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Professional schools must cultivate specific competencies within their students in order to prepare them for their professions, and these competencies are changing. Team-based learning is ideally suited to meet the demands placed on professional schools as they confront new challenges.

Knowledge Is No Longer Enough: Enhancing Professional Education with Team-Based Learning

Jim Sibley, Dean X. Parmelee

The explosion of information and increasing complexity of the modern workplace have placed new burdens and demands on professional schools and programs. Professional schools, such as those in business, engineering, and the health professions, have come under increasing scrutiny as the required exit competencies for graduates have shifted from knowing information to being able to solve complex problems, communicate clearly, collaborate effectively, and use lifelong learning skills. It has become clear that professional schools must make changes in both curricula and pedagogy.

This chapter first describes increased competency-based demands in professional schools and how small group learning is well suited to cultivate those competencies. It then singles out team-based learning (TBL) as a particularly powerful form of small group learning by distinguishing it from other forms of small group learning, charting its recent growth in professional schools and offering some tips for professional school faculty interested in implementing TBL. Finally, it turns to professional school students themselves by reporting—in their own words—how they have experienced various features of TBL—powerful testimony as to how TBL can and does meet the competency-based challenges that professional schools face today.

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Cultivating Competencies: What Small Group Learning Brings to Professional Education

Professional schools define what their graduates should be able to do in the professional workplace by the time they graduate. Accrediting bodies have designated these expected outcomes as *competencies,* and the term *competency* is defined by Govaerts (2008) as "an individual's ability to make deliberate choices from a repertoire of behaviors for handling situations and tasks in specific contexts of professional practice." He reminds us that "competencies are context-dependent and always imply integration of knowledge, skills, judgment and attitudes" (p. 42).

The traditional didactic, instructor-centric model has been the focus of much negative attention in educational community in recent years. The image of the content expert filling up empty vessels is still strongly held by many faculty and students. A lucid and engaging presentation can be well received by students and pleasurable to give, but it may not do much to develop the new required exit competencies. There are compelling studies on the poor efficacy of lectures and the limited short-term and long-term impacts on learning (Bligh, 2000; Freire, 2000; McKeachie, 1986). Clearly new approaches are required to design programs and educational experiences that will develop the knowledge, skills, and judgment students need for their professional careers.

Professional school faculty are transforming knowledge-focused curricula to ones in which the goals and objectives of units of study go beyond simple mastery of the content, for example, "know Ohm's Law," "understand Krebs cycle," or "describe an ideal marketing plan." Traditionally instructors have listed all the important content topic areas, assigned them to the time slot allotted for the course, designated who teaches what, then used a final exam to determine whether the learners have acquired the knowledge. This traditional approach, however, does not promote the development of professional competencies.

Clarity has been growing that instructional design at the professional school level must emphasize the mastery of content in order to apply it—a much greater challenge than "covering content." This transformation requires a new approach to the design of courses and to teaching and learning. The overarching goal becomes significant learning (Fink, 2003)—learning that endures well beyond the end of the course. It also increases the responsibility of the faculty, who now must design and orchestrate learning activities and assessments that enable students first to master the knowledge and then apply it to increasingly complex problems.

As professional schools have evolved toward competency-based education, active learner-centered strategies have become increasingly important. The professions have expressed a need for students who can communicate, value teamwork, solve problems, acquire knowledge that is broad and deep, and do so for their entire career.

Communication Skills. Communication skills are of the cornerstones of professional practice. How one says something is often perceived as being as important as what is said.

The development of communication skills is first encouraged during team test discussions in TBL and then by the appeals process that allows teams to generate a scholarly written argument to appeal their grade on any question in readiness assurance tests. Next, the students engage in lower-stakes intrateam activity reporting discussions and then progress to the higher-stakes interteam activity reporting discussion. Students get to practice their discourse within their team before they publicly commit to a position and then must publicly defend their decisions while questioning the decisions and decision-making processes of those around them. These kinds of discussions can promote higher-level reasoning, deeper-level understanding, and long-term retention (Johnson and Johnson, 2004).

