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Problem-Based Learning: Lessons From Medical Education and Challenges for Management Education

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The call for greater emphasis on relevant skills in the preparation of business and management majors spans several decades, but progress remains elusive. For example, the Porter and McKibbin report (1988) was accepted as ground shaking at the time; however, it seems that the ground has not shaken very much since. Critics suggest the need for greater emphasis on development of relevant management skills appears just as evident today as it was decades ago (Mintzberg, 2004; Rubin & Dierdorff, 2009). Problem-based learning (PBL) is an approach to education focused on skills development (Savery, 2006). In an effort to understand PBL's potential as a pedagogy, the first part of this article briefly reviews its use in medical schools, the arena of professional education in which PBL has its longest and most widespread use. In the second part, we draw upon medical school experience, research literature, and personal experience with PBL to identify and discuss seven critical challenges in applying this approach to skill building in managerial education.

> *"A former student told me the first thing his boss told him his first day on the job: 'Forget everything you learned in business school. Now you're going to learn how things are done in the real world.' That bothered me as a business professor. Would a hospital administrator say that to a brand-new medical doctor?"*
>
> —(Boone, 2013)

Management education needs more emphasis on skills development (Thompson & Koys, 2010; Klimoski & Amos, 2012; Boyatzis, Stubbs, & Taylor, 2002; Dierdorff, Rubin, & Morgeson, 2009; Rousseau, 2006; Rousseau & McCarthy, 2007; Rubin & Dierdorff, 2009; Pincus & Rudnick, 2013; Association of American Colleges and Universities, AAC&U, 2013). Even though the call for greater emphasis on skill building in business education has echoed throughout academia for decades (e.g., the Porter and McKibbn report of 1988), there has only been incremental movement in the recommended direction.

A review of the literature reveals several catalogs of critically important skills, but it also documents our failure to adequately develop most of these in our students (Pfeffer & Fong, 2002; Mintzberg, 2004).

Several studies have consistently identified key skills needed by graduates for successful career entry. They include effective written and oral communications, critical and creative thinking, leading, problem solving, personal continuous learning skills, information literacy, and ethical problem solving. These are confirmed through various studies, for example: the American Society for Training and Development (ASTD) and U.S. Department of Labor study (Carnevale, Gainer, & Meltzer, 1990); the Canadian study on skills for employability (Evers, Rush, & Berdrow, 1998); the National Association of Colleges and Employers study (Coplin, 2003); the global achievement gap study by Wagner (2010); and the Association of American Colleges and Universities study (2013). In addition, the O*Net database (United States Department of Labor, 2013) provides career-related data for 974 occupations, including itemizations of the knowledge and skills needed for specific job categories. This extensive database has been used to demonstrate the gap in skill development in management education. For example, Rubin and Dierdorff (2009) used 52 managerial occupations in the O*NET database to analyze MBA curricula. They found the essential managerial skills needed to effectively prepare students for managerial careers were not evident in typical managerial programs. Thompson and Koys (2010) reached a similar conclusion when they found that over 50% of jobs requiring a BBA or an MBA in the O*NET database required skills such as active listening, critical thinking, time management, speaking skills, monitoring skills, using judgment, coordination, negotiation skills, and skills to select, develop, motivate, and direct employees.

Therefore there is a documented gap between the skills needed for many business and management careers and those acquired during a student's academic career. Problem-based learning is one promising approach focused on integrating skills and knowledge in an academic setting. It has roots in medical education for almost 50 years with demonstrated effectiveness.

PROBLEM-BASED LEARNING (PBL): BACKGROUND

Problem-based learning (PBL) is a pedagogy specifically created for the integration of content knowledge and skill development. Although varied, most definitions of PBL share the common characteristics summarized by Barrows (1996)—they begin with a problem to guide the learning, are learner centered, view the instructor as a facilitator, utilize collaborative small groups, and employ self-directed learning and reflection to acquire new knowledge in a process exemplified in Figure 1. The essential defining characteristic is learning structured around an ambiguous and complex problem in which the professor becomes a facilitator supporting and guiding students in their attempts to solve a real-world problem. The PBL process develops critical thinking and problem-solving skills, problem synthesis skills, imagination and creativity, information search and evaluation skills, ability to deal with ambiguity and uncertainty, oral and written communication skills, and collaboration skills.

We first explore PBL's use and success in medical education, the professional arena in which PBL has seen its most extensive use. We then discuss challenges in applying PBL in business schools.

PBL in Medical Education

Of all the professional schools employing PBL, medical schools have the longest history and the most careful assessments of its results. We agree with Simon (1967) when he argues medical schools offer a useful model for management and other professional schools. We briefly review the use of PBL and its results in medical schools before turning to the challenges of applying the pedagogy in business education.

In 1899, William Osler was the first educator to bring medical students into the hospital environment for a hands-on approach to medical training, the foundation for PBL (Dornan, 2005; Camp, 1996).

