A Newsletter for Undergraduate Problem-Based Learning from Samford University

PBL Insight

to solve, to learn, together

Vol. 3 No. 3

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PBL 2000 Plenary Address Offers Evidence For and Against Problem-Based Learning

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Problem-based learning [PBL], like many other complex concepts, exists in the eye of the beholder. In general, PBL is a method of instruction that uses problems as a context for students to acquire problem-solving skills and basic knowledge. Vernon and Blake (1993) further characterize PBL as the study of real or hypothetical cases in small discussion groups engaged in collaborative independent study using hypothetico-deductive reasoning with a style of faculty direction that concentrates on group process rather than provision of information. However, as these authors concluded from their research:

> PBL is more than a simple teaching method. It is . . . a complex mixture of a general teaching philosophy, learning objectives and goals, and faculty attitudes and values, all of which are difficult to regulate and are often not very well defined in research reports (Vernon & Blake, 1993, p. 560).

For example, in PBL, students confront ill-structured, real-world problems; but are the problems constructed by faculty or by students? Students work in small teams; but are they assigned to teams or can they choose their own team members? Do they stay with the same team for a whole semester or year, or do they change groups periodically? In PBL, students must seek and evaluate information related to the problem they are given to solve; will some of the needed information be provided to the entire class by the instructor, or will students be encouraged to find all the information on their own? When students are tested in PBL settings, are the types of assessment applied consistent with how students learn using PBL? In some institutions, PBL is used throughout the curriculum, in others it is offered only in certain courses, or even in certain sections of some courses; are students randomly assigned to courses or sections that use PBL, or can they select PBL or non-PBL? And what is the impact of having *all* courses in a curriculum taught using PBL, as opposed to having a mixture of PBL and non-PBL courses?

As early as 1986, Howard Barrows (as cited in Nendaz & Tekian, 1999) attempted to define PBL in medical curricula. As Nendaz and Tekian (1999) report, Barrows believes that in an authentic problem-based approach, four main objectives must be achieved: "(a) structuring knowledge for better recall and application in clinical contexts; (b) developing an effective clinical reasoning process; (c) developing self-directed learning; and (d) increasing motivation for learning" (p. 232). But even in medicine, PBL has been implemented in myriad ways. In fact, the term PBL has so many different meanings and has been approached in so many ways that Foley, Polson and Vance (as cited in Distlehorst & Robbs, 1998) have urged colleagues writing about PBL to include sufficient detail about the curriculum to enable others to see how one compares with another.

All of these differing perspectives on PBL have important consequences for evaluation, and to date, PBL evaluation is not sufficiently well developed to have addressed in evaluation designs all of the nuances inherent in the process of implementing PBL. Moreover, most of the comprehensive studies, including the important meta-analyses, have been carried out in the field of medicine, where PBL has the longest history. In other disciplines, evidence of the effectiveness of PBL is just beginning to accumulate along a few well-worn paths of inquiry. Obviously, then, the jury is still deliberating the verdict on the overall effectiveness of PBL. Nevertheless, we can discern some trends in the evaluative data, which we will describe shortly.

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Editor's Notes:

Kristi L. Arndt

What a fall it has been! Many of you joined us in Birmingham for the PBL 2000 conference, the capstone event of the Samford PBL Initiative. We all learned from each other in sharing the Promises, Breakthroughs and Lessons of PBL. Although the keynote, plenary and breakout sessions were inspiring, the participants' genuine interest and enthusiasm was overwhelming. Sean Flynt, a freelance writer, reports on the conference in this issue's Samford PBL Initiative Update.

This issue marks a period of transition at Samford as we complete the Samford PBL Initiative grant and begin the PBL Peer Review project. The first project was designed to address an essential question: "Will PBL improve student learning and help students acquire marketable skills, such as critical thinking, ability to work in groups, effective communication and inquiry skills?" Two articles featured in this issue address this question from different vantage points. In "A Sample of Assessment Findings Related to Samford University's PBL Initiative," James Eck and Dea Mathews describe four instruments used in Samford's assessment efforts and summarize the results. Trudy Banta's PBL 2000 plenary address, "Evidence For and Against PBL" with co-authors Karen Black and Kimberly Kline, takes a wider view of the PBL assessment literature. The authors describe various evaluation instruments that have been used in PBL contexts. They also cite evidence from three meta-analyses of the PBL evaluation literature, indicating some positive effects. We hope these articles will both challenge and inspire you to consider seriously how well your assessment methods match your PBL goals and methods.

In times of transition, reflection on past efforts and anticipation of things to come are appropriate. We appreciate your interest and participation in Samford University's PBL Initiative. I also wish to acknowledge Claire Major's efforts over the past three years and thank her for helping me in my transition to Samford as the new PBL Center director. I look forward to working with you as we begin the PBL Peer Review project to develop and demonstrate effective methods of documenting, evaluating and disseminating scholarly PBL teaching efforts in a way that is considered seriously by important decision-makers and stakeholders. On that note, we have extended the deadline for mini-grant applications for the first round of PBL course portfolio development to January 31, 2001. If you are interested and have not yet applied, please complete and submit the application provided in this issue. You may also apply online at http://www.samford.edu/pbl/. Please contact the PBL Center at pbl@samford.edu for further details.

Enjoy!

News Items from PBL 2000

- In response to numerous requests, audiotapes of Lee Shulman's keynote address, "From Problem to Learning: The Promise and Perils of Problem-Intensive Pedagogies" are available from the Samford bookstore at http://customer.samford.edu/bookstore/.
- The keynote and plenary presentations are available at http://www.samford.edu/pbl/PBL2000/.
- If you attended PBL 2000 and are receiving PBL Insight for the first time, please let us know if you want your name added to our mailing list. If you do not contact us, you will not receive another issue by mail. All issues are available online at the Samford PBL Web site. ▲

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Requests for multiple hard copies can be granted for a nominal cost. For information, please contact the assistant editor.

PBL Insight

A Newsletter for the Samford University PBL Initiative

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Invitation for Submissions:

The editor welcomes contributions to *PBL Insight.* The following are guidelines for those who would like to contribute work on problem-based learning [PBL] in higher education.

Content

The editor welcomes both scholarly and research papers on PBL as well as reports of actual classroom practices.

Format

Scholarly papers, research papers, reports, essays, book reviews, news items and letters to the editor are welcome. Please send both a hard copy and a disk copy of your article to the editor. Microsoft Word is preferred.

Length

Scholarly papers and research reports should be four to eight typed, double-spaced pages (1,000–2,000 words). Book reviews, news items or work documenting practices should be 100–500 words.

Style

APA style is preferred for documenting sources.

Deadlines

Future issues will be finalized one month before publication of the newsletter. Please send contributions for the next newsletter by March 1, 2001.

Please address all contributions to:
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Evidence For and Against PBL

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Evaluating PBL Outcomes

We undertook the research on evaluation of PBL anticipating a dearth of definitive studies outside the field of medicine, and that is precisely what we have found. Nevertheless, we were pleased with the number of studies in medical schools that shed light on some very important issues that interest all of us. And that same basic work is beginning to be done in other fields as well.

Since so much of the work on PBL to date has been in medical curricula, much of the information used to evaluate PBL has come from exams—many of them multiple-choice—on course content in the basic medical sciences. Some assessment has been based on students' performance when presented with problems by patients in real or simulated settings. But more of the evaluative work undertaken so far has relied on traditional tests of content knowledge to look at PBL vs. non-PBL achievement than on measures that assess the particular curricular goals of PBL as described by Barrows (as cited in Nendaz & Tekian, 1999), i.e., strengthening the ability to solve ill-structured problems, developing the capacity for self-directed learning, increasing motivation for learning, and structuring knowledge for better recall and application. However, this may be changing.

A survey of the literature published by Nendaz and Tekian in 1999 indicates that medical schools are increasingly using quite a variety of both formative and summative processes to assess knowledge and problem-solving skills, practical skills and professional attitudes. While these examples are from the field of medicine, most also are applicable in PBL settings in other disciplines.

