Inquiry-Based Cooperative Learning

(Adapted from Smith, 2000a)

Karl A. Smith
University of Minnesota/Purdue University
ksmith@umn.edu
http://www.ce.umn.edu/~smith

Overview of role of inquiry and cooperation in learning. Nature of inquiry in a cooperative context; models and emphasizes for orchestrating student learning experiences and designing inquiry-based cooperative learning environments; and summary of rationale for inquiry based cooperative learning.

A paradigm shift is taking place in science, math, engineering and technology (SMET) education, driven by the National Science Foundation, accreditation processes (such as ABET), changing expectations of employers, the rapidly changing state-of-the-art of pedagogy, and many other forces. Minor modifications in current teaching practices will not solve the current problems. Teaching success in today's world requires a new approach to instruction, and an important part of the new approach is the switch to inquiry-based student-centered learning.

The 1996 report to the National Science Foundation – *Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering and Technology* – articulated ambitious goals for SMET education and highlighted the importance of inquiry (p. ii):

> All students have access to supportive, excellent undergraduate education in science, mathematics, engineering, and technology, and all students learn these subjects by direct experience with the methods and processes of inquiry.

The authors made numerous recommendations, for example they recommended that SME&T faculty (p. iv):

> Believe and affirm that every student can learn, and model good practices that increase learning; starting with the student's experience, but have high expectations within a supportive climate; and build inquiry, a sense of wonder and the excitement of discovery, plus communication and teamwork, critical thinking, and life-long learning skills into learning experiences.

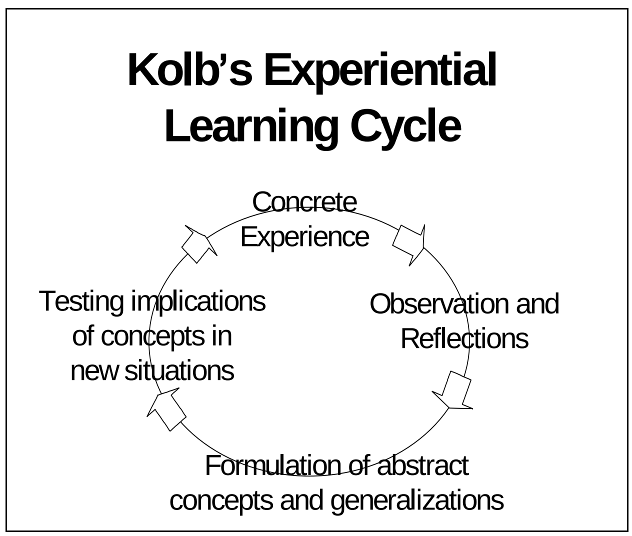
Constructivist teachers and researches provide lots of support and guidance for inquiry-based teaching and learning. For example, Catherine Twomey Fosnot writes (1989, p. 4-5):

> These problems are endemic to all institutions of education, regardless of level. Children sit for 12 years in classrooms where the implicit goal is to listen to the teacher and memorize the information in order to regurgitate it on a test. Little or

> no attention is paid to the learning process, even though much research exists documenting that real understanding is a case of active restructuring on the part of the learner. Restructuring occurs through engagement in problem posing as well as problem solving, inference making and investigation, resolving of contradictions, and reflecting. These processes all mandate far more active learners, as well as a different model of education than the one subscribed to at present by most institutions. Rather than being powerless and dependent on the institution, learners need to be empowered to think and to learn for themselves. Thus, learning needs to be conceived of as something a learner does, not something that is done to a learner.

Eleanor Duckworth provides wonderful rationale for having students' explain (a central idea in inquiry-based education) in her book *The having of wonderful ideas* (1987, p. 130-131). She writes:

> 1. In trying to make their thoughts clear for other people, students achieve greater clarity for themselves.
> 2. The students themselves determine what it is they want to understand.
> 3. People come to depend on themselves.
> 4. Students recognize the powerful experience of having their ideas taken seriously, rather than simply screened for correspondence to what the teacher wanted.
> 5. Students learn an enormous amount from each other.
> 6. Learners come to recognize knowledge as a human construction, since they have constructed their own knowledge and know that they have.



