USING PROBLEM-BASED LEARNING TO DEVELOP SKILLS IN SOLVING UNSTRUCTURED PROBLEMS

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This article describes my efforts to improve student skills in solving unstructured problems in a junior-level undergraduate business course by employing a problem-based learning (PBL) design. A rationale for adopting a PBL approach for this course is articulated. A 7-step problem-solving model is then presented. The course's design is described, including its learning outcomes, PBL projects, associated learning activities, and methods of assessing learning. Finally, student reactions and evidence of learning are discussed. The article concludes by raising a related issue: If graduates possess skills in solving unstructured problems, will businesses be receptive to their use?

Keywords: *PBL; problem-based learning; unstructured problem solving; undergraduate business; model; course design; impact on business*

In a study of organizational decision-making, Nutt (1999) concluded that one half of the decisions studied failed because managers were hasty and cut corners on important steps of the decision process, including problem definition, diagnosis, setting of objectives, identification of alternatives, and implementation. Perhaps recognizing that decision making is problematic, employers have identified problem solving as an important skill for business graduates. In a 1994 list of what every undergraduate should have learned, our college's advisory council ranked decision-making ability as third in

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JOURNAL OF MANAGEMENT EDUCATION, Vol. 28 No. 5, October 2004 591-609
DOI: 10.1177/1052562903257310
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importance in a list of 24 items. More recent reviews of the skills employers identify as important for graduates also point to problem solving as a skill that not just business graduates but all university graduates should possess (Bigelow, 2002; Jones, 1998, p. 1).

When asked what skills are important for their careers, recent graduates of our undergraduate business program consistently point to problem solving. In a 1998 survey, our 1994-1996 graduates ranked defining and solving problems as third in importance in a list of 17 learning topics. The same survey was given to our 2001 graduates, who again ranked problem solving as third in importance.

In 1994, the topic of problem solving was regarded by our college's faculty as well covered. In a survey conducted that year of the time faculty spent on 34 topics in the undergraduate program, the amount reportedly spent on problem solving and judgment was far greater than for any other topic. The assumption seemed to be that if faculty were spending time on a topic, learning would take place.

In 2001, our college began an ongoing process of annual outcomes testing of our near graduates. The purpose is to determine their ability to demonstrate the learning resulting from our undergraduate core curriculum. The college's Outcomes Assessment Group develops tasks that are considered representative of those that graduates will carry out in their careers, and these tasks are assigned to students in the capstone policy course. An evaluation team of faculty and businesspeople is convened once a year for a daylong workshop to assess the results.

The first workshop took place in January 2001. A finding that was immediately apparent to faculty and businesspeople alike was that students had difficulty dealing with problems, particularly if the problems were poorly structured:

> Students dealt very poorly with unstructured problems, usually ignored ethical and legal issues even in cases where the evaluation team felt they were important, and seemed reluctant to use financial and accounting data to back up assertions or justify proposed actions even though such justification is considered crucial in most business situations. By "unstructured problems" the evaluators meant problems whose solutions may involve using knowledge, skills, and abilities from several different areas and in which students are not told beforehand exactly which approaches are to be used. (Core Improvement Team, 2001, p. 1)

Although our college is continuing in its effort to improve students' problem-solving abilities, we quickly decided to redesign the Introduction to

Management course (MGMT 301) so as to place more emphasis on solving unstructured problems.

The Problem-Based Learning Approach

Problem-based learning (PBL) is "a method of instruction that uses problems as a context for students to acquire problem-solving skills and basic knowledge" (Banta, Black, & Kline, 2000, p. 1). Moreover, as Sasse, Davis, and McConnell (2000) pointed out, a PBL approach can also develop team and lifelong learning skills—skills our college has also identified as important (p. 1).

Through its 1960s incorporation of PBL into its medical school, McMasters is widely acknowledged to be the earliest large-scale adopter of a PBL approach at the university level. Several universities have since made extensive investments in PBL, including Samford University, the University of Delaware, Universiteit Maastricht, Aalborg University, Temasek Polytechnic, and the University of Newcastle.

To this point, however, relatively few business schools have adopted a PBL approach. In 2001, Samford's *PBL Insight* periodical listed 106 higher education institutions with faculty members using PBL (Anonymous, 2001, p. 14). Of these, only six were listed as incorporating PBL into business courses. Several universities have incorporated PBL into their MBA programs; for example, at Ohio University (Stinson & Milter, 1996), Pace University (Varanelli, Baugher, & Hall, 2001), the University of Derby, the Australian National Graduate School of Management, Cardean University, the University of British Columbia, Universiteit Maastricht, Universite De Reims, the University of Hong Kong, and the University of Newcastle.

PBL courses are based on problem domains such as diagnosing a patient, solving an engineering problem, coming to terms with social issues, or managing a business. MBA programs usually focus on macro scale domains that concern the organization as a whole; for example, financial analysis, planning, and policy formulation. Because MBA-level problem solvers tend to be working largely from documentation—much of which is publicly available—and have time to research and consider, this macro domain is well suited for developing PBL-based classroom designs.