The range of instruments being applied in assessing outcomes includes the following:

- *Multiple-choice questions* [MCQs] offer high internal consistency reliability, allow for broad sampling of content domains and can be highly valid if properly constructed. MCQs are often used in PBL assessment, but just as often are criticized for assessing only the recall of isolated facts (Nendaz & Tekian, 1999). However, if these questions are designed carefully, for example, by "increasing the number of relevant response options" (p. 234), they can be effective in assessing higher order intellectual skills. Barrows (as cited in Nendaz & Tekian) recommends that if MCQs are to be used, they should be administered in context and immediately after work with a problem.
- *Short-answer questions* [SAQs] offer no response options and thus have some advantages over MCQs in that they provide few opportunities for guessing and "cueing" (Nendaz & Tekian, 1999, p. 234). This format is criticized for its "lack of precision regarding what is expected from the students, the increased faculty time and effort for scoring, and lower test reliability due to the fewer number of test items and more subjective scoring" (p. 234).
- *Extended-matching items* offer numerous response alternatives, thus reducing the risk of guessing and "cueing" (Nendaz & Tekian, 1999, p. 234). Scoring is more mechanical and is thought to be more objective than scoring open-ended items.
- *The Progress Test,* described by van der Vleuten, Verwijnen and Wijnen (as cited in Nendaz & Tekian, 1999), was used first at the University of Maastricht and is administered several times a year. It does not focus on any particular block of content, but rather assesses knowledge across all disciplines and content areas.

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There is a wide range of instruments being being applied in assessing PBL outcomes.

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- *Essay exams* can reflect problem-solving skills and encourage students to synthesize in their own voice all the knowledge they have acquired. Some shortcomings of essay exams include the risks associated with asking ambiguous questions and the reduced reliability of subjective scoring. Swanson, Case and van der Vleuten (as cited in Nendaz & Tekian, 1999) offer the opinion that it is better to provide a large number of short essay questions than a few longer questions in a testing situation.
- *Oral exams* have advantages and disadvantages similar to those of the essay exam, but they may be even harder to grade. Swanson, Norman and Linn (as cited in Nendaz & Tekian, 1999) report that in an attempt to improve the objectivity of oral exams, sets of hypothetical cases, lines of questions and scoring criteria have been prepared in advance, thus creating a standardized or structured oral exam.
- *Patient-management problems, computer simulations and paper cases.* Swanson, Case and van der Vleuten, and Swanson, Norman and Linn (both as cited in Nendaz & Tekian, 1999) report that until the 1980s, patient-management problems presented in case simulations were used widely to test clinical reasoning and problem-solving. Now this type of testing has been replaced with computer simulations and paper cases in situations where a less-expensive form of testing is desired.
- *Modified essay questions* [MEQs]. Feletti (as cited in Nendaz & Tekian, 1999) conducted research involving MEQs to study the clinical reasoning process in a PBL setting. MEQs provide structured items that present a sequence of clinical cases in booklet form. To simulate decision-making in practice, students are not permitted to preview items by looking forward in the booklet, nor may they return to change decisions on earlier items. Feletti concludes that MEQs have acceptable reliability and construct validity and help in diagnosing students' weaknesses in clinical problem solving.
- *Clinical reasoning test modules,* described by Distlehorst and Barrows (as cited in Nendaz & Tekian, 1999), were developed at Southern Illinois University to "reflect the hypothetico-deductive model of reasoning" (Nendaz & Tekian, 1999, p. 235). Students receive workbooks containing a patient history, physical findings and ancillary tests. They must form initial hypotheses and decide on appropriate tests to carry out to reach a final hypothesis. Distlehorst and Barrows write that such modules provide an efficient way to assess clinical reasoning without direct observation by physicians.
- *Clinical reasoning exercises,* described by Neville, Cunnington and Norman (as cited in Nendaz & Tekian, 1999), were developed at McMaster to increase reliability by testing students on 10–20 cases at a time. The exam may be oral or

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Evidence For and Against PBL

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written. The cases are administered in a 30–60 minute period and only a brief assessment is allowed for each case.

- *Problem-analysis questions,* as described by Des Marchais (as cited in Nendaz & Tekian, 1999), were used first at the University of Sherbrooke. The instrument consists of context-dependent, short-answer questions designed to test a student's ability to "analyze information of a short vignette, generate and evaluate hypotheses, and propose explanations to problems" (p. 235).
- *Standardized patient-based tests.* According to Nendaz and Tekian (1999), this type of test is used most often to assess history taking, physical examination, and interpersonal and communication skills. Standardized patients can be useful in covering a broad spectrum of competences and provide sound psychometric properties if the questions are constructed thoughtfully.

Process-oriented instruments used to assess knowledge and problem-solving skills include learning experiences such as the following:

- *Triple jump exercises* are described by Painvin, Neufeld, Norman, Walker and Whelan (as cited in Nendaz & Tekian, 1999) as activities involving students in discussing a written scenario, identifying the relevant learning goals and regrouping to present a conclusion as well as evaluate their own performance. Problem-solving and self-directed learning skills are assessed for formative purposes. Reliability for use in summative evaluation is limited due to the small number of cases that can be considered under these circumstances.
- *The individual process assessment* has been described by West, Umland and Lucero; Kaufman, Mennin, Waterman, et al.; and Kaufman, Klepper, Obenshain, et al. (all as cited in Nendaz & Tekian, 1999). This instrument was developed at the University of New Mexico to assess the range of activities expected of a physician. Students are videotaped in meetings with standardized patients and assessed on their interpersonal and clinical skills. Students submit write-ups; then discuss learning and scientific issues with faculty.
- *The four-step assessment test,* according to Zimitat and Alexander (as cited in Nendaz & Tekian, 1999), has been used at the University of Queensland in Australia to assess individual knowledge, clinical reasoning and group process. The four steps include: (a) solving a case scenario individually, in writing; (b) repeating the first step in a group and presenting new information (observers score this process); (c) engaging for a time in self-directed learning; and (d) taking a written content examination that evaluates the 10 most important learning issues derived from all groups' answers posted previously on a bulletin board. Zimitat and Alexander report that interater agreement among observers of Step 2—the tutorial process—can exceed 80 percent.
- *Tutor, peer and self-assessment.* Assessment during tutorials can exemplify PBL principles and thus serve as the central focus of assessment in a PBL program. Students "develop the ability to give and receive feedback and to appraise one's own needs" (Nendaz & Tekian, 1999, p. 237). These skills are required in clinical reasoning, self-directed learning, communication, critical thinking and working effectively in a team. These methods "possess psychometric shortcomings that limit their use in high-stake decision making" (p. 237).

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John Harris and his colleagues at Samford are pioneers in using course portfolios to assess student outcomes.

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Nendaz and Tekian (1999) report that clinical skills are generally assessed with the Objective Structured Clinical Examination [OSCE] or a variation of this. Often using standardized patients, the OSCE assesses multiple components in a single setting. Raters are located at different stations, and students move from one to another performing various activities, such as history taking, physical exams and communication skills.

Nendaz and Tekian (1999), whose study was limited to the assessment literature contributed by medical school faculty, concluded that despite the publication by Barrows and others of recommendations and guidelines for student assessment in PBL, there is still a lack of consensus and uniformity in the practical application of these general principles.

Others are beginning to do comparative work on PBL in different settings. There are good examples of this at Stanford and at Samford.

According to Bridges and Hallinger (1996), School of Education faculty members at Stanford have implemented problem-based learning in the Program for Prospective Principals. This program was developed in response to a growing concern over the lack of preparedness of graduates of leadership education programs. Leadership was being taught in abstract terms, and students were often analyzing situations that were not very similar to those they would encounter in daily practice. Bridges and Hallinger believed it was necessary to fine-tune concrete skills, such as conducting a meeting, writing effective memos and managing the emotional side of leadership. Class assignments that included the development and presentation of a strategic plan, or an action-oriented performance that would allow students to experience the consequences of their actions, proved to be valuable components of the program.

Some of the assessment tools employed by Bridges and Hallinger (1996) include:

- Integrative essays in which students discuss what they have learned during a project and how they might use this information in the future.
- Protocols or standards students can use to evaluate their own performance.
- Models or examples of products completed by expert practitioners to compare against their own work.
- Forms students create to elicit feedback from peers concerning their performance.

Bridges and Hallinger (1996) report that during a dean-commissioned internal and external review of the Stanford School of Education's academic programs, the Program for Prospective Principals "was the only one singled out for special accolades" (p. 61). The graduates interviewed as a part of this review mentioned the problem-based nature of the curriculum as a "basis for its excellence" (p. 61).

Samford faculty members are pioneers in using course portfolios to assess student outcomes. In addition to a description of the approach used in the course and a sample

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problem, the portfolios prepared by faculty provide an analysis of empirical evidence of student outcomes and a reflective statement. A content analysis of the latter two sections of the portfolios could provide a rich source of evaluative data in the future as more portfolios become available. Preliminary analysis suggests that Samford faculty members are using classroom assessment and continuous quality improvement techniques to take the measure of the PBL learning environment and applying authentic measures to the assessment of student performance. The evaluative data indicate that PBL students are improving their understanding of content, their attitudes toward working in groups, and their problem-solving and critical-thinking skills.