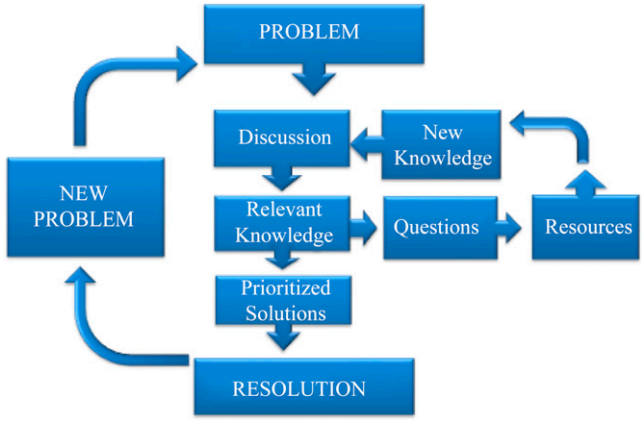

FIGURE 1
Example of the Problem-Based Learning Process

PBL first took root and rapidly grew after World War II. This era was roiled by the confluence of rapid development of new, and often costly, medical procedures, the emergence of new, and little understood diseases, and the daunting increased volume and shrinking half-life of medical knowledge. Recognizing that these challenges required effective acquisition of both knowledge and skills, in 1969, a group of medical educators launched an innovative problem-based learning (PBL) approach to medical education at McMaster University in Canada (Barrows 1985). Their new curriculum focused on a problem-solving process characterized by (1) learning in small groups of students, (2) the use of real patient problems and simulated patients, and (3) a systematic and centrally controlled approach to the organization and management of the program. Success with the program quickly brought widespread adoption of the approach beginning in 1974 with Maastricht University in the Netherlands, Newcastle University in Australia in 1978, and the University of New Mexico in the United States in 1979 (Hillen, Scherpbier, & Wijnen, 2010).

For those unfamiliar with PBL, the following provides an example of how students might experience PBL in a medical diagnosis course. The first day of class, instead of receiving a lecture, students are given a problem such as, "A mother with her infant daughter has come into the office and indicated that the child was experiencing repeated spikes in temperature and, during which, she became lethargic. What sorts of questions would you ask this parent in order to determine the patient's medical history?" The class session would focus on the development of a list of questions that should be asked of the mother and why those questions are relevant. The students would also note the information they have, the information they need, and possible sources of information. They would set a plan of action and identify needed resources. The subsequent class would provide the students with the answers to medical history of the mother and child and focus on the additional information gathered and potential new questions identified. Given these, the students would identify a set of procedures (tests) to help diagnose what may be wrong with the patient and why these tests are relevant. The third class would focus on any new symptoms that appeared and a set of results of the test requested in the previous class, leading to further testing of the patient or to a plan of treatment, and explanations of why these actions were appropriate. The outcomes of the plan of treatment would contribute to the process, and future classes would focus on additional problems in a similar fashion.

The rapid spread of PBL in medical education is testimony to its widely recognized effectiveness in developing better doctors (MacDonald, 1997). For example, Harvard Medical School planned a long-term controlled experiment to evaluate PBL, but after the first semester its use as a successful experience was so evident and compelling that the control group was dropped, and PBL was solely used (Tabbara, personal communication, Nov. 4, 2012). Several authors have chronicled the characteristics and features of successful PBL in medical education. Duch, Groh, and Allen (2001) described specific skills developed in PBL, including the ability to engage in critical thinking; to analyze and solve complex, real-world problems; to identify effective learning tools; to utilize communication skills, and to engage in a process of continuous learning. Schmidt and van der Molen (2001) observed that learners who experience PBL often have a stronger clinical orientation. In a systematic review of 102 institutions where 13 met the inclusion criteria of controlled trials, Koh et al. (2008) reported that PBL had a positive effect on most physicians' competence after graduation in regard to social and cognitive dimensions. Vernon and Blake (1993) concluded that PBL was equal to traditional approaches in terms of scores on medical board examinations and superior in the demonstration of better clinical problem-solving skills.

Despite this body of research, some scholars remain cautious about the use of PBL at the expense of more traditional educational pedagogies. For example, Newman (2003) noted inconsistencies in various PBL approaches when he reported that "the limited high quality evidence available from existing reviews does not provide robust evidence about the effectiveness of different kinds of PBL" (p. 7).

One's position on traditional education versus problem-based education seems to hinge on the relative value one places on mastery of content knowledge versus development of practical skills. In an extensive review of PBL, Albanese and Mitchell (1993) noted that graduates of problem-based medical programs sometimes report a lack of confidence regarding their content backgrounds compared to those who completed a traditional program. Neville (2009) in a review of several meta-analyses reported that the effect of PBL on knowledge depends "on whether one combines application of knowledge

with factual recall or separates the acquisition of knowledge from knowledge application" (p. 7). While this debate continues, it is worth noting that medical educators continue to "vote with their feet" as the use of PBL in educating medical professionals continues to expand—a trend has caught the attention of some faculty in management education.