The problem domain that our college is concerned with is more micro in its scope. It has to do with problematic situations that our undergraduates can expect to encounter in their careers. These situations are likely to be ill structured, in that issues may exist but not be pointed out, and multifaceted, in that more than one issue may be in play. For example, political, ethical, productiv-

ity, and financial issues may exist concurrently and interdependently. Typically, the micro problem solver must not only come up with a solution but also initiate action to make the solution a reality.

A PBL approach seems promising for preparing people to deal with problems of the type encountered in this micro domain (Copland, 2000). In addition, Kearny (2000) suggested that a PBL approach improves retention of learning—another concern identified in our outcomes testing (p. 2). At present, however, only a few educators are using a PBL approach in this area (e.g., Kolb, 1999; R. Purser, personal communication, 2002; Whelan-Berry & Marshall, 2001).

Problem-Solving Steps

Because problem solving is central to PBL, it is first necessary to clarify what is involved in this activity. Duch, Allen, and White (1998) portrayed problem solving in a PBL context as a cyclical process in which students are presented with a problem and engage in a cycle of defining, researching, teaching, summarizing, and integrating learning issues (p. 3). Torp and Sage (1998) extended this process to include generating possible solutions, determining the best fit of solutions, presenting the solution, and debriefing the problem (p. 34). Stinson & Milter (1996) pointed out the need for an additional step in which students incorporate learning into a global framework (p. 38). Jones (1998) polled faculty members, employers, and policy makers to determine important problem-solving outcomes. He concluded that "problem-solving is a complex thinking process that involves multiple dimensions or phases" (p. 10) and provided an extensive list of problem-solving activities.

After reviewing problem-solving literature, our MGMT 301 faculty developed a 7-step problem-solving process. These steps are listed in a rating sheet, shown in Table 1.

The following steps of this model depart from the steps commonly associated with PBL in several ways:

- Step 1: The notion of a problem is replaced with issue raising and objective setting. Nutt (1999) pointed out that identification of problems can lead to defensiveness and efforts to blame others, whereas focusing on what is to be accomplished encourages people to look for answers (p. 75). An emphasis on issues opens up the possibility of capitalizing on opportunities, even when no problems are discernable. Moreover, issues/objectives are more readily related to the later steps of choosing alternatives and following up a solution, making integration of problem-solving steps easier.

TABLE 1

Solving Unstructured Problems: Rating Sheet v.2.3:
Leadership Skills: Individual and Collective Problem Solving

Problem Solver (Team/ Individual name): Problem:

Step	*Rating Criteria*	*Rating*[a]	*Comments*
Step 1: Situational alertness and issue raising	1. Lists important issues in situation (include any issues identified during Step 2 below). 2. Considers possible implicit issues: What don't I know that could affect what I/we do?		
Step 2: Questions, research, and understanding	1. Asks pertinent questions (no fishing expeditions), directed toward understanding potentially important aspects of the situation (e.g., structural, financial, human, political, legal, ethical, and systemic). 2. Research identifies at least four relevant publications (beyond course materials), and if possible draws from Web, library, and journals/magazines. 3. Identifies relevant text concepts and other resources and explicitly uses them to support reasoning in later steps.		
Step 3: Set objectives	Objectives are listed that: 1. Describe a future state where key issues from step one are resolved. 2. Do not point to specific ways of getting to this state. 3. Include additional objectives as appropriate (e.g., cost and time constraints, ethicality/legality, etc.)		
Step 4: Generate alternatives	1. At least 3 distinct alternatives are selected (Live teams only: Ability to generate creative possible alternatives) 2. Selected alternatives plausibly accomplish most or all of the objectives stated in Step 3. 3. Selected alternatives represent the major possibilities inherent in the situation.		

(continued)

TABLE 1 (Continued)

Problem Solver (Team/ Individual name): Problem:

Step	*Rating Criteria*	*Rating*[a]	*Comments*
Step 5: Assess alternatives, choose	1. Alternatives (in rows)/objectives (in columns) are laid out in table format, and every cell is rated. 2. Choice is made by judgment (not numerical scores alone), justified by discussion of pros and cons of choice. (All teams: Choice made by consensus and process is described) 3. A single coherent choice is made.		
Step 6: Implementation and follow-up	Implementation plan includes: 1. Specific discussion of impact on people involved and how this will be managed 2. Actionable steps 3. Time schedule 4. How/when success/failure of solution will be assessed		
Step 7: Carry learning forward	1. Identifies individual and organizational learning derived from problem-solving process. 2. Identifies one or more future contexts for which learning is relevant.		
Effective communication	1. Full APA style in MS-Word document with name/date. 2. Uses subheadings and contextual clarifiers. 3. Explicit and correct APA referencing of all materials. 4. Quality; for example, spelling, grammar, complete sentences.		