James Eck and Dea Mathews (2000) at Samford have administered three measures to assess PBL. The Student Attitudes and Activities Assessment asks students how they spend their time and about their attitudes toward classes. The Instructional Landscape Survey was designed to provide information on the types of in-class activities that are being employed in both PBL and non-PBL classrooms. Finally, the End of Course Evaluation asks both PBL and non-PBL students questions about their perceptions of their abilities to solve problems, identify resources and work in teams, among other abilities. In addition, Samford has administered a standardized test, The Collegiate Assessment of Academic Proficiency [CAAP], in an attempt to compare students enrolled in PBL versus non-PBL courses. So far, the CAAP shows no difference in students' critical-thinking skills in these two settings. Eck and Mathews think this might be attributed in part to the inappropriateness of standardized paper-and-pencil tests for assessing PBL. They believe that the three instruments described previously, while assessing learning only indirectly, can help take the measure of the learning process in PBL courses in ways that standardized tests cannot.

Some Positive Aspects of PBL

The most comprehensive and often cited overviews of evaluative work in connection with PBL are the meta-analyses of Albanese and Mitchell, and Vernon and Blake, both of which were published in 1993. These meta-analyses include medical school studies conducted between the early 1970s and the early 1990s. The Nendaz and Tekian (1999) work cited earlier provides a review of the literature on PBL assessment methods and measures being applied in medical education between 1966 and 1998.

Vernon and Blake (1993) used three types of data to compare PBL and non-PBL students on clinical functioning: (a) ratings and tests of clinical performance, often based on observations of behavior with real or simulated patients; (b) tests of clinical knowledge like Part II of the National Board of Medical Examiners [NBME] test; and (c) measures of humanistic knowledge, attitudes and skills from the Harvard New Pathway PBL program. In terms of clinical performance—making judgments about patients—the data consistently favor PBL students, both in the Vernon and Blake and Albanese and Mitchell (1993) meta-analyses. On tests of clinical knowledge, both sets of authors note a small but non-significant trend favoring PBL students. Block, Style and Moore (as cited in Vernon & Blake) report that at the end of the second year of medical school, New Pathway students at Harvard outscored a non-PBL control group of students who had volunteered for New Pathway but had not been selected on the five patient-related skills of "empathy, patient-centered orientation, comfort with emotions, communication skills and data collection" (Vernon & Blake, 1993, p. 557).

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A sample of assessment findings related to Samford University's PBL Initiative can be found on page 12.
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Both sets of meta-analysis authors, as well as investigators in a number of other disciplines as disparate as business, engineering, and nutrition have found PBL students more satisfied with their learning experiences than others. According to Moore, Block and Mitchell (as cited in Albanese & Mitchell, 1993), PBL students at Harvard were more likely to describe their preclinical years in medical school as "engaging, difficult and useful" (p. 63), while students in Harvard's traditional curriculum were more likely to use the terms "irrelevant, passive and boring" (p. 63) to characterize their preclinical experience. Albanese and Mitchell conclude that students enjoy the small group interactions and atmosphere associated with PBL.

Vernon and Blake (1993) have found PBL students more satisfied than non-PBL counterparts with the educational atmosphere generally, PBL curricula and individual courses, and even parts of courses taught using problem-based methods. PBL also seems to increase class attendance and decrease student distress, including "depression, anxiety, hostility and somatic complaints" (p. 554). Albanese and Mitchell (1993), citing a study by Moore-West, Harrington, Menin, Kaufman, and Skipper, observe that "PBL students rated their experience higher in terms of meaningfulness, flexibility, emotional climate, nurturance and student interactions" (p. 62). Vernon and Blake note that,

> Overall, the results of our meta-analyses support the superiority of the PBL approach over more traditional methods in several of the outcome domains examined. With respect to program evaluation, data on student attitudes (from surveys), class attendance, and student mood or distress were consistently more positive for PBL than for traditional courses or curricula. (p. 557)

With respect to the process of learning, Vernon and Blake (1993), citing a study by Entwistle and Ramsden and another by Entwistle, suggest that PBL students are more interested in finding meaning, or understanding concepts, than in reproducing concepts through rote learning and memorization. PBL students also use learning resources differently. According to Rankin (as cited in Vernon & Blake), they make more use of the library; of journals and online searches; and of self-selected, as opposed to faculty-selected, reading materials. They also express more confidence in their information-seeking skills. Apparently, PBL and non-PBL students do not differ in the amount of time they spend studying. In a study by Blumberg and Michael (as cited in Albanese & Mitchell, 1993) both groups were found to average 25 hours a week in study time.

In prioritizing the complex intellectual skills that PBL can promote uniquely, self-directed learning appears high on the list. Blumberg's (2000) analysis of research evidence indicates that both PBL students and faculty perceive PBL to foster self-directed

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learning. Moreover, PBL students see themselves as continuing to improve their self-directed learning skills, including defining what is to be learned, accessing material and studying the material actively. Blumberg describes active learning as a natural outcome of PBL because students are not given the details and information in lectures and must transform the material as given to them to answer their specific learning issues. Blumberg also demonstrates that PBL students are active library users and employ study strategies that produce deep cognitive processing.

A critical feature of PBL is its collaborative structure. Collaboration engages students in cognitive activities that cannot be carried out individually. The social interaction establishes the context in which shared cognition can occur (Faidley, Evensen, Salisbury-Glennon, Glenn & Hmelo, 2000). Faidley et al. suggest "collaboration grounds knowledge within a community of practice (Lave & Wenger, 1991) and serves to model an aspect of professional expertise associated with teamwork and consultation (Eraut, 1994)" (p. 110). Further, Faidley et al. note a new level of self-consciousness that can occur as a way to reflect on both individual and collective activities during and after the construction of knowledge. This is a process referred to by Schon (as cited in Faidley et al.) "as 'reflection-in-action' and . . . necessarily involves learners' perceptions that, as Schunk (1992) concluded . . . can be as important in predicting performance in academic achievement settings as abilities" (p. 110).

According to Rudeen, Oliver and Prewitt (2000), allied health students at the University of Missouri feel that the openness of PBL problems allows them to think more openly and thus be more prepared for solving problems in their clinics. Students also are more apt to seek up-to-date information from reliable resources in a timely manner. Rudeen and his colleagues concur that this openness prepares students to become both lifelong learners and better practitioners of their health specialties.

Albanese and Mitchell (1993), after investigating a number of dimensions of post-graduate performance and satisfaction, have found graduates of PBL programs to be at an advantage in most of the areas, with the exception of basic science preparation. Citing a study by Woodward and Ferrier, Albanese & Mitchell write that "McMaster graduates viewed themselves as better prepared (than their peers) in independent learning skills, problem solving, self-evaluation techniques, data-gathering skills, behavioral science information, and dealing with the social and emotional problems of patients" (p. 64). A study conducted by Post and Drop (as cited in Albanese & Mitchell) found that graduates of other schools perceived that they had developed stronger skills in clinical reasoning, preventive care and humanistic areas.

PBL graduates receive their first choice for residents' positions at least as frequently as non-PBL graduates; a study by Neufeld, Woodward and MacLeod (as cited in Albanese & Mitchell, 1993) has found that 79 percent of McMaster graduates received their first choices as compared with 59 percent for all Canadian graduates. In analyzing their data, Albanese and Mitchell found that ratings given by supervisors to PBL graduates were higher than those given to graduates of traditional curricula.

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There is mounting evidence from studies in science, engineering and business that PBL students do as well on tests of content knowledge as do students in traditional curricula.

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Challenges Facing PBL

In the beginning, the learning curve for PBL students schooled in traditional, positivist approaches is steep. In fact, Stinson and Milter (1996) have found that adapting to PBL is hardest for those who have become most adept at lecture-discussion and assessment that involves recall primarily. Lieux (1996) has surveyed nutrition and dietetics students in her PBL course and her non-PBL course during the same academic year. The perceptions of the non-PBL students mirrored those of PBL students when asked who learned more: both thought the non-PBL students learned more. The PBL students concluded that since they covered less material, they were learning less. Lieux has used the results of these evaluations to change the way she orients students to PBL. If presented with generalizations from research about how students learn, then shown how many of these principles are included in PBL, students develop higher expectations for their learning.

Other authors have shown that students need training in processing skills before they undertake PBL. Woods (1996) provides students opportunities to develop problem-solving, interpersonal, group process and self-assessment skills before encountering PBL activities.