When we create activities that lead to intellectual conflict and then facilitate discussion constructively, we help students reach a higher-level of reasoning, encourage divergent thinking, foster creativity, and promote long-term retention (Johnson and Johnson, 1995).

Valuing Teams. Many students and instructors have had poor team experiences, so it is very important to instill in students the value and power of working in teams. This can be difficult in academic cultures that routinely celebrate individual achievement and success. Many positive aspects of teaming can be demonstrated to students with TBL.

As teams become more cohesive and more effective, they can begin to recognize the hallmarks of good team behaviors: improvements in communication skills; a willingness to divide effort fairly; generosity in giving credit; the ability to constructively provide criticism as well as to care, share, and support others; and the embracing of team spirit. Students begin to recognize that "teams can give individuals insights and understandings that could never be achieved alone" (Johnson and Johnson, 2004, p. 9).

Problem Solving and Critical Thinking. The crafting of good problems is one of the keys to success in team-based learning. Problems can be crafted to increase in difficulty as the students' problem-solving skills progress. Serial problems with slight shifts in context can help students develop problem-solving skills that are not context bound. The discourse within the teams and during reporting activities allows students to explore other students' thinking and articulate their own thinking more clearly.

Many factors are important in the development of expert problem-solving skills. TBL creates opportunities for students to develop these skills aided by the frequent feedback from their teammates and the instructor. It is helpful to remember that problem solving often occurs in team settings, where "individuals share in problem solving and contribute to group success, in which problems are not well defined and decision makers have imperfect knowledge and in which no single best answer is readily available" (Hunt, Haidet, Coverdale, and Richards, 2003, p. 13).

The recognition of gaps in one's knowledge (metacognition) and development of task-focused energy to seek relevant information is the first key to expert problem solving. Metacognition has been described by Bransford as "an internal conversation" (2000, p. 21). Team-based learning provides many opportunities for students to engage with this conversation, which is externalized in both intrateam and interteam discussions. This can be key to the identification of knowledge gaps for students. These gaps revealed during team discussions, simultaneous reporting, and the full class reporting discussions can be a powerful motivator for continued learning.

Another struggle for students, especially in the health professions, is to remain problem minded for as long as possible and avoid the rush to solution or diagnosis. Adequately examining, defining, and establishing the nature of the problem is key to finding good solutions. TBL provides many opportunities to defend one's thinking and examine others' problem-solving processes. Another factor important to problem solving is the recognition that context can have large effects on the desirability of a solution. In TBL we have the ability to present a series of activities based on the similar problems, which allows students the chance to examine the effect of detail and context on a reasonable solution.

Depth versus Breadth. The depth-versus-breadth debate is a source of tension in most curriculum redevelopment projects. At first glance, it seems intuitively obvious that sacrificing breadth of coverage for depth of learning may leave students with gaps in their knowledge. However, the question that must be asked is whether it is possible to cover everything the student will need in professional practice in the undergraduate curriculum. Hung (2004, p. 14) and others believe that this is not possible or even desirable since "knowledge is constantly expanding, and we question the possibility that any course, or program of studies, can provide a full understanding of a content's breadth" (p. 14). If it is not possible to cover the breadth of a subject area, should we not then help students acquire the lifelong learning and problem-solving skills that will allow them to research and solve new problems as they arise in their professional practice? Many curricular experts now believe that superficial coverage must be replaced with "learning with understanding" (Bransford, 2000, p. 8).

In a study that compared outcomes from didactic lecturing to an active learning strategy in a large group setting, Haidet and others (2004) found that "the teacher was able to cover the same amount of conceptually complex and mathematically-oriented content in the active session as in the didactic session with no detrimental effects on short- or long-term knowledge acquisition or attitude enhancement" (p. 23). Another study that compared examination performance in a second-year pathology curriculum found no significant difference in student performance when comparing a case-based group discussion cohort to a team-based learning cohort (Koles and others, 2005). This is consistent with findings from the University of

British Columbia Engineering school (T. Froese, personal communication, April 2005). Koles, Stolfi, and Parmelee (2008) compared the examination performance of students in a second-year medical school class on questions related to material taught only in TBL format versus standard lecture format. There was significantly better performance for the class as a whole on questions related to material covered in the TBL portion, and the effect was even stronger in students in the lower quartile of the class.