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NOTE: a. Rating: — = not present; - = below expectations; OK = satisfactory; OK+ = above expectations

- Step 2: Students are prompted to consider the situation using a number of different frameworks. Rynes and Quinn-Trank (1999) suggested that business students tend to view business situations through a single rational business-logic framework where the organization is similar to a machine and employees are made to work through the use of reward systems. In complex situations, however, more than one framework is usually needed for understanding. Bolman and Deal (1997) pointed out that chronic use of a single framework inhibits problem solving by preventing "seeing old problems in a new light or finding more promising tools to work on perennial challenges" (p. 5). Studies of entrepreneurs also point to the importance of using frameworks in the early stages of problem solving (e.g., Cowan, 1986, Gaglio & Katz, 2001).
- Step 6: The model assumes that the problem solver will not only come up with a solution but will also be involved in carrying it out. This means that when considering situations, students must be asked to take the point of view of a particular protagonist in the situation. This determines the kinds of actions available to them to effect a solution.
- Step 7: This step responds to Stinson & Milter's (1996) concern that students be able to place their learning in a global framework that can be applied to other situations. This is consistent with the notion of a learning organization.
- Effective communication: This step is included because problem solvers need to be able to communicate what they have done, not simply to an instructor but also to team members and to others when implementing a solution.

The steps in Table 1 are in the form of a rating sheet that lists criteria by which the results of an individual or team problem-solving effort can be assessed. The approach to problem solving taken in this course, then, is to provide a metastructure, or higher level structured process that can be applied to unstructured situations to develop solutions.

Incorporation of PBL Into the Revised Course

The design of the revised course occurred through four steps. First, our management group developed a set of learning outcomes that established the educational identity of the revised course. Following this, I (a) developed a series of PBL projects that are aligned to these outcomes, (b) added readings and components for team and problem-solving skill building, and (c) developed a process for assessing student learning. Each of these steps is described below.

STEP 1: COURSE LEARNING OUTCOMES

In redesigning our introductory management course, our management group drew extensively on surveys of employers and recent graduates. We developed a list of seven learning areas that businesspeople and recent gradu-

ates consistently pointed to as important. We formulated learning outcomes for each of these areas and agreed that all instructors teaching the course would design their courses to accomplish these outcomes:

1. Roles and responsibilities: Identify leadership roles and responsibilities responsive to the changing context of business today.
2. Self-management: To plan and direct one's own activity to meet personal, organizational, and career goals.
3. Problem solving: Carry out/facilitate effective problem solving as an individual and in a team.
4. Teams: Recognize and respond to team process problems; carry out team-building activities needed to develop task effectiveness.
5. Motivation: Utilize motivational principles in evaluating and developing programs for attaining organizational goals.
6. Negotiation: Recognize the need for and carry out negotiation steps to enable parties to reach mutually agreeable arrangements.
7. Leadership: Surface organizational problems/opportunities; develop initiatives to mobilize resources to resolve them.

After much discussion we concluded that the best name we could think of to communicate the nature of the revised course was "Leadership Skills."

Problem solving is explicitly listed in the third outcome above but also underlies four other course outcomes: Outcome 1 (self-management) can be seen as dealing with unstructured problems regarding development and career choices; Outcome 4 (team skills) can be characterized as the ability to facilitate the development of an effective problem-solving team; Outcome 6 (negotiation) fits quite well with the idea of jointly carrying out the solving of unstructured problems with another party; and Outcome 7 (leadership) can be focused on lateral leadership (Fisher & Sharp, 1998, chapter 2) in which the person raises and addresses organizational problems in situations when he or she is not in a position of authority.

By emphasizing the problem-solving basis of these skills, it is possible to design a course that addresses a variety of topics and provides in-depth practice in the underlying skill of problem solving. To reinforce this underlying theme of the course, I provided students with a wallet card that visually depicts the problem-solving steps listed in Table 1. During the semester, I repeatedly reminded them of the relation between course activities and the problem-solving steps.

STEP 2: PBL PROJECTS

The heart of the course's design is a set of PBL projects, in which individuals and teams are provided situations and asked to carry out the steps of the

unstructured problem-solving process. Because solving unstructured problems required the exercise of a number of skills in concert, these projects demand a fair amount of time and effort to complete. I included four PBL project assignments in the course. These are described below.

Project 1: Individual introductory situation. Students are given details about a hypothetical situation in which they are working in an engineering firm and are assigned to a disciplinary review committee. The committee is considering what should be done about a bridge inspector who contributed to a news article that embarrassed the firm. Students are asked to write an essay describing what they would do. After turning in an essay, they are given an opportunity to search for additional information. This information is provided in the form of an online office with clickable items, including a phone, various manuals, and a filing cabinet. Not all the materials are relevant, making it necessary for students to ascertain the relevance of various pieces of information. They are then asked if they would change what they said in their first essay. They are invited to reflect on how they approached the problem given them and are introduced to the problem-solving model shown in Table 1. The purpose of this exercise is to raise their awareness of their problem-solving tendencies, and to gain an appreciation for the qualities of a real-world situation: for example, a poorly defined problem, no superior who will clarify the situation, multiple issues, and the need to do something, as opposed to simply recommending what should be done.