To serve as a framework for interpreting the results of their literature review, Albanese and Mitchell (1993) have organized their meta-analysis in several sections, each guided by its own research question about the outcomes of PBL. Their questions include the following:

1. What does PBL cost compared with conventional lecture-based instruction?
2. Do PBL students develop the cognitive scaffolding necessary to easily assimilate new basic sciences information?
3. To what extent are PBL students exposed to an adequate range of content?
4. Do PBL students become overly dependent on a small-group environment?
5. Do faculty dislike PBL because of the concentrated time commitment required? (p. 55)

Many critics have cited initial and ongoing costs associated with PBL as disadvantages. The studies Albanese and Mitchell (1993) reviewed reveal that there are many factors to consider, such as time commitments of faculty and students, requirements of support personnel, the need for rooms for multiple small group meetings and multiple copies of library materials to support small group investigations. With regard to efficiency of time utilization, Shahabudin (as cited in Albanese & Mitchell) calculated the time needed to cover the same content in a PBL versus lecture-based course. Shahabudin "estimated that it takes approximately 22 percent more time to cover content in PBL (120 weeks by PBL versus 98 weeks by lecture)" (pp. 70–71). Albanese and Mitchell conclude, nevertheless, if there are 40 to 100 students in a class, the cost of faculty time to prepare lectures and give them is at least as much as the cost of tutoring small groups of up to 10.

Eisenstaedt, Barry and Glanz (as cited in Albanese & Mitchell, 1993) compared test performance of second-year medical students in a PBL unit on hematology at Temple University School of Medicine with the performance of medical students receiving material via course lecture.

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Students instructed via lecture had a mean score of 80 percent versus 67 percent for the PBL group. Two years later, however, the two groups earned approximately the same score—with a mean of 68 percent for non-PBL versus 65 percent for the PBL group. Albanese and Mitchell believe that the Eisenstaedt study, along with another study conducted by Coulson (as cited in Albanese & Mitchell), supports the notion that learning is retained longer by PBL students than conventional students. This is based on the fact that PBL students' scores did not decline over time to the same degree as conventional students' scores. Benefits of PBL in terms of developing a continuously improving, lifelong learner ultimately may be deemed sufficiently substantial to outweigh PBL's additional costs. But at the moment, cost remains a serious concern.

Albanese and Mitchell (1993) reviewed several studies addressing the concern that PBL students may not develop the cognitive structures necessary to assimilate new basic science information easily. In a majority of those studies, PBL students scored lower on basic science tests than did their non-PBL counterparts. This was a central concern of some of the medical school faculty at the University of Missouri–Columbia [UMC]. Then faculty members Blake and Parkison (1998) conducted a study to assess UMC faculty physicians' perceptions of clinical performances of students who had completed a new PBL pre-clinical curriculum. The results do not validate the original concern: Just 13 percent of the faculty assessed the students who completed the new curriculum as having inferior knowledge of basic sciences, 30 percent considered new curriculum students' knowledge of basic sciences superior to that of their predecessors, and 57 percent felt that knowledge of the basic sciences was the same in the two groups. Supervisors of the Missouri PBL graduates in clinical settings rated them as competent or more so than graduates of traditional curricula. Due to a variety of issues that must be confronted when doing clinical evaluations, such as the amount of interaction supervisors have with residents and the use of personal and secondary observations, Blake and Parkison conclude that there is insufficient information in the evaluative literature to support or refute the concern about development of cognitive structures. Nevertheless, there is mounting evidence from studies in science, engineering and business to indicate that PBL students do as well on tests of content knowledge as do students in traditional curricula. Perhaps this is becoming less of a concern than it once was.

A related fear is that PBL students will not develop as broad a knowledge of content as they would have with a traditional lecture-discussion format. In medicine, PBL students often rate their own basic science background as weaker and have performed less well on basic science tests, including the NBME Part I exam. While this finding may be due in part to the nature of the measurement process employed, students who direct their own learning may, in fact, learn a narrower range of content because the topics they spend time studying are not considered central by many experts or because they develop misconceptions due to the limited feedback they receive from faculty.

▼ ▼ ▼

More systematic evaluation is needed, based on explicit PBL objectives, using assessment techniques related to the learning outcomes valued by stakeholders in the PBL process.

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However, as the studies by Coulson, Eisenstaedt, et al. (as cited in Albanese & Mitchell, 1993) show, PBL students have greater long-term retention. While traditionally trained students appear to have a broader grasp of content, PBL students tend to retain their more narrowly focused knowledge longer.

Some educators fear that PBL students will become overly dependent on a small-group environment. Albanese and Mitchell (1993) concede that this concern may have merit and note that PBL is often coupled with primary-care curricula, one purpose of which is to increase the supply of physicians in underserved areas—areas where a physician is likely to have little contact with other physicians. Tolnai (as cited in Albanese & Mitchell) found that only about 45 percent of McMaster graduates were working in solo practice or in a rural setting (population less than 30,000). Further, Albanese and Mitchell suggest that while there are multidisciplinary health-care teams, in such a team, members have different roles and responsibilities, and the roles played by members of PBL groups are not predetermined in this way.

Faculty must make an enormous initial investment of time to engage in the background study and preparation necessary to use PBL in a class. Assuming the role of tutor or coach is also very time-consuming. Bridges and Hallinger (1996) note that the success of a PBL environment is dependent upon both faculty attitudes "and faculty actions prior to, during and following a PBL project" (p. 58). They suggest that instructors should develop a vision that rises above "the affective and cognitive turmoil that students experience" (p. 58). Citing their 1995 work, Bridges and Hallinger suggest that they "need to preserve the perspective that for students being lost at sea is part of the journey; not far off, near the horizon, are calmer waters that lead toward the desired destination" (pp. 58–59).

Some have speculated that faculty would not embrace PBL because of the concentrated time commitment required. Evaluative data do not support this contention: Once faculty have had an opportunity to try out the role of tutor, most are willing to repeat their experience, primarily because they enjoy the increased contact with students. McAuley and Woodward (as cited in Albanese & Mitchell, 1993) found that 72 percent of McMaster faculty named PBL as their preferred approach to curriculum, while Moore-West and O'Donnell (as cited in Albanese & Mitchell) published a study in which 95 percent of faculty who had served as PBL tutors said they would do so again. Nevertheless, we estimate that perhaps 15 percent of faculty are not comfortable with PBL, and after the novelty of PBL has worn off, we wonder if faculty will be willing to continue to spend the additional time to support it. In most settings outside medicine, PBL is too new to permit an answer to this question.

Conclusion

PBL is a relatively young methodology. Since it has not been embraced universally in any field and is just beginning to be tried in some, the number of cases where systematic evaluation could be attempted is limited. Given human nature, the inclination to implement, implement, implement, with little attention to the need for evaluation, is great.

Even where PBL has been tried, it is often a piecemeal approach, with some faculty applying it in some courses. In such

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The Samford PBL Initiative Update

PBL 2000 Attracts 663 Participants, Explores Pros and Cons of Movement

by Sean Flynt, freelance writer

One of the most compelling arguments for undergraduate problem-based learning [PBL] is the increasing pressure on higher education to produce competent graduates who have both knowledge and practical skills, according to Russell Edgerton, director of the Pew Forum on Undergraduate Learning. Unfortunately, said Edgerton, "the majority of faculty are still wed to ideas that marginalize teaching" in favor of scholarly research. Respect for scholarly, reflective teaching is growing, however, he suggested.

Edgerton shared his thoughts as a plenary speaker at PBL 2000, an international conference on PBL at the undergraduate and professional level in Birmingham, Alabama, October 29–31, 2000. Samford University in Birmingham and The Pew Charitable Trusts were co-sponsors of the event that registered 663 participants from 30 states and eight countries from as far afield as Australia and Malaysia.

Other speakers hinted at the difficulties universities face in trying to meet the demands for more practical education.

In the keynote address, Lee Shulman, president of the Carnegie Foundation for the Advancement of Teaching, provided an extensive historical and educational context for the evolution of PBL suggesting the concept goes back as far as John Dewey. He cited Jerome Brunner's book, *Learning by Discovery,* published in 1966, in which Brunner argued that learning by discovery would be more engaging, more powerful, and have results that would be more persistent and enduring than learning of the traditional didactic kind.

"I hesitate to say a hung jury, but what was very clear even then [1966] was that this was not a simple question because of the power of the kinds of learning called discovery learning or problem-centered learning," he said. "It varies enormously depending on whom you are teaching, what you are teaching, to what end and in what kind of context," he said.

The varieties of PBL are like penicillin, Shulman suggested. "[PBL is] not like penicillin in that it has a very specific, particular impact on a particular domain of microorganisms [and] the impact is varied. But it's like penicillin in a sense that you or I do not want to go to a physician whose only drug is penicillin."