PBL in Management Education

Compared to medical education, there is a relative paucity of research of PBL in managerial education (Hmelo-Silver, 2004). There is evidence that PBL supports the need to engage students, a key element in improving learning outcomes and student satisfaction (Dean & Jolly, 2012; Hallinger & Lu, 2011). Advocates have supported the use of PBL as a means to increase student engagement (Godfrey, Illes, & Berry, 2005). Koh et al. (2008) reported that PBL had a positive effect on competence in social and cognitive dimensions. Neville (2009) reported moderate to strong levels of support for PBL in a meta-analysis of four competencies related to clinical practice: (1) coping with uncertainty, (2) appreciation of legal and ethical aspects, (3) communication skills, and (4) self-directed continuing learning (p. 9).

Drawing upon their firsthand experience with using PBL to educate business professionals, Stinson and Milter (1996) reported:

> We now have more than ten years' experience implementing problem-based learning. While some may still have concerns about the effectiveness of the process, we do not. Rather, our concerns center on the implementation of problem-based learning. Inappropriately used, problem-based learning will not lead to robust learning (p. 37).

We concur: PBL offers an important complement to pedagogies focused on imparting content knowledge. The issue is not that one is better than the other, but how both can be done well (Varanelli, Baugher, & Hall, 2001). The goal is to integrate instructional approaches with different strengths to maximize student learning outcomes, including competent performance in real business.

Placing PBL in the Broader Curriculum

So, how does PBL fit alongside other more common business school pedagogies, such as lecture and discussions and case studies? Is PBL to be part of a larger course, the basis of its own course, part of a major, or cut across an entire program? As advocates of PBL, we might encourage broad application. However, our enthusiasm is tempered by experience, suggesting the need to see PBL as a pedagogical tool to complement or substitute other pedagogies as needed to achieve learning goals. Simon (1967) suggested that "almost every curricular area can be organized so that practical management problems are rubbed up against economic and psychological theories and mathematical techniques—and conversely" (p. 13). The extent of its use needs to be matched to learning priorities and organizational realities regarding the institution's culture, processes, and commitment.

In the calls for greater emphasis on skills development, nothing suggesting emphases on content knowledge is wrong or should be wholly replaced. In fact, as we discuss below, content knowledge is an essential form of preparation for PBL. Likewise, we do not see PBL as a replacement for its better-known relative, case-based learning (CBL). The major difference between the two is that CBL provides cases that have solutions; whereas PBL provides problems that are yet to be solved. CBL provides a safe environment in which to take risks; whereas PBL provides a risky environment with a safety net. PBL provides more skill development in high-performance team work and in building structure within an unstructured environment; whereas CBL provides a more structured environment for the team with much of the material needed to make a decision embedded in the case. In short, we see the need for a blend of pedagogies—lecture and discussion, CBL, and PBL—in most business schools, and in Table 1 we highlight the strengths of each.

However, the blending of pedagogies is only a part of the challenge in bringing PBL to the curriculum: PBL, itself, must be developed with care to ensure that it can be an effective force in achieving student learning outcomes. We now focus on some of the important key issues in developing an effective PBL experience.

ISSUES IN EMPLOYING PROBLEM-BASED LEARNING (PBL)

Our varied personal experiences with PBL convince us there is no one set of universally applicable guidelines for making PBL work. Rather, there must be high-level administrative support for the change

that PBL requires. Also, faculty involved must tailor their efforts to the particular situation they face to customize the learning experience to the kinds of content and skills they want to develop. In the sections below, we look at the seven key issues in implementing PBL depicted in Figure 2. For each issue, we explore options faculty face and propose examples and guidelines intended to aid them in making the most appropriate trade-offs. This discussion begins with a focus on the first key issue, the scale and scope of the PBL experience.

Scale and Scope

A team of faculty members interested in bringing PBL into a curriculum will need to consider the question of scale and scope in relation to the achievement of identified student learning outcomes. For instance, the multidiscipline team approach required to implement PBL at a program-wide level or multicourse level requires the program be organized collectively, with each discipline surrendering some autonomy to create the sort of "controlled chaos" experience PBL entails. Hillen et al. (2010), in a chronology of the development of PBL at Maastricht University in the Netherlands, reported that their preexisting interdisciplinary central organization of the curriculum allowed for the easy identification and resolution of issues, especially in regard to quality and quantity of instruction, and performance standards for the disciplines.

In our experience, team design and governance can be stymied by stressing the individual faculty member's academic freedom, concerns about insufficient representation of specific disciplines, increased requirements of faculty time for coordination and collaboration, and inflexible administrative structures. Therefore, it is important that institutions considering PBL analyze their unique culture to determine the commitment and feasibility of faculty and administrators' adjustment to the requirements of PBL in the selection of scale and scope for their program and courses. This is essential for the success of its implementation.