Large student enrollments (>100 students) are common in science courses, especially introductory courses. Jean MacGregor, Jim Cooper and I interviewed over 70 faculty for our *New Directions for Teaching and Learning* book *From Small Groups to Learning Communities: Energizing Large Classes*. We learned that many faculty are using inquiry-based processes in these large biology, physics, and chemistry classes (MacGregor, Cooper, Smith, & Robinson, 2000). We also learned that many faculty implement student-centered inquiry based learning by using a learning cycle model. One common learning cycle model is Engage, Explore, Explain, Evaluate. Another is Kolb's Experiential Learning Cycle.

Most faculty who have implemented inquiry-based models are involving the students in active, interactive and cooperative activities with other students. Cooperative learning is one of the most common ways faculty create more inquiry-based student-centered classrooms.

Cooperative Learning

Cooperation is working together to accomplish shared goals. Within cooperative activities individuals seek outcomes that are beneficial to themselves and beneficial to all other group members. **Cooperative learning** is the instructional use of small groups so that students work together to maximize their own and each others' learning (Johnson, Johnson and Smith, 1991a, 1991b). Carefully structured cooperative learning involves people working in teams to accomplish a common goal, under conditions that involve both *positive interdependence* (all members must cooperate to complete the task) and *individual and group accountability* (each member is accountable for the complete final outcome).

There are many ways to implement cooperative learning in engineering classrooms. Informal cooperative learning groups, formal cooperative learning groups, and cooperative base groups are the most common. Each has a place in providing opportunities for students to be intellectually active and personally interactive both in and outside the classroom. Informal cooperative learning is commonly used in predominately lecture classes and will be described only briefly. Formal cooperative learning can be used in content intensive classes where the mastery of conceptual or procedural material is essential; however, many faculty find it easier to start in recitation or laboratory sections or design project courses. Base groups are long-term cooperative learning groups whose principal responsibility is to provide support and encouragement for all their members; that is, to ensure that each member gets the help he or she needs to be successful in the course and in college.

Informal cooperative learning groups are temporary, ad hoc groups that last from a few minutes to one class period. They are used to focus students' attention on the material to be learned, set a mood conducive to learning, help organize in advance the material to be covered in a class session, ensure that students cognitively process the material being taught, and provide closure to a class session. They are often organized so that students engage in **focused discussions** before and after a lecture and interspersing **turn-to-your-partner** discussions throughout a lecture. Informal cooperative learning groups help counter what is proclaimed as the main problem of lectures: "The information passes from the notes of the professor to the notes of the student without passing through the mind of either one."

Cooperative base groups are long-term, heterogeneous cooperative learning groups with stable membership whose primary responsibility is to provide each student the support, encouragement, and assistance he or she needs to make academic progress. Base groups personalize the work required and the course learning experiences. These base groups stay the same during the entire course and longer if possible. The members of base groups should exchange phone numbers and information about schedules as they may wish to meet outside of class. When students have successes, insights, questions or concerns they wish to discuss; they can contact other members of their base group. Base groups typically manage the daily paperwork of the course through the use of group folders.

The focus of this short article is formal cooperative learning groups, since they are probably the most difficult to implement and they have the greatest potential for supporting inquiry-based learning. **Formal cooperative learning groups** are more structured than informal, are given more complex tasks, and typically stay together longer.

Essential Elements: What Makes Formal Cooperative Learning Work

Problems that commonly occur when using formal cooperative groups may be minimized by carefully structuring the basic elements. Many faculty who believe that they are using cooperative learning are, in fact, missing its essence. There is a crucial difference between simply putting students in groups to learn and in structuring cooperation among students. Cooperation is **not** having students sit side-by-side at the same table to talk with each other as they do their individual assignments. Cooperation is **not** assigning a report to a group of students where one student does all the work and the others put their names on the product as well. Cooperation is **not** having students do a task individually with instructions that the ones who finish first are to help the slower students. Cooperation is much more than being physically near other students, discussing material with other students, helping other students, or sharing material among students, although each of these is important in cooperative learning.