Wim Gijselaers of Maastricht University, the Netherlands, agreed that PBL is like penicillin in that it can be tremendously helpful, yet fails against "resistant strains" of ineffective teaching. Also, he noted the absence of conclusive evidence that PBL is a significantly better or worse method than traditional lecture.

There is anecdotal evidence, however, that PBL gives both students and faculty more satisfaction even if it does not dramatically improve skills or deepen understanding, Gijselaers claimed. Several speakers said that benefit alone is reason to incorporate PBL in undergraduate education.

Citing cases for and against PBL, Trudy Banta of Indiana University–Purdue University, Indianapolis, explained that evaluations of PBL's effectiveness have focused on medical education. Those studies give the advantage to PBL over traditional methods but can only tenuously be assumed to hold true in other educational contexts.

There are some clear advantages of PBL, Banta suggested, including improved postgraduate performance and satisfaction, reduced classroom stress and more faculty collaboration. She said there simply must be further study to determine how best to implement PBL and objectively measure its effects. "It seems that is part of Samford University's mission," she said.

PBL 2000 was very much a how-to event, with most sessions devoted to specific PBL strategies and the personal experiences of those currently using the method. Appropriately, the conference ended on Halloween with attendees taking home a variety of educational treats.

Dramatic changes in education are like the discovery of new continents, suggested David Chapman, associate dean of Samford's Howard College of Arts and Sciences. "New discoveries may inspire exciting expeditions and interesting stories without really changing the way we live," he said. "The discoverers must colonize the new lands to effect permanent change.

"Samford University is establishing colonies in PBL," he said, noting that the University offers 52 courses that emphasize student ability to solve complex and relevant real-world problems.

Johnnie Rasberry, a doctoral student of education at Mississippi State University, attended to see if PBL could be used to reduce the dropout rates among young African-American men. "Many of these students are dropping out mentally in the fourth or fifth grade and physically a few years later," he said. He sees in PBL's concrete, active and relevant approach to learning "a new opportunity" for engaging troubled students.

Yves Mauffette, a conference presenter from the University of Quebec at Montreal, said PBL 2000 attracted more participants than he had ever encountered in PBL meetings. Also, he said, they were from a diversity of fields and disciplines, which may significantly contribute to the advancement of PBL by demystifying this pedagogical approach.

James Watters of Queensland University of Technology in Brisbane, Australia, noted that he had traveled "halfway around the world" to attend PBL 2000. "I really enjoyed the conference, met some interesting people, identified some key [Internet] sites where PBL is being implemented in my area of interest and brought back a number of ideas to implement in my programs," he said.

Danin Bodnar of the Department of Nursing at Gran MacEwan College in Edmonton, Alberta, called PBL 2000 inspiring and added that it is great that educators are re-examining approaches to learning. The level of interest in PBL and the willingness to share successes as well as limitations was a high point of the conference for Bodnar, who said she would attend a similar conference hosted by Samford. "Further networking is essential," she said. "PBL users/practitioners need to move toward common ground."

Another Canadian, Beverly Williams on the faculty of nursing at the University of Alberta at Edmonton, gave PBL 2000 high marks: "a stimulating, high-energy conference with great opportunities for collegial dialogue!" adding that conference themes—

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Promises, Breakthroughs and Lessons—were evident in all keynote addresses and presentations.

"I was somewhat surprised by the variety of educational practices that have been labeled PBL," Williams said. "It strikes me that if we want to build a credible evidence base for the value and practice of PBL, we need to be mindful about what we label as PBL."

"I was awed by the enthusiasm and desire to learn of the many participants," said Janet Alexander, assistant professor of nursing at Samford. "There was excellent discussion in the sessions I attended and led. I had many who spoke to me afterward about what they had learned and what more they hoped to learn. The comments that I was most proud to hear were from those who appreciated the contributions of my students." ▲

PBL 2000 Gets High Marks for Planning, Organization

Thanks to 307 registrants at PBL 2000 who completed an overall conference evaluation form. Their responses provide further evidence of the success of PBL 2000. On a scale of 1 to 5 (where 1 is poor and 5 is outstanding), attendees, on average, indicated as follows:

- Conference Organization = Very Good (Average 4.2)
- Conference Meeting Facilities = Very Good (Average 4.1)
- Overall Content of PBL 2000 = Very Good (Average 4.1)
- Opportunities for Effective Learning = Very Good (Average 4.0)
- Registration materials = Very Good (Average 3.9)
- Conference timing = Very Good (Average 3.8)
- Birmingham as Conference location = Very Good (Average 3.6)

Selected Comments:

- Great Job! Evidence of excellent planning. Great chance to interact with peers. Atmosphere friendly, helpful and supportive.
- Outstanding! Five stars!
- The friendliness of the staff and presenters was outstanding. I have been to many conferences; this has been one of the most enjoyable.
- Very well organized! Also appreciate the international quality of presentations and participants.
- This was a marvelous conference! I would love to return next year to attend PBL2001.
- Very well organized! Great networking and interdisciplinary discussions.
- Your support team was incredible, friendly, responsive, accessible—a huge asset.
- Excellent planning, nice blend of theory and practice.

Resource Roundup

PBL in Nutrition—Video Review

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Samford University

"Problem Based Learning—A Reasonable Adventure"

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As this 28-minute video begins, we are introduced to Barbara Lohse Knous and her students as she explains the small-group, student-centered educational strategy, Problem-Based Learning [PBL]. This group of students is in a clinical nutrition class at the University of Wisconsin–Stout.

The video follows these students through a PBL introduction, subsequent processing and solving of problems related to medical nutrition therapy and kidney disease. Although these students are in the nutrition/dietetics field, the information shared in the video pertains more to the process of PBL and not the particulars of PBL and dietetics education.

The video alternates between slides of PBL definitions/terms and actual student discussions concerning the PBL process in solving the problem assigned for their course. Some of the PBL informational slides include problem presentation and hypothesis generation, problem introduction, request for additional information through an information order, and identification of learning issues.

Learning issues are defined as a point at which the students recognize their lack of knowledge or information about an issue. After creation of the learning issues, the students embark on the independent study aspect of the course. Students research their chosen learning issue outside of class and report back to their group for further discussion when their research is complete.

The author discusses the role of the group tutor and how to train students to research information and use good resources. After the students have finished their problem and discussed it with the class they are given the objectives and the real plan for their particular problem. Evaluation of students is based on their discussion, journal entries and written products. The exam for the course is referred to as a "Triple Jump" exam consisting of another problem each student individually encounters using the PBL method.

Implementation of PBL as a teaching method is presented, along with tips for presenting PBL to new facilitators. The video concludes with a summary of the concepts of PBL and student opinions and reviews. A booklet that contains nutrition problems, including the one used in the video, accompanies the video. The booklet highlights the problem vignette, the data sheet, an exhibit of the learning issues selected by the students, the actual problem outcome and learning objectives, a sample evaluation protocol and a list of PBL resources.

The video presentation uses a documentary/Power Point slide format that appears to be best suited for introducing PBL to new faculty, facilitators and tutors. The last one-third of the video includes information on how to present PBL to other professionals (not students). The booklet is specifically geared to medical nutrition therapy classes but could also be used as an example problem when introducing problem development and assessment in both clinical nutrition and other courses.

The video plus the booklet are available for $88. Each can also be purchased separately. For more information, contact Barbara Knous via E-mail at KnousB@m1.uwstout.edu or via phone at (715) 232-1994.

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Resource Roundup cont.

Call for Papers:

Journal On Excellence In College Teaching—Special PBL Issue

Manuscripts are solicited for publication in the *Journal on Excellence in College Teaching [JECT],* a peer-reviewed journal published by and for faculty at universities and two- and four-year colleges to increase student learning through effective teaching, interest in and enthusiasm for the profession of teaching, and communication among faculty about their classroom experiences. The *JECT* provides a scholarly, written forum for discussion by faculty about all areas affecting teaching and learning, and gives faculty the opportunity to share proven, innovative pedagogies and thoughtful, inspirational insights about teaching.

Manuscript Preparation Guidelines

Recently, research in the fields of cognitive science, educational psychology and instructional design have shed light on the way people learn and on what pedagogical settings can best promote learning. People learn by establishing and reworking connections, patterns and relationships. Also, direct experience shapes individual understanding.

Students learn best with substantial interaction and personal support. In addition, learning occurs best in the context of engaging with a compelling problem (Ewell, *Change,* 1997).

Problem-based learning, an approach to learning in which problems serve as the context and the stimulus for learning, has received increasing attention in higher education, in part because it is derived from what we know about promoting learning. In October 2001, *JECT* will dedicate a special issue to PBL and invites manuscripts that address the following issues in PBL.