An example is the challenge faced by Ohio University faculty as they developed and implemented an MBA-wide PBL curriculum (Stinson & Milter, 1996). This 2-year program was characterized by a series of nine residencies. The program centered on eight projects focused on large macroproblems that address business holistically. To provide this sort of program, faculty had to collectively agree on the eight problems forming its basis, allocate time across disciplines, ensure that essential discipline-specific content was somehow woven into the eight problems, sequence delivery of content to fit the needs of students trying to solve the problem as well as the needs of faculty trying to ensure a logical sequence of content specific to their individual topics, and agree upon and administer an integrated evaluation and grading scheme. Such shared responsibilities are in sharp contrast to the sentiment that "professors rule their courses" prevalent in many

TABLE 1
Contrasting the Three Most-Common Means of Learning in Business

Education	Lecture/Discussion-based learning	Case-based learning	Problem-based learning
Instructors' role in learning	Instructor presents fact-based lectures to students; can teach very large numbers of students.	Instructor guides students in analysis of prepared case; usually works with multiple groups (size varies) of students.	Instructor facilitates student immersion in problem; usually works with multiple groups of approximately 4–8 students.
Relative strengths	Knowledge and concepts conveyed in familiar format and setting.	Exposure to broad range of settings in controlled and convenient format.	Skill development by addressing problems in their natural settings.
Costs and efficiencies	Relatively low instructor preparation; may lend itself to economies of scale through its use with large-size classes.	Additional cost incurred in preparation or acquisition of cases; typically taught in moderate–small classes.	Extensive set-up costs with every class or project; typically delivered in smaller classes broken into teams.
Complementary aspects	Provides factual knowledge and theoretical concepts that can be drawn upon in cases or problems.	Provides skill development and practice in controlled, low-risk environment.	Provides skill development and practice in live business environment (range from low to high risk) with no previously established solution.

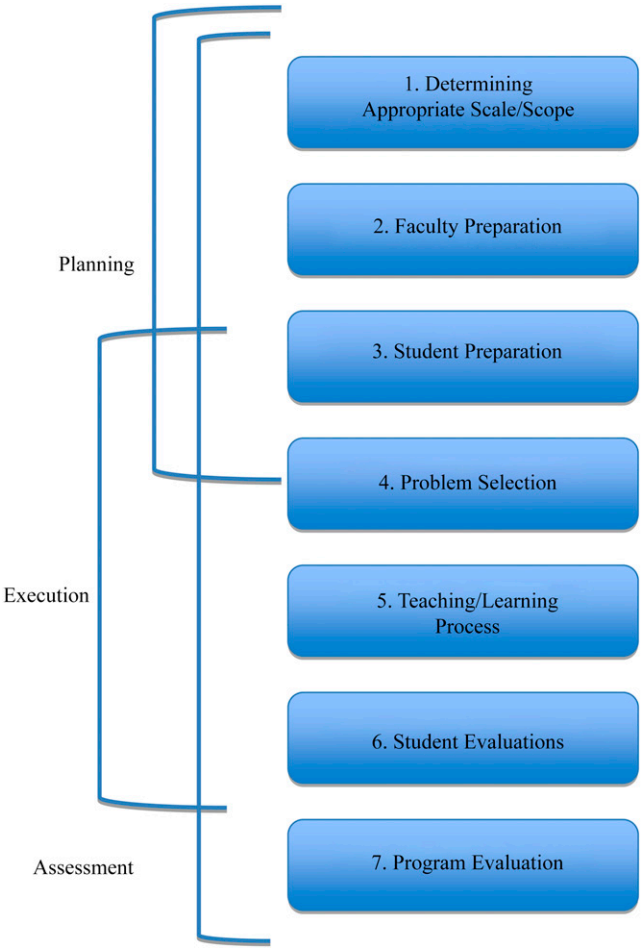

FIGURE 2
Issues in Employing PBL

schools. The evolution of PBL at Ohio University resulted in an MBA that integrated content courses with PBL. Pace University studied and adapted the Ohio University model when it ventured into the use of PBL (Varanelli, Baugher, & Hall, 2001).

Another example was when the University of Tennessee MBA program adopted PBL as the core of its pedagogy program-wide. It required the faculty to invent entirely new processes for collaboration, planning, and consensus decision making. The faculty created a "pit" process in which anyone proposing a session in the program had to stand before the participating faculty to justify the session's inclusion. Approval required consensus of the whole, in which "100% of the team members are at least 70% comfortable with the proposal." Frequently, experts in one area needed to make a case for the inclusion of content, a significant departure from the norm of faculty members having virtually uncontested authority over the content of their courses. This created some challenges in developing a single 12-hour required course for the first year, particularly when a new faculty member replaced an experienced one. Eventually, faculty worked through many of the issues facing collective planning and governance and gradually modified their approach to PBL.

Their early experience with PBL convinced faculty of its potential, and today there is still pervasive use of PBL at the University of Tennessee. Now PBL takes place at the individual course level. For example, for the past several years, all MBA students take a required course built around work as consulting teams engaged by executive directors of local nonprofit organizations on problems selected by the nonprofit and the faculty overseeing the course, and recently, this course has been adapted for use in a new undergraduate course.

Our advice to faculty considering PBL is to balance the costs and benefits incurred by moving to broader applications of PBL. There are benefits to be had at the broadest levels of scale and scope, as PBL is designed to align with the achievement of student learning outcomes, evidence of which is required for accreditation (e.g., see Association of American Colleges and Universities, 2013). However, a smaller effort made available to a greater number of students may be a logical approach to those just starting on a PBL journey. There are important gains to be made by adopting PBL at any level, and, especially when first starting out, it may make more sense to focus on narrow applications, starting with a single course, or even a single module in a larger course, and expanding the scale and scope as the organization is ready. Scale and scope is one key issue, with faculty preparation as the second significant consideration.