To be cooperative a group must have clear positive interdependence, members must promote each other's learning and success face-to-face, hold each other personally and individually accountable to do his or her fair share of the work, appropriately use the interpersonal and small group skills needed for cooperative efforts to be successful, and process as a group how effectively members are working together. These five essential components must be present for small group learning to be truly cooperative.

Well-structured formal cooperative learning groups are differentiated from poorly structured ones on the basis of five essential elements. These essential elements should be carefully structured within all levels of cooperative efforts. The five essential elements and suggestions for structuring them are as follows:

1. **Positive Interdependence.** The heart of cooperative learning is positive interdependence. Students must believe that they are linked with others in a way that one cannot succeed unless the other members of the group succeed (and vice versa). Students are working together to get the job done. In other words, students must perceive that they "sink or swim together." In formal cooperative learning groups, positive interdependence may by structured by asking group members to (1) agree on an answer for the group (group product--goal interdependence), (2) making sure each member can explain the groups' answer (learning goal interdependence), and (3) fulfilling assigned role responsibilities (role interdependence). Other ways of structuring positive interdependence include having common rewards such as a shared grade (reward interdependence), shared resources (resource interdependence), or a division of labor (task interdependence).

2. **Face-to-Face Promotive Interaction.** Once a professor establishes positive interdependence, he or she must ensure that students interact to help each other accomplish the

task and promote each other's success. Students are expected to explain orally to each other how to solve problems, discuss with each other the nature of the concepts and strategies being learned, teach their knowledge to classmates, explain to each other the connections between present and past learning, and help, encourage, and support each other's efforts to learn. Silent students are uninvolved students who are not contributing to the learning of others or themselves.

3. **Individual Accountability/Personal Responsibility.** The purpose of cooperative learning groups is to make each member a stronger individual in his or her own right. Students learn together so that they can subsequently perform better as individuals. To ensure that each member is strengthened, students are held individually accountable to do their share of the work. The performance of each individual student is assessed and the results given back to the individual and perhaps to the group. The group needs to know who needs more assistance in completing the assignment, and group members need to know they cannot "hitch-hike" on the work of others. Common ways to structure individual accountability include giving an individual exam to each student, randomly calling on individual students to present their group's answer, and giving an individual oral exam while monitoring group work. In the example of a formal cooperative learning lesson that follows, individual accountability is structured by requiring each person to learn and teach a small portion of conceptual material to two or three classmates.

4. **Teamwork Skills.** Contributing to the success of a cooperative effort requires teamwork skills. Students must have and use the needed leadership, decision-making, trust-building, communication, and conflict-management skills. These skills have to be taught just as purposefully and precisely as academic skills. Many students have never worked cooperatively in learning situations and, therefore, lack the needed teamwork skills for doing so effectively. Faculty often introduce and emphasize teamwork skills through assigning differentiated roles to each group member. For example, students learn about the challenge of documenting group work by serving as the task recorder, the importance of developing strategy and talking about how the group is working by serving as process recorder, providing direction to the group by serving as coordinator, and the difficulty of ensuring that everyone in the group understands and can explain by serving as the checker. Teamwork skills are being emphasized by employers and the ABET Engineering Criteria 2000. Resources are becoming available to help students develop teamwork skills (see Smith, 2000, for example).

5. **Group Processing.** Professors need to ensure that members of each cooperative learning group discuss how well they are achieving their goals and maintaining effective working relationships. Groups need to describe what member actions are helpful and unhelpful and make decisions about what to continue or change. Such processing enables learning groups to focus on group maintenance, facilitates the learning of cooperative skills, ensures that members receive feedback on their participation, and reminds students to practice cooperative skills consistently. Some of the keys to successful processing are allowing sufficient time for it to take place, making it specific rather than vague, maintaining student involvement in processing, reminding students to use their teamwork skills during processing, and ensuring that clear expectations as to the purpose of processing have been communicated. A common procedure for group processing is to ask each group to list at least three things the group did well

and at least one thing that could be improved.