While PBL had its inception in medical schools in the 1960s, many professional and undergraduate institutions are beginning to adopt this method. During this history in higher education, the processes of PBL have evolved and different models have emerged. Papers describing the processes associated with PBL in various instructional settings will make up a section of this double issue. Papers that illustrate the complexity of PBL and that describe its diversity in higher education are particularly welcome.

Research on PBL has moved from comparing PBL outcomes with outcomes in a traditional lecture format toward an examination of PBL as a method. Papers researching PBL assessment and evaluation will be a focus of a section of this special double issue, and papers that address assessment of PBL and what is learned from that work are welcome.

The intended audience for *JECT* is typically undergraduate and college teachers from a wide range of disciplines. This special double issue will feature articles describing the process of PBL, and PBL assessment and evaluation. Manuscripts should be no longer than 4,000 words, including references and appendices.

Accepted for publication will be papers on college and university teaching that demonstrate scholarly excellence in at least one of the following categories:

Research: Reports important results from one's own experience or research; describes a problem clearly; provides baseline data; explains what the researcher has done and why; and provides results and suggestions for future studies in this area.

Integration: Integrates research of others in meaningful way; compares or contrasts theories; critiques results; and/or provides context for future exploration.

Innovation: Proposes innovation of theory, approach or process of teaching; provides original and creative ideas based on results of research by self or others; and outlines proposed strategy for testing effectiveness of ideas.

Inspiration: Provides inspiration for teaching excellence; combines personal values, insight and experience to communicate enthusiasm and dedication to outstanding teaching.

Papers appearing in the issue may be interdisciplinary or specific to one or a group of disciplines, and may address a general or specific audience.

PBL Manuscript Due Date

The complete manuscript is due to the Managing Editor by February 1, 2001.

Review Process

Manuscripts will be reviewed first by the editorial staff. Those that are appropriate for this issue will be sent to at least two members of the special issue review board, experts in teaching scholarship. Additional reviewers will be consulted as necessary. All reviews will be blind, that is, without identifying the author(s) to the reviewers. Reviewers will be encouraged to write comments for the author(s). Editorial feedback and/or reviews will be provided to authors for all manuscripts. Articles may be accepted or rejected outright, or accepted with a request for revision.

Format

Please prepare your manuscript according to APA format as described in the *Publication Manual of the American Psychological Association,* Fourth Edition. The main points to remember are the following:

- ▲ Include an abstract of 100 words or less. See pages 8-11 of the *APA Manual* for guidance on how to write a good abstract.
- ▲ Citations appear in a references section at the end of the manuscript. See pages 174–222 of the *APA Manual* for the formats for different types of reference material. Only and all sources cited appear in the references section. Suggested readings may be listed in a separate bibliography.
- ▲ In the text, sources are cited by author(s) and date, and page numbers for direct quotations. See pages 95–99 and 168–174 of the *APA Manual* for citation formats.
- ▲ Headings, if they are used, are not numbered. See pages 90–93 of the *APA Manual* for guidance concerning headings.
- ▲ The proper physical appearance of the manuscript is described on pages 237–48 of the *APA Manual.*
- ▲ Many reviewers tell us tables, figures and charts are effective ways to replace dull text, and examples and stories help capture the reader's interest.
- ▲ When you describe new approaches and programs, please include evaluative information.

Submission Requirements

Submit to the Managing Editor all of the following documents:

Hard copies:

- ▲ three copies of the cover sheet (see the *JECT* Web site)
- ▲ three copies of your complete manuscript
- ▲ three blind copies of the manuscript that omit your name and any reference to your institution

Disk copies:

- ▲ one file with cover sheet information
- ▲ one file of your complete manuscript
- ▲ one blind copy file that omits your name and any reference to your institution

Use Rich Text Format (RTF) and a 3.5" diskette.

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Evidence For and Against PBL

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settings, PBL does not receive the fair hearing it deserves. Albanese and Mitchell (1993) conclude that "PBL has produced some very positive outcomes" (p. 78) in medical schools where evaluative studies have been undertaken. But some questions remain about the adequacy of student preparation using this approach. These authors suggest that further study should be directed toward finding "an optimum balance of teacher-directed and learner-directed instruction, what cognitive processes are developed by PBL, and what methods of PBL are less costly" (pp. 78–79), particularly for class sizes of more than 100 students.

Systematic cost-benefit studies are among the most-needed evaluations because the benefits are becoming clearer and clearer, but are increases in the quality of student learning worth the extra costs in faculty and student time, facilities, etc.? Answers are needed because we all know that cost is often used to kill a good program.

More systematic evaluation is needed, based on explicit PBL objectives, using appropriate assessment techniques related to the learning outcomes valued by stakeholders in the PBL process. Nendaz and Tekian (1999, p. 240) provide sound recommendations that include the following:

1. Enhance formal continuous formative evaluation, particularly with instruments that promote self-directed learning.

2. Use the context of a working problem to assess knowledge and problem-solving skills. Recognize that PBL represents diverse ways of learning and knowing and therefore should utilize diverse methods of assessment.

3. Prevent negative steering effects for students by the judicious choice of assessment content, instruments and timing. Students learn what will be on their tests; the form and content of assessment instruments influence what they study and what they learn. Students decide how they will study and what they will learn, so they should also be involved in determining how they will be assessed.

4. Implement a longitudinal and centralized student academic profile. Test scores over time provide an academic profile that can be used to make decisions about promotion or needed remediation.

5. Nendaz and Tekian further argue that because there is no single best choice assessment method, "triangulation of diverse instruments is required to obtain a fair judgment about students" (p. 240).

6. Because such a wide range of assessment instruments is already available, they recommend that efforts concentrate on coming up with the right combination of existing instruments rather than on developing new ones. They suggest that "even though the assessment methods have been evaluated individually . . . the value of each of them must be considered not only as an individual tool, but in the context of the integral educational strategy an assessment program offers" (p. 238). We don't know nearly enough about how our old methods of testing work in this new learning environment.

Ernie Boyer (1990) taught us to value the scholarship of teaching right alongside the scholarship of discovery, of integration and of application. The scholarship of teaching is defined as a "dynamic endeavor involving all the analogies, metaphors and images that build bridges between the teacher's understanding and the student's learning" (p. 23). Boyer further suggests that "teaching at its best involves not only transmitting knowledge, but transforming and extending it as well" (p. 24). If those who believe in PBL would pledge to add an evaluation component to their plan for implementing PBL, and to share their findings with colleagues, then five years from now, we would have some answers to current questions about which approach works best with which students under what circumstances. Perhaps Samford faculty can provide the forum that will give the opportunity to bring everyone up to date on PBL work in the years to come.

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A Sample of Assessment Findings Related to Samford University's Problem-Based Learning Initiative

James C. Eck, Director of Institutional Research, and Dea G. Mathews, Institutional Research Analyst, Samford University

Introduction

Problem-Based Learning [PBL] efforts have expanded, in part, because educators, administrators and policy makers are calling for a change in the way that teaching and learning happen in undergraduate education. Many studies have suggested that this change needs to take place because American students are ranking lower than students in other areas of the world in mathematical problem solving and scientific knowledge and comprehension (Lapoint, A., Mead, N., and Phillips, G., 1989). Furthermore, keen critical-thinking skills and problem-solving ability are demanded by today's marketplace (Levine, 1989). At the core of PBL is the integration of specific courses and classroom contexts for enhancing students' critical-thinking skills and for developing both a collective and independent ownership of knowledge.

This article reviews four instruments that were used as part of Samford University's PBL assessment efforts. The Student Activities and Attitudes Assessment [SAAA] and the End of Course Evaluation [ECE] were used to determine the effectiveness of PBL at the university, college and course level. The Instructional Landscape Survey [ILS] was developed to depict the current state of our university's instructional landscape and to compare the extent to which students and faculty were experiencing courses similarly. A standardized test developed by ACT, the Collegiate Assessment of Academic Proficiency [CAAP], was also used to assess the level of critical thinking attained by students in PBL versus non-PBL courses.