Lifelong Learning. With the ever-expanding world of information, we must foster lifelong learning skills in students. Gone are the days of professional schools' providing a lifetime of knowledge. The ability to critically read and process information from a variety of sources is key to a successful professional life. Ryan (2008) has highlighted many positive learning outcomes resulting from required preclass readings. They can help students become familiar with the nature of the literature in their discipline and help them to process and retrieve relevant information quickly. Ryan writes, "Most students don't preview and scan the text before reading, as expert readers usually do. We help students understand and appreciate how professional and technical material is formally presented. . . . This will better prepare them for what they will be asked to do later in most professions" (n.p.) When students are required to read the preparatory material, discussions in class will likely be more thoughtful and more engaging, not just for the instructor but for the students as well. A student who comes to class prepared and with background knowledge is transformed from a passive to an active learner.

Team-Based Learning: A Powerful Form of Small Group Learning

Team-based learning is a powerful form of small group learning. In this section, we first distinguish TBL from problem-based learning, chart TBL's growth in professional school settings in recent years, and offer some advice to professional school faculty interested in implementing TBL.

Team-Based Learning Versus Problem-Based Learning. Given the professional competencies necessary now and how TBL supports their instruction, it is appropriate to acknowledge that some instructors have been using problem-based learning (PBL) to achieve the same affect. Indeed, PBL has been heralded by some as the answer to creating the professionals of tomorrow. In problem-based learning, students are presented a problem to solve and must determine for themselves what information is important within the problem and what information is still needed before a solution can be proposed. Students in PBL often work collaboratively, with small groups guided by "tutors," who ensure that conversation stays productive.

PBL and TBL share some of the same pedagogical virtues, but PBL places significantly greater resource demands on the institution than does TBL. For example, PBL faculty-to-student ratios have been reported in the

range of six to one (Hunt, Haidet, Coverdale, and Richards, 2003) and eight to one (A. Bradley, personal communication, April 2007). The University of British Columbia Medical School has over four hundred PBL tutors and uses seventy tutors in any particular week (Amanda Bradley, personal communication, April 2007). This requirement for large amounts of faculty time, administrative support, and physical space can make PBL unsuitable for many schools.

In contrast, TBL is well suited to achieve similar good student outcomes while conserving precious resources, since it is scalable to much larger student-to-faculty ratios of two hundred to one and above (Hunt, Haidet, Coverdale, and Richards, 2003) and can be facilitated in large classroom settings.

From our experience and that of others, we have become convinced that TBL provides an enormous opportunity for faculty to become more fully engaged with their students than with lecture-based instruction or other small group format such as PBL.

The Growth of Team-Based Learning in Professional Education. In 2001, the U.S. Department of Education awarded a grant to explore the use of team-based learning in medical education to Baylor Medical College. This award funded several years of nationwide workshops for faculty, direct support to medical schools to implement the strategy, and further support for its dissemination. Several medical schools were searching for ways to have more active learning instead of a steady stream of lectures. However, they chose not to develop a PBL curriculum because of its high student-to-faculty ratio requirements. Instead, several of these schools sent key faculty to workshops on TBL.

Many returned to their home campuses and either converted entire courses to the TBL strategy (Nieder, Parmelee, Stolfi, and Hudes, 2005) or began to use it episodically in place of existing faculty-led small group discussions. Within several years, several publications indicated the positive academic and noncognitive outcomes of TBL in medical education (Dunaway, 2005; Kelly and others, 2005; Koles and others, 2005; Vasan and DeFouw, 2005; Searle and others, 2003; Baldwin, Bedell, and Johnson, 1997). Schools of nursing, veterinary medicine, dentistry, physicians' assistants, and other allied health professions programs have also developed TBL within existing curricular structures.