The basic elements of a well-structured formal cooperative learning group are nearly identical to those of high-performance teams in business and industry as identified by Katzenbach and Smith (1993):

> *A team is a* ***small number*** *of people with* ***complementary skills*** *who are committed to a* ***common purpose****,* ***performance goals****, and* ***approach*** *for which they hold themselves* ***mutually accountable****.*

Structuring these five essential elements is critical to the success of formal cooperative learning groups. The next section describes in detail how these elements can be structured into formal cooperative learning groups.

Professor's Role in Structuring Formal Cooperative Learning Groups

Before choosing and implementing a formal cooperative learning strategy, there are several conditions that should be evaluated to determine whether or not it is the best approach for the situation. First, is there sufficient time available for students to work in groups both inside and outside the classroom? Second, are the students experienced and skillful enough to manage their work in formal cooperative learning groups? Third, is the task complex enough to warrant a formal group? Fourth, do other instructional goals (such as the development of students' critical thinking skills, higher level reasoning skills, or teamwork skills) warrant the use of formal cooperative learning groups. If several of these necessary conditions are met, then there is probably sufficient reason to proceed to planning a formal cooperative learning lesson.

Formal cooperative learning groups may last from one class period to several weeks to complete specific tasks and assignments--such as learning new conceptual material, decision making or problem solving, writing a report, conducting a survey or experiment, preparing for an exam, or answering questions or homework problems. Any course requirement may be reformulated to be cooperative. In formal cooperative groups the professor should:

1. Specify the objectives for the lesson. In every lesson there should be an academic objective specifying the concepts, strategies, procedures, etc. to be learned and a teamwork objective specifying the interpersonal or small group skill to be used and mastered during the lesson.

2. Make a number of instructional decisions. The professor has to decide on the size of groups, the method of assigning students to groups, how long the groups stay together, the roles the students will be assigned, the materials needed to conduct the lesson, and the way the room will be arranged. Although each of these decisions is complex, some general guidelines may be useful. Further elaboration is available in Johnson, Johnson and Smith (1998a). First, keep groups small, especially at the beginning. Groups of 2 or 3 maximize the involvement and help create a sense of interdependence and accountability. Second, you choose the groups. Random assignment works very well for many faculty. Stratified random (stratify students along some relevant criterion, such as computing skills or experience) and then randomly assign student from each category to all the groups. Permitting students to choose their own groups often leads to students working with friends who have a lot of other things to talk about beside the work and to some students being left out. Third, keep the groups together until the task is completed and perhaps longer. Changing groups periodically gives students a chance to meet more of their peers and helps them gain skills for quickly getting a group up and running. Fourth, choose roles that are consistent with the requirements of the task and are important for the smooth functioning of the group. Many faculty only assign a recorder for the first group assignment.

3. **Explain the task and the positive interdependence**. The professor needs to clearly define the assignment, teach the required concepts and strategies, specify the positive interdependence and individual accountability, give the criteria for success, and explain the expected teamwork skill to be engaged in. To make a group project truly cooperative, positive interdependence and individual accountability must be structured in a variety of congruent ways. Positive interdependence is typically structured by asking the group to prepare a single product (goal interdependence), asking the students to make sure each person in the group can explain the groups' answer (learning goal interdependence), giving the group one copy of the assignment (resource interdependence), and assigning a special role to each member (role interdependence). Individual and group accountability is typically structured by assigning specific functions to each role, randomly calling on individuals to explain their group's answer, monitoring the groups and occasionally asking a student to explain his or her group's answer or method (individual oral exam), asking each member to sign the group's report, and of course, by giving individual quizzes, exams and writing assignments. Course with extensive formal cooperative learning usually use a combination of group assignments and individual assignments to determine each student's final grade. Typical distributions between individual and group are 95-5 to 70-30, that is, between 5 and 30 percent of an individual students grade is based on group work. Some faculty use groupwork as a base line or threshold that students must complete satisfactorily, but base grades on individual work only. A few faculty in project based courses base 100 percent of each students grade on group work.