The Collegiate Assessment of Academic Proficiency [CAAP]

The Collegiate Assessment of Academic Proficiency is a critical-thinking test that is used to measure a student's ability to clarify, analyze, evaluate and extend arguments. The CAAP test is a standardized test consisting of four passages that are representative of the kind of issues commonly found in a college curriculum. Each passage presents one or more general arguments and uses a variety of formats, including case studies, debates, dialogues, overlapping positions, statistical arguments, and experimental results or editorials. This 32-item, 40-minute, multiple-choice test was administered to entering freshmen at the beginning of the 1998 fall semester and at the end of the 1999 spring semester. No differences in critical thinking emerged between PBL and non-PBL students. We also administered the CAAP to entering freshmen in the 1999 fall semester. Because of the sequencing of PBL courses, we re-administered the CAAP at the end of the fall semester rather than waiting until the end of the 2000 spring semester. Again, no differences in critical thinking emerged between PBL and non-PBL students. Because CAAP was developed to measure gains in critical thinking that occur during the first two years of college, our post-test assessments may have occurred too early to recognize gains. We would also maintain, however, that standardized tests, such as CAAP, may not be best suited for estimating gains related to PBL.

Student Attitudes and Activities Assessment [SAAA]

Samford University developed the Student Attitudes and Activities Assessment that measures both student attitudes toward classes and how they spend their time in the course. At the beginning and end of the 1998 fall term, PBL and non-PBL students responded on a five-point Likert scale (values included strongly disagree, disagree, neutral, agree and strongly agree) to 17 attitude statements. Examples of attitude statements included "I value different points of view," "I enjoy writing multiple drafts of papers" and "I enjoy making oral presentations." Students' attitudes toward their courses were generally neutral and remained neutral regardless of whether the course was a PBL section or a traditional section.

At the end of the 1998 fall term, PBL and non-PBL students also responded on a four-point scale (values included never, occasionally, often, very often) to 27 activity statements. Examples of activity statements included "I worked cooperatively with other students on course assignments," "I spent at least five hours or more writing a paper" and "I wrote a rough draft of a paper and then revised it myself before turning it in to the instructor." Among the 27 activity statements, differences between PBL and non-PBL students emerged on four statements. These four statements included the following: "There are multiple opportunities to work in groups," "Our group received useful feedback from the instructor throughout the semester," "I interacted with my instructor as part of this course" and "I interacted with students outside of class." On each of these four statements, students indicated that the activity occurred more often as a part of PBL courses than students enrolled in traditional courses. Because the SAAA did not provide any further insights regarding our PBL Initiative, the measure was not repeated in the fall of 1999.

Instructional Landscape Survey [ILS]

Samford University also developed the Instructional Landscape Survey to gauge ongoing activities in PBL versus non-PBL courses. The survey consists of 29 classroom activities, and faculty responded based on a 5-point scale (values included never, rarely, sometimes, often and very often). Classroom activities included whole class discussion, writing activities, small-group discussion and lecture. In the fall of 1998, approximately 100 faculty responded to the ILS. These faculty responses served as a measure for evaluating the terrain of the instructional landscape prior to the infusion of PBL. Faculty indicated that traditional activities such as whole-class discussion, exercises or problems determined by professor, question-and-answer (professor asking most questions and students answering), exercises or problems completed by individual students, and full lecture were most prevalent. Prior to PBL implementation, games/simulations; role-playing activities; guest speakers; lab work

continued on page 13

within local organizations, businesses and schools; and service-learning projects occurred least often. Although it will take a period of at least a few years, we will use the instructional landscape survey to assess the extent to which PBL has changed the teaching and learning environment for both students and faculty.

Realizing that the instructional landscape of an institution cannot change overnight, we continued to use the ILS in the fall of 1999 with a slightly different focus. In 1998, only faculty responded to the ILS. In the fall of 1999, both faculty and students responded to the ILS. While we had gained information from students (SAAA) and faculty (ILS) about classroom activities in 1998, we decided to ask both faculty and students to respond to the same survey to estimate the correlation between faculty perceptions and student experiences. Generally, the correlations suggest that students and faculty are experiencing courses in a similar fashion. After sufficient time has passed to investigate instructional landscape differences between PBL and non-PBL courses, we will re-administer the ILS to both faculty and students to identify changes occurring in our University's instructional landscape.

The End of Course Evaluation [ECE]

The End of Course Evaluation was distributed in the fall terms of 1998 and 1999 to students enrolled in all PBL courses and a sample of non-PBL courses. The following six statements utilized a 5-point Likert scale with values of strongly agree, agree, no opinion, disagree and strongly disagree:

- This course increased my ability to solve real-world problems.
- This course encouraged me to consider alternatives when solving problems.
- This course improved my ability to identify appropriate resources.
- This course increased my ability to work effectively on a team.
- This course encouraged me to take an active role in my learning.
- I have used knowledge and methods drawn from outside this course to complete my course assignments.

Assessment findings indicate that for both years, PBL students were more likely than non-PBL students to agree with the statements posed on the survey. Hence, students may have attained higher levels of learning with PBL than with non-PBL courses.

Summary

Effective assessment efforts are based on multiple longitudinal measures. Our data suggest that standardized tests may provide little, if any, information about differences in PBL versus non-PBL approaches to teaching and learning. We have developed, therefore, three additional measures that are designed to address PBL head-on. Each measure suggests that PBL is having a positive impact on student learning at Samford University. Over time, we anticipate that our understanding of PBL and its outcomes will mature and our measures will improve. Meanwhile, as we revise our assessment measures, we will need to work closely with other institutions that have incorporated PBL in their curricula to develop valid and comprehensive PBL assessment measures that are criterion sensitive. ▲

References

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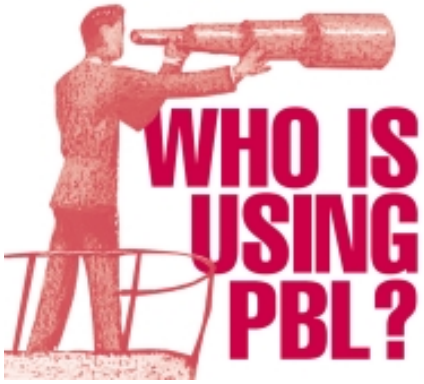

If you are currently using Problem Based Learning [PBL] in your undergraduate courses, or if you know of someone at your institution who is using PBL in undergraduate education, please contact us. We are very interested in learning about your efforts and about PBL at your institution.

Please contact Valerie McCombs via E-mail (pbl@samford.edu) or regular mail at the following address:

Valerie McCombs, Assistant Editor
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PBL Insight Online

Download the newsletter from our Web site

http://www.samford.edu/pbl/

Undergraduate Institutions with Faculty Members Using PBL

United States

Allegheny University; Philadelphia, Pa.: Public Health
Aurora University; Aurora, Ill.: PBL courses provided by the Illinois Mathematics and Science Academy
Belmont University; Nashville, Tenn.: Humanities, Philosophy
Bloomsburg University; Bloomsburg, Pa.: Speech Pathology
Butler University College of Pharmacy; Indianapolis, Ind.: Pharmacy
California State University—Bakersville; Bakersville, Calif.: Education
Clarkson University; Pottsdam, N.Y.: Health Science, Physical Therapy
Clemson University; Clemson, S.C.: Computer Science, Engineering
Crichton College; Memphis, Tenn.: Biblical Studies
Florida State University; Tallahassee, Fla.: Education
Illinois State University; Normal, Ill.: PBL courses provided by the Illinois Mathematics and Science Academy
Itawamba Community College; Fulton, Miss.: English, Biology, Computer Technology, Economics, Science, Mathematics, Electronics, Nursing, Respiratory Therapy
Ivy Tech State College; Terre Haute, Ind.: Science and Mathematics
Kutztown University of Pennsylvania; Kutztown, Pa.: Health Studies
Maricopa Community Colleges; Tempe, Ariz.: PBL materials for several courses
Mitchell Community College; Statesville, N.C.: Biology
New College of University South Florida; Sarasota, Fla.: General Biology, Methods in Field Ecology, Biogeography, Genetics, Invertebrate Zoology
Northeastern Illinois University; Chicago, Ill.: Educational Psychology
Piedmont Technical College; Emerald Road, S.C.: Engineering Technology
Quinnipiac College; Hamden, Conn.: Physical Therapy, Occupational Therapy
Rose-Hulman Institute of Technology; Terre Haute, Ind.: Engineering
Samford University; Birmingham, Ala.: Arts and Sciences, Education, Business, Nursing, Pharmacy
San Diego State University; San Diego, Calif.: Education
Southern Illinois University, Carbondale; Carbondale, Ill.: History
Stanford University; Stanford, Calif.: Engineering
Texas Tech University; Lubbock, Texas: Nursing
University of Alabama at Birmingham (School of Nursing); Birmingham, Ala.: Nursing
University of Colorado at Boulder; Boulder, Colo.: Medicine, Life Sciences
University of Connecticut; Storrs, Conn.: Engineering
University of Delaware; Newark, Del.: Biology, Biochemistry, Chemistry, Criminal Justice, Education, International Relations, Marine Studies, Mathematics, Nutrition/Dietetics, Physics/Science, Political Science, Exercise Science
University of Denver; Denver, Colo.: Business
University of Minnesota; Minneapolis, Minn.: Civil Engineering
University of New Hampshire; Durham, N.H.: Nursing
University of North Carolina at Chapel Hill (School of Nursing); Chapel Hill, N.C.: Nursing
University of South Carolina; Spartanburg, S.C.: Mathematics
University of Texas—El Paso; El Paso, Texas: Education
University of Texas Houston Health Science Center; Houston, Texas: Nursing
Utah State University; Logan, Utah: Education, Technology
Washington University; St. Louis, Mo.: Biology, Biomedical Sciences
Western Wisconsin Technical College; LaCrosse, Wisc.: Respiratory Therapy