The popularity of TBL in engineering education has increased. Engineering programs have long been synonymous with teamwork, but the TBL methodology had been used in only a small number of engineering courses in various institutions, such as the University of Oklahoma, University of Kentucky (L. Michaelsen, personal communication, June 2008), and the University of Missouri-Rolla (Weeks, 2003) prior to 2004. TBL in engineering schools began to see more widespread implementations in 2004–2005, with the University of British Columbia's (UBC) second-year mechanical design course (Ostafichuk and Hodgson, 2005) and a fourth-year construc-

tion management course (Froese, 2005). At the same time, the University of Kentucky, with the help of Derek Lane, was redeveloping its civil engineering capstone project course to incorporate TBL (Yost and Lane, 2007). Since these first courses, a large number of courses at UBC have been delivered successfully using the TBL format. These courses have ranged from the softer skills courses like Technology and Society to "hard" skill courses in the engineering sciences like Aerodynamics and Orthopedic Biomechanics.

Implementing TBL in Professional School Settings. A number of elements are critical for successful implementation of TBL in a professional school setting:

- The institutional culture, including the students, must support instructional innovation and understand that a new strategy has a trial-and-error period. The faculty member initiating TBL must be open to and welcome ongoing feedback from the students, seeking their thoughts on how to make a module stronger.
- The instructor must prepare well ahead. Unlike lecture preparation, which can sometimes be done at the last minute because one has done it so many times, writing a good TBL module takes an enormous effort, and peer review is very helpful before trying it out with students. Fortunately, once a module has been delivered and adjusted for the inevitable glitches, it can be used again and again with little additional preparation.
- The instructor will have to embrace the philosophy of developing learner-centered activities for classroom time and become comfortable with the idea that students can learn the content outside class (if they are told what to read or do). Part of this paradigm shift includes the instructor's learning to resist lecturing—by responding to student questions with questions and getting them to explain their thinking. For the expert professional who is teaching in a professional school or program, this is one of the biggest challenges: withholding a direct approach to just answer a question or tell the class what the answer is. This can be difficult for many of us, who can experience a great deal of pleasure from being the expert and having students expect us to pontificate on a moment's notice.

TBL instructors learn to craft the objectives and advanced preparation materials after they have written the team application activities, thereby ensuring a tight fit between preparation and potential success with the most challenging component of the module. With TBL, the Socratic method of exploring students' thinking using questioning becomes the mainstay of the process, for which students are forever grateful. A key to the success of TBL is the instructor-specified objectives for the module and how the instructor specifies the necessary advanced preparation.

In Their Own Words: How the TBL Process Develops Professional Competencies

The development of specific exit competencies in students is at the heart of professional education. In this section, we review several of the key components of TBL and note how each supports the development of these competencies. We also include comments by students that describe how they experienced the various components of TBL. These comments illustrate the power of the components, individually and collectively. (The comments are from student focus group transcripts and course evaluations at Boonshoft School of Medicine, Wright State University, from 2005 to 2007.)

Team Composition. In TBL, three principles should guide the instructor in creating teams: never use student-selected teams, spread the wealth of resources across teams (for example, students' experience, ethnic diversity, skills, attitudes), and make the selection process transparent. When students learn that their assignment to a team is based on a principle of resource wealth distribution, they value their team members from two perspectives: "we are all pretty equal, and we each may have some particular strength to bring to the discussions." Here is a student's description of how one instructor put teams together:

> Right from the start, we knew this class would be different. Prof X said we would be working in teams, but, they would not be self-select. She gave everyone a five-minute five-question math quiz and didn't allow calculators. They were really hard questions, and only a few of us could answer them in our heads, so to speak. She lined us up by our scores, and we counted off to get our team assignment. Cool. Every team got at least one person who could do higher-order math without a calculator. Most of us got none or one correct.