Project 2: Team situation. When teams are formed, each is assigned a problem situation. To date, I have developed three team situations. The first involved development of a team service project. The second was the "clock-watchers" video, which portrays the plight of four temps in a credit firm. Teams were asked to put themselves in the position of a manager in this firm. The third was the "Startup.com" video, which documents the rise and fall of a Web business. Teams were asked to put themselves in the position of Isaza Tuzman, the founding entrepreneur, at the point the Web bubble burst.

I have given the team assignment in three phases. After providing initial information about the team situation, I first asked teams to identify issues in the situation and rank them according to importance, and to develop a list of questions that need to be answered to understand the situation. These were submitted to me, and I responded to them before assigning the next phase. The purpose of this first phase was to get a sense of how teams are approaching the situation, and to provide some coaching. I may, for example, point out additional areas they might want to consider, comment on themes in their line of reasoning, and inquire whether some questions are relevant to understand-

ing the situation. An additional reason for phasing the assignment is to curtail a rush to solution. Student teams often seem uncomfortable in the presolution steps and, unless the project is phased, may rush to a solution immediately.

The second phase is to research the questions asked, and to proceed through the problem-solving steps to the point in which they identify a solution. I emphasize that there is no particular right answer that I am looking for or favoring and that the purpose of the assignment is to practice carrying out the problem-solving steps well. My assumption—which has so far been borne out in practice—is that if all the steps are done well, the solution will be sound. They are then asked to write out what they did and turn it in to me. My primary intent for the Phase II assignment is to ensure that teams are on schedule; I do not score the project until all the steps are completed and submitted.

The third phase is to develop an implementation plan and follow-up, and to consider how what they have learned can be used in future situations. For teams that were assigned the service project, I also asked that they actually implement their solution and describe what happened.[1] Teams then compile the three phases into a report and turn it in for scoring.

Project 3: Individual negotiation situations. Around midsemester, I have students undergo six rounds of negotiation in triads. Negotiation situations are drawn from Asherman and Asherman (1995). Each triad has two negotiator roles and an observer role. People in negotiator roles fill out a planning sheet, which places negotiation planning in a problem-solving context. After the two negotiators finish their negotiation session, the observer provides feedback, based on an observer checklist. The two negotiators then fill out a debriefing form—again tied to the problem-solving steps. After six rounds are completed, individuals are asked to write a paper describing what they learned about carrying out the problem-solving steps in negotiation situations—with all their paperwork attached.

Project 4. Individual "capsule" situation. At semester's end, students are asked to respond to a so-called capsule situation—because the materials and time for problem solving are encapsulated into the bounds of a traditional final exam. Students are provided with a situation description and a collection of documents with varying degrees of relevance. The assignment is to read the situation description, take the point of view of a designated protagonist in the situation, and write a document describing how the student would carry out the problem-solving steps shown in Table 1. They are asked to complete the exam in 2 hours and are permitted to draw on all materials covered

previously. The capsule situation provides students a concluding opportunity in the course to demonstrate their ability to carry out problem-solving steps shown in Table 1. The capsule score is a significant contributor to students' grades.

STEP 3: ADDITIONAL ACTIVITIES

The PBL projects described above constitute a major means for accomplishing the MGMT 301 course's learning outcomes. In developing an effective design for accomplishing these outcomes, however, I found it necessary to add three additional elements to the course. These involved readings, skill practice in carrying out problem-solving steps, and a series of team-building activities. Each of these is described below.

1. Reading assignments. After a review of texts our management group chose Kinicki & Kretner's *Organizational Behavior: Key Concepts, Skills, and Best Practices* (2003) text. I also require Covey's (1989) book, which addresses several course topics including proactivity, listening, and win-win negotiation. I make the point early on in the course that the concepts provided in these readings are only useful insofar as they are used, and that course activities will center on application, not simply understanding. The skill-building assignments described next provide practice in doing so.
2. Decision skill-building assignments. Most students come to the course with very little experience or skill in carrying out problem-solving steps. I have found that simply providing an opportunity to use problem-solving skills does not necessarily develop those skills (Woods, 1996, chapter 3). I found it necessary to carry out a series of skill-building activities to help students gain familiarity with the kind of thinking associated with solving unstructured problems. These activities are similar to what Whelan-Berry and Marshall (2001) describe as unit PBL problems (p. 7). Throughout the semester, I assign video clips and ask students to write an essay for each, which answers four questions:
   - Take the point of view of (a designated person in the clip). What issues do you see in this situation?
   - What concept that we have studied do you think is most pertinent for addressing a key issue you identified?
   - How does this concept apply to this situation?
   - How can this concept be used to move forward on the issue you identified?