Faculty Preparation

None of the authors have ever met a business-school faculty member who has had significant formal training in PBL; any expertise typically comes from some mix of informal mentoring and learning by trial and error. In other words, faculty members preparing themselves to teach using PBL will probably manage the process personally. What issues will they need to address?

A roadmap is the best place to start any journey, and our hope is this article and its 7-part model will provide at least a high-level map of the various territories to be crossed. But, beyond the overall roadmap, when it comes to what can be done to

personally prepare for the challenges ahead, we see a pair of critical issues to address.

First, the faculty member must become comfortable in dealing with ambiguous, real-world problems for which there are no ready answers. PBL is messier than teaching textbook knowledge and engaging in case-based learning. Students often come across genuine dilemmas, unfamiliar challenges, and "unknowables" that can be disconcerting to accomplished and seasoned faculty. Our suggestion for such colleagues is to reframe their expectations. Self-discovery is important in this process. The faculty member needs to guide the process with the right questions and suggest useful approaches to dealing with situations where building student maturity and competence calls for them to critically think, problem solve, negotiate, and communicate.

The toolbox for PBL instructors needs to include the critical thinking skills, logical analytical frameworks, content resources, and group-processing techniques suited for discovering answers. Having these tools available allows us to be comfortable saying, "I don't know the answer," because we can follow that statement up with "but I have some good ideas on how to approach the question." This shift in our role as faculty members goes hand in hand with a shift in emphasis from our teaching to students' learning skills.

Second, faculty members who want to incorporate PBL in their teaching must have a good source of industry or organization contacts to select varied problems. We are reminded of a colleague at a well-respected university, serving on a faculty development committee, who made the comment, "Sure it would be nice to invite executives to campus to interact with our faculty, but we don't know any executives, and even if we did, they would not be interested in working with us." This colleague would find PBL very difficult.

Faculty who regularly engage their students in working on "live" problems from the world of business need a network of business contacts they can draw upon. And, to ensure that students in PBL will benefit from these interactions, the network will need to be large enough to allow the faculty member to pick and choose from multiple options, since not all practitioners make equally good teaching partners. To facilitate this, we have found it useful to network and collaborate with various centers across our universities. For example an alumni center, an internal clearinghouse, and centers focused on entrepreneurship, tech transfer, family business, and nonprofits have all provided the authors with useful and interesting problems for our students. Although faculty members need to prepare differently, students need to understand that their class experience and expectation will change under a PBL environment. Deliberate student preparation is the third key issue significant to an effective PBL learning experience.

Student Preparation

Although there are exceptions, very few students will come to management education classes prepared for PBL unless there is an intentional effort to prepare them. PBL has been adopted in a few U.S. middle and high schools (see, New Tech Network, 2013; Buck Institute for Education, 2013) with reports of success (Ravitz, 2010). But these schools are still the exception rather than the rule, and the typical student will benefit from efforts to prepare for a type of learning they are likely to find new and very different from their previous experience.

A pedagogy based on delivering content through lectures offers a certain comfort for both students and instructors. There is a structure, a set of norms clarifying expectations, and a linearity to the process missing from PBL (the instructor teaches certain facts and the students then indicate that they know them through some sort of testing). By comparison, PBL looks hectic, disorganized, and even chaotic. Unless students are prepared for this difference, they may be distracted by unnecessary anxiety and feel they are not learning anything, since they cannot recite the long lists of concrete ideas typically conveyed in lecture-based learning (Michaelson, Peterson, & Sweet, 2009).

In our experience, preparing students for PBL entails blending it with complementary pedagogies and carefully managing student expectations. We know of very few cases in which students engage in PBL without first—or simultaneously—being exposed to relevant content knowledge through lectures and discussions. We also have found that case-based learning is a useful middle ground, offering a great way to transition from straight lectures and discussion to PBL.

DePaul's Integrated Marketing Education program exemplifies this sort of preparation (L. Hamer, personal communication, spring 2013). The department had a traditional lecture approach for most of its classes, but also exposed students to case studies in several courses. To manage student expectations, the nontraditional nature of the

program was explained before students enrolled and reinforced early during their participation in the class. The program was defined in the catalog with the following:

> The real world focus of IME (Integrated Marketing Education) is an outgrowth of DePaul's strong links to the Chicago business community. Instead of a series of classes that address a single marketing function, the IME curriculum features courses that address marketing issues in the way that managers are likely to encounter them. The stage is set for life-long learning in the marketing profession (DePaul University, 2014).

Admission to the program was competitive and entailed an interview. During this, the students were briefed about the nature of the course, including its emphasis on less-traditional approaches to learning, the approach to the evaluation of their performance, and the potential challenges they might experience. Selection was based on students' maturity, determined by responses in the interview and by previous coursework. There needs to be a clear understanding that a PBL framework is designed for skill and knowledge development in an environment alien to most students. PBL requires students to be active participants in their education, and their education includes harder to measure skill development. The problem *is* the vehicle to create this more complex learning, so the choice of the problem is the fourth key issue critical to the success of a PBL effort.