4. **Monitor students' learning and intervene within the groups to provide task assistance or to increase students' teamwork skills.** The professor systemically observes and collects data on each group as it works. When it is needed, the professor intervenes to assist students in completing the task accurately and in working together effectively. While students are working faculty can learn a great deal about what the students know about the material and can often identify problems students are having either with the academic material or working in the group. Typical things to look for are on-task, interactions (what happens when someone says something?), involvement, strategy the group is using, how the groups deal with task or group functioning difficulties, etc.

5. **Evaluate students' learning and help students' process how well their group functioned.** Students' learning is carefully assessed and their performances are evaluated. A criteria-referenced evaluation procedure must be used, that is, grading must NOT be curved. Written exams, quizzes, and papers are typically used to evaluate individual student's learning. The professor provides time and a structure for members of each learning group to process how

effectively they have been working together. A common method for processing is to ask the students to list things they did well while working in the group and things that they could improve. A quick process strategy is to ask each individual to list something they did to help the group accomplish its task and one that they could do even better next time.

Problem-Based Cooperative Learning

A typical format for problem-based cooperative learning is shown in the figure on the right. The format illustrates the professor's role in a formal cooperative learning lesson and shows how the five essential elements are incorporated.

Problem-based learning results from the process of working toward the understanding or resolution of a problem. The process of problem-based learning is shown the figure below and is contrasted with subject-based learning (Woods, 1994.) Problem-based learning is very suitable for introductory sciences (as it is for medicine and engineering, where it is currently used) because it helps students develop skills and confidence for formulating problems they've never seen before. This is an important skill, since few science, mathematics, or engineering graduates are paid to formulate and solve problems that follow from the material presented in the chapter or have a single "right" answer that one can find at the end of a book.

The largest-scale implementation of PBL in large, introductory courses is occurring at Samford University in Birmingham, Alabama and The University of Delaware in Newark, Delaware. Both schools have invested heavily in faculty development and are now becoming resources to other campuses around the country.

Problem-Based Cooperative Learning

TASK: Complete the task or solve the problem)

INDIVIDUAL: Estimate answer. Note strategy.

COOPERATIVE: One set of answers from the group, strive for agreement; make sure everyone is able to explain the strategies used to solve each problem.

EXPECTED CRITERIA FOR SUCCESS: Everyone must be able to explain the strategies used to solve each problem.

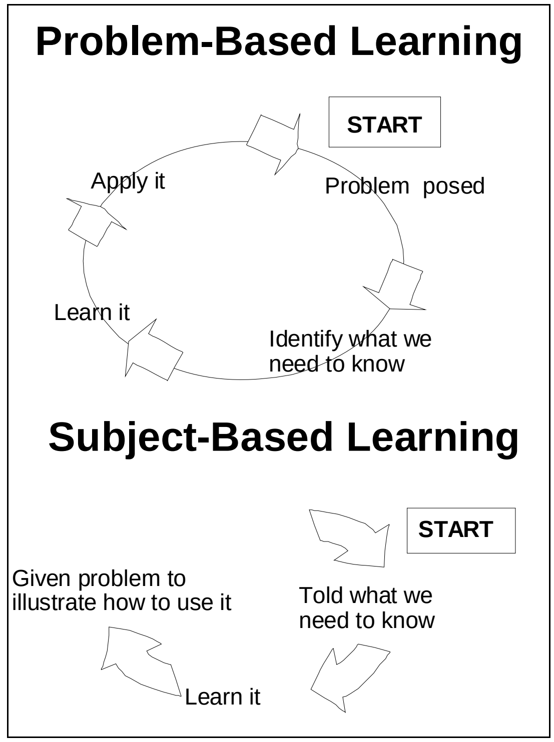
EVALUATION: Best answer within available resources or constraints.

INDIVIDUAL ACCOUNTABILITY: One member from any group may be randomly chosen to explain (a) the answer and (b) how to solve each problem.

EXPECTED BEHAVIORS: Active participating, checking, encouraging, and elaborating by all members.

INTERGROUP COOPERATION: Whenever it is helpful, check procedures, answers, and strategies with another group.