This activity helps students practice issue raising and using concepts to develop solution alternatives. I also assign two microproblems during the semester, which start with a one- to two-paragraph situation description. In the first problem, students are asked to fill out a structured form that takes them from issue raising to identifying a solution. In the second, they go through the entire problem-solving cycle.

3. Team-building assignments. Students are assigned to teams in the 3rd week of the semester. Whereas many PBL instructors use team sizes of four to five team members (e.g., Duch, Groh, & Allen, 2001; Wang, Thompson, & Shuler, 1998, p. 5; Whelan-Berry & Marshall, 2001, p. 7), I create initial teams of six to eight members. The reason for this larger size is that developing team skills is an explicit goal of the course. The larger team size provides students with a more realistic team setting, more interactions, and a wider variety of individuals with which to work. In forming teams, I seek to assemble so-called "stranger" groups where people have not worked together before, to include critical masses of men/women/cultural/age subgroups, and to provide the greatest possible variety in majors. Teams are assigned team-building activities throughout the semester. These start with consensus exercises in which teams create a name, develop norms and an enforcement process, and a mission. In addition, teams are asked to conduct two process observations, develop a celebration plan for semester's end, and conduct mid- and end-of-semester peer ratings. Members must maintain a satisfactory average on these ratings to stay on the team. Teams are asked to keep a log, which I review midsemester, and to write a team process report at semester's end. Student feedback indicates these activities have been very helpful in creating effective, functioning teams.

STEP 4: ASSESSMENT OF LEARNING

The course syllabus describes how each of the course's learning outcomes will be assessed. For all but the team-building outcome, assessment is based on project assignments, in which individuals and teams apply the problem-solving steps to unstructured situations. The checklist shown in Table 1 is used to score all these assignments. Thus, most scoring in the course is based on demonstrated competence in problem solving.

The use of an instrument designed to assess competence creates a problem in grading: Although students may learn a lot in the course, it is quite possible that even the best students will not demonstrate 100% competence in their problem solving. I have concluded that, given the long way our students have to go in learning problem solving, it would be inappropriate to translate competency scores directly into grades (e.g., 90% is an "A," 80% is a "B," etc.). Were I to do so, most students would fail the course. Instead, I go through the familiar process of so-called curving in making this translation. In this way, I gain measures of competence (their original scores) and an acceptable grade profile (curved scores) for the course.

Results

The changes to MGMT 301 were largely for the purpose of developing students' competence in solving unstructured problems. Were they effective

in doing so? In addition, we were aware that the revised design departed significantly from that of traditional college courses. How would students respond to those changes? Below, I discuss what we found concerning each of these questions.

STUDENT REACTIONS

A common theme in the PBL literature is that students have a mixed response when encountering a PBL class format. Sasse et al. (2000) cited student comments that indicate they enjoyed the format and that it had a positive impact on their learning. However, these authors also found that many students expressed frustration because of the ill-structured nature of the format. Stinson & Milter (1996) reported that they frequently heard statements such as "what are we supposed to do," "how do we do that," or "if you would only tell me what you want, I would do it" (p. 41). Neo, Chye, Da Silva, and Hock (2000) remarked that "as with every change, resistance is a constant," and that students expressed concern about the PBL curriculum, the role of instructors, assessment, need for group skills, and resources. Finding that more than 46% of students "did not find PBL interesting," Chye, Neo, and Da Silva (2000) commented that this was a reaction to a new method of learning (p. 9). They also reported student complaints that there were too few notes, that many students preferred a passive learning style to an active one, that more studying was required, and that students were anxious about the relative ambiguity of the PBL approach, as opposed to the rigid and clear structure of the lecture approach. Poon (2000) reported that although students recognized the educational benefits of a PBL approach, they were concerned about how it would affect their grades.

Students in my course have also expressed ambivalence toward the PBL approach, and the results above are quite representative of their responses. Many of our students are skeptical of the value of a university education—aside from the employment doors a degree opens. As students approach graduation, they are glad to have a course that credibly promises to help them deal with important real-life situations they can expect to encounter after graduation. In particular, many students have expressed appreciation for the negotiation project experience, that this can help them in dealing with conflict situations—a type of situation with which students often have difficulty.

On the other hand, many students have become accustomed to a course-credit view of education, in which a degree is obtained by accumulating credits—with little thought for the learning that may occur in the process. Although agreeing in principle that a PBL approach is beneficial, many stu-

dents have second thoughts when actually confronted with unfamiliar class experiences in which the traditional relation between individual action and grades no longer holds.