Australia

Deakin University; Geelong, Victoria: Physical Education
Flinders University of South Australia; Adelaide, South Australia: Nursing
Griffith University; Nathan, Queensland: Nursing
LaTrobe University, College of Northern Victoria; Bundoora, Victoria: Science Education, Nursing
Monash University; Clayton, Victoria: Civil and Mechanical Engineering
New South Wales College of Law; Kensington, New South Wales: Law
University of Adelaide; Adelaide, South Australia: Architecture
University of Melbourne; Parkville, Victoria: Macroeconomics
University of Newcastle; Callaghan, New South Wales: Medicine, Nursing, Occupational Therapy, Architecture
University of New South Wales; Sydney, New South Wales: Social Work
University of South Australia, Underdale; Underdale, South Australia: Nursing
University of Southern Queensland; Toowoomba, Queensland: Education, Technology, Nursing
University of Sydney; Sydney, New South Wales: Programming, Computer Science, Education
University of Sydney, Cumberland College; Lidcombe, New South Wales: Health Sciences, Community Health, Physiotherapy
University of Technology, Sydney; Sydney, New South Wales: Architecture, Electrical Engineering
University of Western Sydney, Macarthur; Macarthur, New South Wales: Faculty of Health
University of Wollongong; Wollongong, New South Wales: Law

Belgium

Université Catholique De Louvain; Louvain-la-Neuve: Engineering

Canada

McMaster University; Hamilton, Ontario: Chemical Engineering, Medicine, Nursing, Physical and Occupational Therapy, Humanities/Globalization
University College of Cape Breton; Sydney: Arts and Sciences
University of Alberta; Edmonton, Alberta: Nursing
University of British Columbia; Vancouver, British Columbia: Civil Engineering
University of Montreal, Québec; Montreal, Québec: Biology
University of New Brunswick; Fredericton, New Brunswick: Forestry
University of Ottowa; Ottowa, Ontario: Health Sciences, Nursing

Denmark

Aalborg University; Aalborg, Denmark: Humanities, Social Sciences, Sciences, Engineering

Hong Kong

The University of Hong Kong; Hong Kong: Medicine, Dentistry, Speech and Hearing Sciences

The Netherlands

Delft University of Technology; Delft: Faculty of Architecture
Maastricht University; Maastricht: Arts and Culture, Business, Education, Medicine
Auckland Institute of Technology; Mt. Albert: Integrated Business Studies
The Open Polytechnic of New Zealand; Lower Hutt: Applied Science, Business

Sweden

University of Karlskrona; Karlskrona: Computer Science and Business Administration

United Kingdom

Aberdeen University; Regent Walk, Aberdeen: Teacher Training
Anglia Polytechnic University; Nursing
Bell College; London: Nursing
Birmingham University; Egbaston, Birmingham: Dentistry
Bournemouth University; Poole, Dorset: Nursing
Brighton University; Brighton: Nursing, Physical Therapy
Brunel University; Uxbridge, Middlesex: Occupational Therapy
Cardiff University; Occupational Therapy, Physiotherapy, Speech Therapy
City University; London: Occupational Therapy, Nursing
Coventry University; Coventry: Mechanical Engineering, Electronic Engineering
Dundee University; Dundee, Scotland: Nursing, Medical
Glasgow University; Mechanical Engineering
Glasgow Caledonian University; Scotland: Nursing, Vision Sciences
Imperial College; Scotland: Nursing, Vision Sciences
Leeds University; Leeds: Various projects related to work-based learning.
Manchester Metropolitan University; Manchester: Management and Business
Napier University; Edinburgh, Scotland: Health Studies, Nursing
Newcastle University; Newcastle upon Tyne: Medicine, Speech Therapy
Paisley; Paisley, Scotland: Nursing
Portsmouth University; Portsmouth: Business
Robert Gordon University; Aberdeen: Computing, Nursing
Southampton University; Southampton: Nursing, Medicine
Strathclyde University; Glasgow: Mechanical Engineering, Health Sciences
Thames Valley University, Wolfson Institute of Health Sciences; London: Nursing
University of East London; London: Architecture
University of Lincolnshire and Humberside; Law
University of Liverpool; Liverpool: Medicine
University of Luton; Luton: Nursing
University of Manchester; Saford: Medicine
University of Warwick; Coventry: Academic Staff Development

PBL Portfolio Peer Review

Mini-Grant Application (also available at www.samford.edu/pbl)
Samford University
Supported by a grant from The Pew Charitable Trusts

The Samford University Center for Problem-Based Learning [PBL] is soliciting applications from prospective portfolio developers for the first round of PBL Portfolio Peer Review mini-grants. Each mini-grant is $750. If you are not currently using PBL in your teaching but plan to incorporate it soon, you may participate in a later round of submission. Portfolio reviewers will include experts in the academic disciplines and instructional design including PBL. Submissions from individuals who have incorporated PBL into their teaching for more than one semester will be given priority. For consideration in the first round of portfolio peer review, please complete this form, confining your responses to the space provided. To receive full consideration for the initial round, you must complete and return this application to Dr. Kristi Arndt, Director, Center for PBL, Samford University, 800 Lakeshore Dr., Birmingham, AL 35229 by **January 31, 2001.** Online applications may be submitted at www.samford.edu/pbl. We will notify you shortly thereafter regarding the acceptance status of your submission. If you are primarily interested in applying for the second or third round, complete the contact information and items 1 and 2 only.

Name _____ Title _____

Address _____

City _____ State _____ Zip_____

Institution _____ Phone _____ Fax _____

Department_____ E-mail _____

1. Select the opportunity you are most interested in:
____ First round (complete this application; if selected, submit portfolio by July 31, 2001)
____ Second round (complete application in 2001; if selected, submit portfolio in fall of 2001)
____ Third round (complete application in 2001; if selected, submit portfolio in spring of 2002)

2. Indicate the category that best fits the PBL portfolio you are developing. If your PBL implementation involves a discipline that is not listed or involves integration across several subject areas, select "other" and describe.

❒ Business	❒ Nursing
❒ Education	❒ Pharmacy
❒ Fine Arts	❒ Physical Science
❒ Humanities	❒ Social Science
❒ Mathematics	❒ Other (describe): _____

3. Which percentage best represents the amount of time spent on PBL-related activities in the course or instructional unit?
❒ 100% ❒ 75% ❒ 50% ❒ 25% ❒ less than 25%

4. Identify and briefly describe the PBL instruction you will portray in your portfolio. Include the format of PBL and any of the following as appropriate: name and duration of course or instructional unit, its relationship to the overall curriculum, typical number and level of students, individually taught or team taught, etc.

5. Are there others who teach similar material in the same or other courses? If yes, list the course(s) and indicate whether PBL is currently being used.

6. How long have you been using PBL in this particular course or unit of instruction? Was this a new course or revision of an existing course? If a revision, describe the previous method(s) used.

7. When and how did you learn about PBL? What PBL experiences have you had outside of your own classroom (e.g., meetings, workshops, visits by consultants, etc.)? If possible, identify specific meetings, workshops or consultants.

8. Why are you using PBL? What goals and objectives do you have for your learners?

9. Which of the following methods do you use to assess student learning and development? Check all that apply.

____ Essay examinations
____ Lab practical examinations
____ Performance evaluations
____ Projects
____ Self assessment
____ Faculty assessment of students in group
____ Other (describe):_____

____ Objective item examinations
____ Problem-solving exercises
____ Reflective journals
____ Portfolios of student work
____ Peer assessment of other students in group
____ Assessment of group as a whole (teamwork)

10. Is your institution likely to consider the PBL instructional portfolio as evidence of scholarly work in promotion and tenure decisions? If yes, what evidence do you have of this?

For more information, contact the Center for Problem-Based Learning at Samford University:
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