaching classmates, students are active participants in the learning process and are more likely to relate to the background, knowledge, and interests of fellow students. As students take on different roles in groups (e.g., leader, recorder, skeptic), they establish communities of peers, becoming co-learners and therefore co-teachers. Such academic communities enable students to develop substantive support, which in turn may improve retention rates. In addition, recent research suggests that students benefit more from learning/academic community than social community.

**Combination.** The concept of combining instructional strategies to maximize the learning experience may not be considered important universally among PBL advocates, since in the classic model PBL is often seen in opposition to the lecture. Proponents of this view see learning on a continuum. Illustrations of this continuum depict a scale ranging from passive learning to active learning, with lecture on the extreme passive end and PBL on the extreme active end. While it is true that PBL emphasizes construction and collaboration, Cross reminds us that “passive learning is an oxymoron; there is no such thing.”

Many PBL advocates do not define PBL in opposition to the lecture. In fact, many institutions using PBL encourage a combination of the strategies under the problem-based umbrella. Problem-based lecturing is one example. This

strategy accomplishes two goals. First, it improves the lecture method itself. Students must prepare for the lecture, and they must listen and ask questions, because the lecture is one resource they may use to solve the problem. Technology has also been used under the PBL umbrella. Many faculty members have found that a webpage is an excellent place for progressive disclosure of parts or stages of a problem. They have used real data, and sometimes real texts, to bring the “real world” into the classroom. Faculty members have incorporated service-learning into their PBL classes, as faculty and students have worked directly with the community. In short, PBL can incorporate a rich variety of instructional strategies.

## Challenges of PBL

PBL is proving to be an exciting method that can increase student problem-solving abilities and bolster student and faculty attitudes. However, challenges arise. Among them is adopting PBL without sufficient commitment from staff and faculty. Another challenge involves the amount of time involved in course design when reward and incentive structures tend to favor traditional research. Along similar lines is time for faculty development. Faculty must spend considerable time and effort in course design, problem development, and dealing with group processes, yet often faculty members have had very little training on how to do so. Another challenge relates to student preparation. Many times students have experienced only traditional classrooms, and they may feel anxiety about their new roles. It is important to provide students with information about why they need to change and why what they are doing is important. Another challenge is assessing a new methodology when traditional forms of assessment reward students for the gains in learning that result from the traditional lecture classroom.

## For More

As part of its PBL Initiative, Samford is conducting research on PBL in undergraduate education, both nationally and internationally, and is working to become a national clearinghouse of information. To communicate the results of project findings, we publish a newsletter, *PBL Insight*, three times a year. The Samford PBL Initiative website ([www.samford.edu/pbl](http://www.samford.edu/pbl)) tells about PBL nationally and internationally and about Samford's efforts. We are holding a national conference in the year 2000 (October 29–31) to learn from others using the method and to report on what has been learned through our project; you can register through a link on our website. For more information about PBL and the Samford initiative, contact John Harris, project coordinator, or me at the address on page 7.