One way of thinking about the issues instructors face when implementing this approach is that they are changing the way they and their students think about the course and their role in it. The Samford PBL Initiative (2002) identified 13 differences between a traditional and a PBL classroom; for example, concerning the role of the instructor, working in groups, responsibility for learning, degree of structure, passiveness of students, the existence of so-called right answers, and how performance is measured. Instructors pioneering PBL approaches are likely to find they are interacting with students who are trying to make sense of the course from a traditional point of view. Woods (1996, chaps. 4 and 5) found that traditionally students expect to be given exercises in which they use pattern recognition to identify a procedure that can be used to derive a solution.

A recent example from my experience concerns a query from a project team. A representative had sent me a list of questions that the team needed to research to understand the assigned project situation. In responding to them, I acted as a facilitator and invited them to think about the assumptions underlying their questions. They responded, saying they were having difficulty deciphering my feedback. They wanted to know if I was saying that their questions were the wrong way to go, and whether the team needed to scrap these questions. Although I responded within a PBL framework as a facilitator, this team seemed to be trying to interpret my response within a traditional framework, in which I would provide unambiguous feedback about the correctness of their response and what they should do to improve it. Consequently, in interacting with project members, I am careful to look for this kind of misinterpretation and to redirect the discussion to our underlying frameworks.

Of course, this kind of misinterpretation can also occur when the institution asks for student reactions to courses. An instructor implementing a PBL design well could be assessed, in part, as an instructor implementing a traditional design poorly. Recent efforts by the Association to Advance Collegiate Schools of Business (AACSB) and other accrediting institutions, however, are placing increasing emphasis on evidence that actual learning is taking place. The new AACSB standards for business schools, for example, now include an assurance of learning set of standards (Association to Advance Collegiate Schools of Business, 2003). As business colleges incorporate these new standards, instructors who adopt innovative, but effective, course designs should find their institutional standing to be on an upswing.

EVIDENCE OF LEARNING

In considering how students' decision competencies changed, it is useful to first consider their competence at the start of the course. This is one purpose of the introductory situation described earlier: to get a sense of how students naturally deal with situations. I rated their responses using the Solving Unstructured Problems Rating Sheet, and the results are shown in Figure 1. The seven problem-solving steps are arrayed in a radar-chart format. The inner circle depicts the averaged ratings for this first assignment.

In responding to this situation, many students raised questions about what they needed to know to respond. Because the situation is in an actual engineering context, it is possible to conduct some helpful library or Web research. Despite this, none reported doing any research. Moreover, none employed concepts—from this or any other course. Virtually all of them jumped to Step 4 by identifying a single alternative/choice. Some mentioned benefits of their choices, and some then considered implementation issues. A few students proposed long-term solutions (e.g., clarify policy), which did not respond to the problem at hand, and which were more appropriately a part of Step 7. The initial decision process demonstrated by students, then, typically followed two steps: (a) to try to understand the situation by reading the information provided and (b) to think of a solution that seems to follow from this information, justify it in terms of its benefits, and possibly provide some thoughts about implementation.

This approach is consistent with Woods's (1996) observation that students tend to orient to problem situations as exercises, to be solved by applying a prelearned procedure (chap. 4, p. 5). It is also consistent with a satisficing decision style (Simon, 1983), in which the search for a solution stops when the first viable alternative is identified. These approaches are considerably faster and easier than the 7-step process used in the course. Perhaps because of this, and because of their familiarity with the 2-step process, some students have shown resistance to using the 7-step process, which requires more thinking, time, and effort. I think this resistance stems from students' familiarity with making 2-step decisions that seem to them to have worked well in the past. Because most students have yet to encounter complex situations where they must make highly consequential decisions, they do not yet realize that the 2-step approach does not work well in all situations. This lends credence to Tan's (2000) conclusion that learners' experiences can sometimes be "miseducative," when students incorporate counterproductive behaviors learned elsewhere into their PBL activities.

To get a sense of problem-solving competencies at semester's end, I compared students' responses on the introductory situation with the average rat-

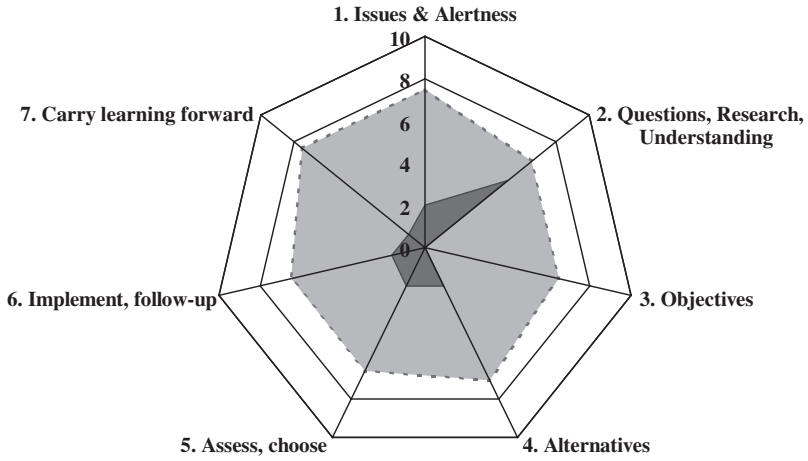

Figure 1: Radar Chart of Student Competencies in the Steps of Solving Unstructured Problems: Initial Testing (Inner Solid Line Shape) versus End of Semester (dotted line shape)

ings of students on the end-of-semester capsule exam. The results are shown in Figure 1, as the larger circle, with a dotted boundary. We see that by semester's end students showed considerable improvement in their ability to go through the problem-solving steps—and in doing so, to develop credible and implementable solutions.