Problem Selection

By definition, the foundation of problem-based learning is the problem. Get the problem wrong, and the viability of the entire endeavor is in question. For many of us in our delivery of more traditional courses, we did not have to worry much with the choice of problems. Our role was to prepare students to be future problem-solvers; we provide the knowledge and tools, and the real world provides the problems after the students leave campus. But in PBL, the instructor shoulders the burden of bringing the problems onto campus and into the classroom.

Obviously, the problem needs to develop and draw out the expertise associated with the particular course or program; a course on international management needs to involve problems related to international firms and their operation. The best problems are often those striking a compromise on several dimensions. They are neither overly complex nor trivially simple (varied with the scale and scope of the PBL effort as discussed above). Ideally, a problem is big enough and complex enough to engage the complete team of students and reduce opportunities for social loafing (Comer, 1995). But, the problem needs to be doable within the scope of the program, semester, or course in a typically crowded curriculum, and tractable enough to be meaningfully addressed by students within the allotted time frame. Faculty will often choose common problems over extremely arcane or specialized problems; say, working out a production schedule for a small manufacturing firms rather than a hospital's operating room. Finally, many of us feel it is important to engage a client organization wrestling with a strategic problem and an executive-level champion willing to work with the students to address it, as this opens up previously unavailable possibilities for student learning and skill development.

Below is a sampler of problems at the center of some of our most successful semester-long PBL efforts:

- Should an industrial caterer purchase a residential caterer business?
- How best might a manufacturer partner with an upstream supplier to create a single-source business-to-business solution for customers?
- How can an investment firm improve its accuracy in submitting change orders on investments?
- What combination of metrics and scorecards should a nonprofit charter school adopt?
- What earned-income opportunities hold the most promise for a local zoo?
- How might a manufacturer design its packaging to make its electric lawn care products more appealing to women?

While preparation is a big part of a successful PBL intervention, what goes on in the class is also a key issue that can ensure the effectiveness of the PBL approach.

Teaching–Learning Process

Instructors need to prepare to efficiently manage the PBL process. So much of success with PBL boils down to the mundane issues of logistics and administration. Depending on the scale and scope of the PBL effort, the work entailed in managing it varies from incidental (you describe a problem

being faced by a company, and you ask the class to spend part of a session brainstorming options) to extensive (multiple teams each engage to address different problems with different companies in a course-long, semester-long, or even program-long assignment). As the scale and scope expands, it becomes more critical for instructors to be prepared with a system for efficiently managing the effort. Otherwise, the time required can simply overwhelm the best of intentions, and we have often seen colleagues back away from PBL because of the time and effort required.

There is a clear inflection point in the relationship between the scale of PBL problems and the amount of work required to manage them. When the project entails an outside client organization paired with the student teams, the work takes on an additional and significant layer of complexity. In these situations, the instructor must do much of the prework to ensure there is a commitment by the outside client organization to provide the necessary information to the students and opportunities to engage with the students as the project unfolds. This sort of engagement typically depends on the organization finding real value in the student project and assigning an executive to champion it. In our experience, this begins with the faculty member establishing clear performance expectations between the client organization and the students, and the faculty member closely monitoring the project's progress to ensure the delivery of the expected value to sustain the relationship.

Table 2 provides a framework we have found useful in building the systems we use to efficiently manage PBL efforts that fall toward the middle of the range of possible scale and scope, such as a single class involving three or four teams of students engaged with different organizations on different problems. With group work and PBL focus on skill development, an effective measurement of student learning is the sixth key issue.

Evaluating Students

One form of feedback students respond to best is a grade, and a carefully designed and explained grading system can focus the learning process and improve its effectiveness. Evaluating and grading students in PBL is often a very different process from that commonly used in more traditional courses, which involves two major challenges. First, PBL is messier than more traditional pedagogies, and second, skill development is a more slippery outcome to measure than knowledge capture.

In a traditional lecture-based course, instructors typically know the right answer to problems they present to their students, so grading is relatively simple; the answer is either correct or not. In PBL, there are many possible right answers and many partially right answers that may lead to a more complete answer. In addition, there are many paths to those complete answers. The instructor may wish for the students to explore as many paths as will be useful in solving the problem because of the learning opportunities this affords. At the same time this complex system of possible paths and solutions can lead students down blind alleys and dead ends, which may frustrate and discourage, but it can also lead to the acquisition of important skills or the synthesizing of new problems. How does one assign a grade in such messy, confusing, and varied situations?

Also within this messy context, how does one best assess the extent to which skills are being developed? This is an important goal, since much of the value to be had from PBL is based on the skill development opportunities it provides. Skill development has been measured as attitudinal changes through self-report measures (e.g., New Tech Network, 2013; Buck Institute for Education, 2013; Decker, Brown, Vosahlik, Higginbotham, & Wilson, 2010) and by peer assessments (Peterson, 2004). The instructor bases both approaches on perceptions of participants rather than more verifiable measures. We typically address this at least partially by using outcome measures, such as an evaluation of a final report. While these may reflect analytic and organizational skills, they may also miss other important interpersonal and leadership skills developed as part of the PBL process.