In the workplace, employees rarely get to select with whom they will work with. Nevertheless, team formation in undergraduate courses can still be a contentious issue for students (and therefore instructors). Students often suggest using student-selected teams, but Brickell, Porter, Reynolds, and Cosgrove (1994) suggest that student-selected teams are often just "social entities" and show that these teams underperform when compared to instructor-selected teams. We do the students no favors when we accommodate their desire for student-selected teams. During the application activity phase, the teams come to rely on this diversity of knowledge, skills, and attitudes and the richness it brings to the problem-solving process. The appreciation of the importance of diversity within a team and the strength it brings to the decision-making process is an important realization for students.

Grades. Many educational programs struggle with the goal of helping students become adult learners. Larry Michaelsen learned early that students work more productively and display the attributes of adult learners when proper incentives and assessment structures are present. The impor-

tant principle in designing assessment practices and instruction in TBL is to emphasize the importance of teamwork. If students have a sense of buy-in on the importance of the dynamic of teamwork, they will work harder and more productively in team activities.

Students at most professional schools come from competitive backgrounds, and initially they are unnerved by the prospect that their individual performance in TBL does not "count" as much as their team's productivity for their own grade. It is important to align the grading practices with the goal of getting the teams to become adult learners. We can achieve this goal by encouraging them to work well and productively together, ensure that teammates come to class prepared, put personality issues aside, and participate fully in the problem-solving process.

These shifts in the classroom can be viewed by students as changes in the rules of engagement and should be thoughtfully presented to students so they understand the rationales and benefits of the TBL approach. Engaging the students in a whole-class decision-making process on the development of the grading structure can send a powerful message that their instructors are working to develop their students' skills and competencies for future careers. Students at this level, initially surprised by the invitation, embrace this offer and buy in to the TBL process—for example:

> This was a real shocker. The whole class had to decide proportional weights for each of the TBL parts, within a range. Never before has a teacher asked for our input on what should count more or less. We had a couple of team members that had been in a TBL course before. They convinced us, and the rest of class, to minimize the grade weight for individual work. With the minimized grade weight of the individual work, we all had to work harder for the group weight!

Readiness Assurance. For instructors, the readiness assurance tests (RATs) can be a highly rewarding experience. The students come to class on time and prepared, When they start the team readiness assurance test (tRAT), the whole class becomes animated, and the ground is being set for the harder group application questions to follow. By moving around the classroom during the gRAT and listening, the instructor can quickly identify misconceptions or gaps in knowledge in the class, but often they are addressed within the teams. This student described the process:

> As soon as the clock struck the hour, we took our iRATs [individual readiness assurance tests] for fifteen minutes. Everyone came on time and was serious. As soon as we turned in our answers and began the tRAT, all hell broke loose as we argued over many of the questions within our teams, but mostly we learned what we didn't know from our peers. I sometimes felt gypped that the professor didn't do a lecture when the class started, but doesn't matter—we learned what we had to learn. Lectures are overrated.

Professionals in the workplace must not only come prepared and ready to contribute, but also need the ability to teach themselves to meet challenges in the professional practice. In a TBL course, responsibility for learning shifts from the instructor to the team and ultimately the individual student. This shift begins to happen during preparation for the readiness assurance process. Students are required to teach themselves, and during the testing phase they get prompt and unambiguous feedback on the quality of their preparation.

Many other important professional competencies are engaged in the readiness assurance process: the competencies of punctuality, communication, collaboration, consensus decision making, and respect for minority opinion are all of special importance. The structure of the readiness assurance process ensures that these competencies are important. In the professional school curriculum where covering the infinite amount of content is impossible, students soon grasp that just mastering a body of knowledge is not enough; they must go beyond it and often in great depth—an important lesson in self-directed learning for their future professional roles.

> [The professor] gave us the learning objectives and assignments for each TBL module at the beginning of the course. The only two surprises were that they really matched what we did and learned in the module, and to contribute the most in your team, you had to go beyond the minimum in the assignment. I've never worked so hard in a course in my life; I wanted our team to rule.