Despite these encouraging findings, I doubt that a single course on problem solving will have a lasting effect on students' problem-solving behavior. In our outcomes testing, we found that our students are having difficulty retaining learning. Furthermore, in a study of the impact of a PBL course, Johnston and Waters (2001) found that at course's end, students were more likely to take a deep approach to problem solving. In a 6-month follow-up, however, they found evidence of a shift back toward surface learning approaches. It seems plausible that our students too will follow this pattern. Our college is now working on ways to reinforce course learning so that when learned, it is called for again in later courses. Doing so can reinforce not only problem-solving skills but also learning in core areas such as basic financial analysis, use of economic frameworks, teamwork, and oral/written communication.

Conclusion: Closing the Loop

I began this article by citing Nutt's (1999) finding that many businesspeople have difficulty with problem solving. Because there is ample evidence that our students share this difficulty, my focus has been on how to improve students' problem-solving skills. Our consideration, however, should not end as students graduate. The ultimate justification for what educators do lies not simply in what students learn but also in what they do after they graduate. Can we assume that if we graduate students with improved problem-solving skills that they will go on to raise the quality of decision making in the organizations they go to?

Argyris (2002), in his studies of learning in organizations, pointed out that many organizational members work from a Model 1 theory in use (pp. 212-213). This theory emphasizes rationality, being in control, winning, and suppressing negative feelings. These emphases do not seem consistent with carrying out some of the problem-solving steps shown in Table 1; for example, engaging in collaborative problem solving; spending time on the earlier, more tentative steps of problem solving; and employing multiple perspectives. With respect to the latter, Abrahamson (1997) also suggested that a single rational orientation is dominant in contemporary businesses (p. 496). Nutt's (1999) study lists problem-solving dynamics reminiscent of Model 1 thinking; for example, hasty problem definitions, bias toward action, fear of being seen as indecisive, and wanting to seem to be on top of things (p. 79).

Argyris (2002) suggested that this kind of thinking can prevent learning from experience because such people can be "blind to their incompetencies and are unaware that they are blind" (p. 206). Similarly, Nutt (1999) observed, "Even when managers know that making decisions in this way is foolhardy, the pressure for a quick fix often wins out," and "The most successful tactics are infrequently used and the least successful frequently used" (pp. 79-80).

These studies raise the possibility that simply improving our students' problem-solving competencies may not be sufficient to improve organizational problem solving. Our graduates may simply become socialized into Model 1 thinking, discard their learning, and join the "skilled incompetent" (Argyris, 2002, p. 213). To the extent we are committed to improving problem-solving practices in organizations then, we may need to better educate not only our students but their employers as well.

Note

1. Unlike the two video projects, the service project required that teams actually carry out their action plans, thereby providing members with valuable practice in implementing a plan. The service project, however, turned out to be difficult to fit into a semester schedule. By the time the necessary prework was completed (i.e., team formation, early team development, problem-solving skill building, and three-phased team assignment), there was perhaps a 2- to 3-week window near semester's end to carry out the plan. This narrow time window limited the service options available to teams, who most commonly came up with joining an externally sponsored neighborhood service event, conducting their own cleanup event, or creating a Web site with some kind of information useful to students.

References

Abrahamson, E. (1997). The emergence and prevalence of employee-management rhetorics: The effects of long waves, labor unions and turnover, 1875-1992. *Academy of Management Journal*, *40*, 491-533.

Anonymous. (2001). Undergraduate institutions with faculty members using PBL. *PBL Insight*, *3*(3), 14.

Argyris, C. (2002). Double-loop learning, teaching, and research. *Academy of Management Learning and Education, 1*(2), 206-218.

Asherman, I., & Asherman, S. (1995). *25 Role plays for negotiation skills*. Amherst, MA: HRD Press.

Association to Advance Collegiate Schools of Business. (2003). *New standards—business, approved April 25, 2003*. Available from www.aacsb.edu/accreditation/brc/standards-4-25.pdf

Banta, T., Black, K., & Kline, K. (2000). PBL 2000 plenary address offers evidence for and against problem-based learning. *PBL Insight*, *3*(3), 1-7.

Bigelow, J. (2002). *Preparing graduates for organizational situations: A frames/problem-based approach*. Unpublished manuscript.

Bolman, L., & Deal, T. (1997). *Reframing organizations: Artistry, choice, and leadership* (2nd ed.). San Francisco: Jossey-Bass.