Given the several and varied challenges in grading PBL work, a multitrait, multimeasure approach seems appropriate. Faculty need to establish criteria, scoring guides, and benchmarks to measure both team and individual student learning and performance (Ungaretti, Chomowicz, Caniffe, Weiss, Johnson, Dunn, & Cropper, 2009). In our experience, most instructors using PBL will blend assessments, such as those evaluating the quality of the finished report, the quality of the approach or methodology used to address the project, the contributions to the team, and the knowledge and skills demonstrated.

One option for use in this blended approach is the other activity points (OAP) system designed to

TABLE 2
Examples of Questions That Shape an Efficient Delivery of PBL

Managing expectations
• What documentation will be provided to client companies explaining their roles, obligations, and the sorts of deliverables they can expect?
• What documentation will be provided to students explaining what they can expect from the instructor and the client organization, and what sort of deliverables they will be expected to produce?
• What is the process for resolving unexpected issues that will inevitably arise?
Developing a statement of work
• Will the instructor work with the client organization to establish the problem statement, or will students do this as part of their assignment?
• Will the instructor provide a boilerplate statement of work to help ensure consistency across student efforts?
• Will the instructor ensure that the client organization identifies a champion to serve as the students' contact and liaison?
• What will be the response when students and clients are partway through the term and discover a new, more exciting problem they want to pursue instead of the original problem?
Managing student engagement
• What is the level of effort, and how will the instructor monitor student and client effort?
• Will the instructor be present when students engage with client organizations, or will they go alone?
• What will be the process to address dysfunctional teams?
• Will the course rely upon a master plan or generic framework all students use, or will each project be unique?

Note. Assumed scale/scope of PBL effort: A "midrange" effort in which student teams in a single class each engage with different "client organizations."

deal with some of the messiness of PBL by either encouraging continued exploration or to redirect problem-solving behavior to more potentially fruitful paths of exploration (Peterson, 2004). The approach awards points for unexpected activities that helped move the PBL process along, and it deducts points for actions that inhibited the process.

For example, a recent team working in a PBL class realized it would be beneficial for their client, the team, and other stakeholders (in this case the instructor) to get together so everyone knew each other better and also so everyone was clear on the plan for addressing the agency's challenge. Therefore, the team invited all the stakeholders to dinner. This activity was not part of the assigned problem, but it clearly moved the project forward in an effective manner. To encourage the team to continue to build strong relationships with all stakeholders and to encourage the open communication that was fostered by the dinner, other activity points (OAP) were awarded to signal the positive affect of this behavior.

Another team started turning in detailed minutes from their team meetings to include action items different team members were assigned. The minutes allowed the instructor to see the inner workings of the team and to encourage the continuation of this behavior, OAPs were awarded.

On the other hand, in the same PBL class, another team found themselves entangled in an ethical dilemma around a cash contribution to an agency that was questionable in how it had been obtained. Since the team was not completely open about how the contribution had been obtained, a potential ethical situation was created, and it tarnished the reputation of the team because they were not transparent and forthcoming. In this case OAPs were deducted to send a clear message that this type of behavior was not acceptable.

In using OAP, the focus in grading is not on answers or outcomes, but rather on the interactions within the group in keeping a messy process moving in a positive direction. If skill development is a fundamental goal of a particular PBL effort—and it almost always is—then this needs to be a priority in grading. Peer assessment can be done using multimeasures comparative perceptual data, but it may also be desirable to assess skills with more tangible evidence, such as behaviors exhibited. Regardless of the method used, there is value in not waiting to the end of the course to use them. We see benefits from an assessment during the process so that individuals assessed will have an opportunity to learn from the assessment and make improvement before the end of the class.

Continuous improvement should be the part of every course and every program, so the seventh and final key issue is how to develop a process to define the desired outcomes of a PBL approach, track the outcomes, and analyze the outcomes and make improvements in the approach. We advocate a comprehensive approach to program analysis in using PBL or not.

Evaluating Programs

Beyond evaluating students, faculty members have a responsibility to assess learning that occurs in any program. A thorough treatment of program evaluation is beyond our scope here, but given our focus on PBL, it is important to consider the special challenges of assessing a program intended to deliver skills development as opposed to just imparting knowledge. Consider the following two programs, which have successfully gone beyond evaluating knowledge delivery to also assess skills development outcomes for successful career placement.

The University of Wisconsin–Stout, a Baldrige recipient (National Institute for Standards and Technology, 2013), tracks the following outcomes related to its degree programs:

- Percentage of students with a job in their desired area at graduation.
- Students' salary level in their positions when hired.
- The students' job position and salary after 5 years.
- Alumni surveys that assess how well the program meets their career requirements.
- Surveys of hiring organizations to assess their satisfaction with both skill and content knowledge of those hired from the University.

The University of Wisconsin–Stout (2013) uses the information gathered to drive changes in its programs and improve the alignment between what the participants in the program are learning and what is required for the careers they will be entering, with a heavy emphasis on skills development. While the first three items provide the outcome measures of success of the program, the last two items can provide a source of data that indicates where the gaps in learning in the program may occur. The close ties that Stout has to those who provide careers to the students help Stout to focus on the content and *skills* that the students need. Tracking these key performance indices (KPIs) helps Stout to keep current with needed student preparation.