Group Application. The culmination experience during each module for faculty and students is the group application experience. Often the teams explain their solutions well, and the instructor's work has then been accomplished through the careful design of the module and the facilitation of student discourse. For the instructor, this component can provide an expertise opportunity because the instructor may have to point out the most practical solution to students who do not have the benefit of the instructor's experience or expertise:

> We usually couldn't wait to get to this part because the answers would never be in the book or on the Internet. You had to interpret some data and make a hard decision. Then it was tough to hear from another team how they approached the question—they made more sense and our argument wouldn't hold up. But sometimes, we'd think we were on the right track; one of us would stand up and make the case. What a thrill when the class would clap. We got it!

The solving of complex, multidimensional, poorly defined problems in diverse teams of people is an integral part of the professional workplace. The TBL application activity phase allows students to practice not only their problem-solving skills, but their interpersonal communication and critical thinking skills. It is important that instructors scaffold the development of students' discourse and problem-solving skills, first by letting them practice

their discourse in smaller team settings and later in the more public venue of the whole class. The development of these important skills is essential for their later success in the professional workplace. Many competencies are simultaneously addressed within the context of the delivery of the application activities: preparation that goes beyond the minimum, communication, problem solving often with ambiguous data, and team consensus decision making. Many of these competencies are first engaged in the readiness assurance process and are reinforced and further developed in the application activity phase.

Peer Evaluation. It is important that instructors help students learn how to provide constructive feedback that is appropriate for a particular setting. Using the peer evaluation process in TBL and providing specific instruction on making feedback helpful, we can help our students develop these important competencies. When students learn how to evaluate their peers honestly and give constructive feedback, they will likely succeed more readily in the workplace. Students sometimes need to be coached in the skills of providing helpful constructive feedback. Many TBL practitioners use the Michaelsen and Schultheiss article, "Making Feedback Helpful" (1989), to help their students develop their constructive feedback skills.

Accountability is one of the keys to success with team-based learning. Accountability among teammates, in both the classroom and workplace, can be implicit and explicit. In the classroom, the implicit sense of duty to teammates can be fostered during team activities, provided the activities are carefully designed to foster team cohesiveness by requiring preclass preparation, creating opportunities for participation and interdependence. The idea that teams are very good at some tasks and not as good at others is a valuable realization that can help students to excel in the workplace.

There have been some interesting developments recently in the TBL community on the use of peer evaluation. Yost and Lane (2007) now lets their students select the criteria that the teams will use to evaluate each other. The selection of criteria by the students creates a stronger buy-in for the peer evaluation process and makes the criteria for a good performance very explicit to students. A similar method is now being piloted at the University of British Columbia's Mechanical Engineering department (P. Ostafichuk, personal communication, May 2008). Recently Koles, Stolfi, and Parmelee (2008), at Wright State Medical School, has introduced qualitative assessment of student comments, hoping to help students develop their skills in providing constructive feedback. Here is how one student characterized the effect of this process:

> Our team studied the peer evaluation questions the very first day so that we knew how we were to evaluate each other at the end, knowing that it would count for our grade. I know that I changed my behavior starting that day. I tend to procrastinate and not cover details well, so I really prepped ahead for the first time in my life. I wasn't going to get dinged for this.

Conclusion

With its history of curricular success and excellent outcomes for both students and instructors, TBL is a good fit for professional education. For learners, TBL ensures mastery of core content in the defined domain, engages students in solving progressively complex problems, requires development of interpersonal and communication skills essential for the workplace, and inspires critical thinking skills for making decisions as an individual and within a team. For instructors, it is a strategy that energizes a classroom with dialogue and debate by requiring them to ask, "How did you get to that conclusion?" rather than stating, "Let me tell you the way it is." TBL's learner-centered perspective and tried-and-true practices can help create practitioners of tomorrow within environments of limited resources, high faculty work loads, and large class settings.

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