Chye, M., Neo, L., & Da Silva, G. (2000, December 4-7). *Student evaluation of the subject under problem-based learning mode: The case of practice of entrepreneurship*. Paper presented at the Second Asia-Pacific Conference on PBL, Singapore.

Copland, M. (2000, December 4-7). *Learning to frame problems of school leadership through problem-based learning*. Paper presented at the Second Asia-Pacific Conference on PBL, Singapore.

Core Improvement Team. (2001). *Assessment of skills possessed by graduating seniors college of business and economics spring 2001*. Available at http://cobe.boisestate.edu/corePlus/reportfinal.pdf

Covey, S. (1989). *The seven habits of highly effective people*. NJ: Simon & Schuster.

Cowan, D. A. (1986). Developing a process model of problem recognition. *Academy of Management Review*, *11*, 763-776.

Duch, B., Allen, D., & White, H. (1998). PBL: Preparing students to succeed in the 21st century. *PBL Insight*, *1*(2), 3-4.

Duch, B., Groh, S., & Allen, D. (2001). *The power of problem-based learning: A practical "how to" for teaching undergraduate courses in any discipline*. Sterling, VA: Stylus.

Fisher, R., & Sharp, A. (1998). *Getting it done: How to lead when you're not in charge*. New York: HarperCollins.

Gaglio, C. M., & Katz, J. A. (2001). The psychological basis of opportunity identification: Entrepreneurial alertness. *Small Business Economics*, *16*, 95-111.

Johnston, C., & Waters, L. (2001, June 20-23). *Computer assisted, problem based learning: A new form of CAOS*. Paper presented at the 8th Annual EDINEB Conference, Nice, France.

Jones, E. (1998). Defining crucial problem-solving outcomes for graduates. *PBL Insight*, *1*(2), 1, 10.

Kearny, T. (2000, December 4-7). *Problem based learning and education Queensland: The learning organization*. Paper presented at the Second Asia-Pacific Conference on PBL, Singapore.

Kinicki, A., & Kretner, R. (2003). *Organizational behavior: Key concepts, skills, and best practices*. Boston: McGraw-Hill.

Kolb, J. (1999). A project in small-group decision-making. *Journal of Management Education*, *23*(1), 71-79.

Neo, L., Chye, K., Da Silva, G., & Hock, D. (2000, December 4-7). *Tried and tested: Issues and implications for educators in problem-based learning—Relearning from the learners' perspective*. Paper presented at the Second Asia-Pacific Conference on PBL, Singapore.

Nutt, P. (1999). Surprising but true: Half the decisions in organizations fail. *Academy of Management Executive*, *13*(4), 75-90.

Poon, T. (2000, December 4-7). *Managing student learning experience: Using computer simulation in problem-based learning*. Paper presented at the Second Asia-Pacific Conference on PBL, Singapore.

Rynes, S. L., & Quinn-Trank, C. (1999). Behavioral science in the business school curriculum: Teaching in a changing institutional environment. *Academy of Management Review*, *24*, 808-824.

Samford PBL Initiative. (2002). *What is problem-based learning?* Retrieved October 2002, from www.samford.edu/pbl/what3.html#Traditional%20versus%20PBL%20Classroom

Sasse, C., Davis, J., & McConnell, C. (2000, September). *Using problem-based learning: A multidisciplinary investigation* (A Rockhurst University Carnegie Seminar Project). Retrieved October 2002, from http://cte.rockhurst.edu/carnegie/PBL.htm

Simon, H. (l983). *Reason in human affairs*. Stanford, CA: Stanford University Press.

Stinson, J., & Milter, R. (1996). Problem-based learning in business education: Curricular design and implementation issues. *New Directions for Teaching and Learning*, *68*(Winter), 33-42.

Tan, K. (2000, December 4-7). *Experience the difference: How experience produces problems in problem-based learning for adults*. Paper presented at the Second Asia-Pacific Conference on PBL, Singapore.

Torp, L., & Sage, S. (1998). *Problems as possibilities: Problem-based learning for K-12 education*. Alexandria, VA: Association for Supervision and Curriculum Development.

Varanelli, A., Baugher, D., & Hall, J. (2001). A problem-based, collaborative learning approach to distance education at the MBA level: e.MBA@PACE. *Business, Education, and Technology Journal*, *3*(1), 36-43.

Wang, H., Thompson, P., & Shuler, C. (1998). *Essential components of problem-based learning for the K-12 inquiry science*. Retrieved October 2002, from www.usc.edu/hsc/dental/ccmb/usc-csp/esscomponent.pdf

Whelan-Berry, K., & Marshall, J. (2001). Undergraduate business education and problem-based learning. *PBL Insight*, *3*(1), 7-11.

Woods, D. (1996). *Problem-based learning: Helping your students gain the most from PBL*. Available in WordPerfect format at http://chemeng.mcmaster.ca/pbl/pbl.htm