DePaul University, in a similar fashion, used the O*Net database to identify knowledge and skills needed for the types of jobs and careers targeted by DePaul's programs. Surveys were sent to recent graduates to determine the type of jobs graduates held. Respondents were also asked to rate "how important specific skills or knowledge were on the job" and "how well DePaul prepared you to use those skills or knowledge" (Thompson & Koys, 2010). Survey results helped the faculty team monitoring the program to better align it to the needs of DePaul graduates and the organizations hiring them. Similar information from surveys of the immediate supervisors of DePaul graduates was used. In addition, using the O*Net database compared to careers that alumnus have or student aspired to provided cogent direction for program improvement. The results indicated significant gaps in the skills DePaul was providing its students. The resultant increase in skill training has begun through a hybrid of traditional and PBL learning by individual efforts, although a more comprehensive approach would lead to more significant improvements. Having a better understanding of the career needs of students through actual market assessment is important in exposing the need for PBL as well as for providing a marker of its success.

Examples such as these suggest rigorous program assessments will often lead to a more balanced blend of knowledge delivery and skills development, and this more balanced approach will often entail greater use of PBL. These sorts of assessments are exactly what the Association of American Colleges and Universities (AAC&U) is emphasizing in its more recent standards and what are being reflected in the learning assessment trend that has gone on for the past decade. They are also evident in the maturation of the assessment approach of AACSB and the Higher Learning Commission (HLC). These assessments also provide a source of information to further advance our knowledge of improving the efficacy of a PBL approach. Finally, they reflect a scholarly, evidence-based approach to teaching that is focused on asking questions to discover and apply new knowledge to advance management education.

RESEARCH QUESTIONS TO ADVANCE PBL

We have provided a framework of some of the most basic issues involved in PBL and discussed these issues drawing upon our personal experiences, the experiences of others, and the literature on PBL.

While this may provide a useful starting point for instructors seeking to employ PBL, we would like to identify some of the more interesting questions arising from our work for those who might be interested in advancing the research on PBL. As stated above, we feel it is appropriate to move beyond the question of whether PBL is effective, to instead focus research on how to make PBL more effective. Below is a sampler of research questions that could advance that cause, organized using the three major elements of our framework depicted in Figure 2:

Preparation

- Are overall learning outcomes better under sequential or parallel delivery of content knowledge and PBL?
- What cultural shifts and high-level administrative support are essential for effective implementation of PBL?
- What skills are gained from broad-scaled PBL efforts that cannot be gained from more narrow efforts or cases?
- How steep are the faculty and student learning curves for PBL? Can big gains in student and faculty abilities come from even a limited use of PBL and, if so, what is the tipping point where gains occur?

Execution

- What elements of PBL's value proposition are most appealing when recruiting organizations to participate?
- What level of commitment is required of the client organization to be valuable to students' PBL experience? What are the critical roles required of the champion from the client organization to ensure student success?
- What are the most common points of failure in delivery of PBL?
- How much time does it typically take to manage PBL efforts of a given scale?
- What faculty and administration commitment is required to support PBL?

Assessment

- What is the valence and impact of faculty feedback to students versus client feedback to students in PBL?
- In a multitrait, multimethod approach to assessing PBL, how correlated are evaluations by students, faculty, and outside participants?
- Are the assessments of student learning outcomes in PBL valid and reliable?
- Will recruiters pay higher starting salaries for students from programs emphasizing greater skills development from pedagogies such as PBL?

These questions provide a glimpse of the rich platform that PBL offers management education to explore, examine, and advance effective instruction.

In closing, as Dierdorff, Nayden, Jain, and Jain (2013) stated about graduate management education, but could apply to all management education,

> Why would someone pursue graduate management education? Why would organizations seek to hire those with graduate management degrees? What are the implications of graduate management education for society at large? Such questions are fundamental to the ultimate purpose of today's schools of business (p. 24).

An effective management education includes content and *skill* development. PBL provides an approach that can effectively address the needed skills of graduates. We have presented how PBL has been an effective approach for medical education. We shared its ability to address skills demanded of management graduates that cannot readily be addressed through lecture and discussion and CBL.

PBL is not without its issues. We have tried to present seven critical challenges in the use of PBL. We have provided lessons learned and important elements to consider when considering it. In addition, we have considered the difficulty in assessing skill improvements in an individual and the need to have better measures of overall program outcomes for both content and skill measures. PBL is a great tool to enhance student learning and engagement. It provides another dimension to effective pedagogy. It provides skill development through interaction with real problems that have no preestablished answers. PBL can be an effective approach to providing a competitive advantage to those institutions that care about the full development of their students. The importance of this higher level of knowing is reflected in the following quotes:

> *"Tell me and I forget, teach me and I may remember, involve me and I learn."*
>
> — Benjamin Franklin

> *"Any fool can know. The point is to understand."*
>
> —Albert Einstein

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