Faculty members at the University of Delaware have implemented PBL in many introductory courses, including biology, biochemistry, chemistry, criminal justice, education, international relations, marine studies, mathematics, nutrition/dietetics, physics, political science and exercise science (Allen, Duch and Groh, 1996; Groh, Williams, Allen, Duch, Mierson, and White, 1997). They started with grant support from National Science Foundation (NSF-DUE) and the Fund for Improvement of Post-Secondary Education (FIPSE) and have now had more than 25% of the faculty participate in weeklong formal workshops. Deborah Allen and Barbara Duch also recently wrote a book of PBL problems for introductory biology (Allen and Duch, 1998).



The intellectual activity of building models to solve problems--an explicit activity of constructing or creating the qualitative or quantitative relationships--helps students understand, explain, predict, etc. (Smith and Starfield, 1993; Starfield, Smith, and Bleloch, 1994). The process of building models together in face-to-face interpersonal interaction results in learning that is difficult to achieve in any other way.

Support for Cooperative Learning

The empirical and theoretical evidence supporting cooperative learning is vast. During the past 90 years, over 350 experimental studies have been conducted in college and adult settings comparing the effectiveness of cooperative, competitive, and individualistic efforts. These studies have been conducted by a wide variety of researchers in different decades with different learner populations, in different subject areas, and in different settings. More is known about the efficacy of cooperative learning than about lecturing, the fifty-minute class period, the use of instructional technology, or almost any other aspect of education. From this research you would expect that the more students work in cooperative learning groups the more they will learn, the better they will understand what they are learning, the easier it will be to remember what they learn, and the better they will feel about themselves, the class, and their classmates. The multiple outcomes studied can be classified into three major categories: achievement/productivity, positive relationships, and psychological health. Cooperation among students typically results in (a) higher achievement and greater productivity, (b) more caring, supportive, and committed relationships, and (c) greater psychological health, social competence, and self-esteem. A summary of the studies conducted at the higher education level may be found in Johnson, Johnson, & Smith (1991a, 1991b, 1998b, 1998c, 2006, 2007), and Smith, Sheppard, Johnson and

Johnson (2005). Springer, Stanne and Donovan, (1999) summarized the research for college level one science mathematics, engineering and technology. A comprehensive review of all studies and meta-analyses of their results is available in Johnson & Johnson (1989).

Cooperative learning researchers and practitioners have shown that positive peer relationships are essential to success in college. Isolation and alienation are the best predictors of failure. Two major reasons for dropping out of college are failure to establish a social network of friends and classmates, and failure to become academically involved in classes (Tinto, 1994). Working together with fellow students, solving problems together, and talking through material together has other benefits as well (McKeachie, 1988; McKeachie, et al., 1986):

> Student participation, teacher encouragement, and student-student interaction positively relate to improved critical thinking. These three activities confirm other research and theory stressing the importance of active practice, motivation, and feedback in thinking skills as well as other skills. This confirms that discussions . . .are superior to lectures in improving thinking and problem solving (1988, p. 1)

References

Allen, D.E., and Duch, B.J. *Thinking toward solutions: Problem-based activities for general biology*. Philadelphia: Saunders College Publishing, 1998.

Allen, D.E., Duch, B.J., and Groh, S.E. AThe power of problem-based learning in teaching introductory science courses. In L. Wilkerson and W.H. Gijselaers (eds.), *New Directions for Teaching and Learning,* no. *68, pp.* 43-52, 1996.

Duckworth, E. 1987. *The having of wonderful ideas" & other essays on teaching and learning*. New York: Teachers College Press.

Fosnot, C.T. 1989. *Enquiring teachers, enquiring learners*. NY: Teachers College Press.

Groh, S.E., Williams, B.A., Allen, D.E., Duch, B.J., Mierson, S. and White, H.B. AInstitutional change in science education: A case study. In A. P. McNeal and C. D'Avanzo (eds.). *Student active science: Models of innovation in college science teaching*. Philadelphia: Saunders College Publishing, 1997.

Johnson, D. W., Johnson, R. T., & Smith, K. A. 2006. Active Learning: Cooperation in the College Classroom (3rd ed.). Edina, MN: Interaction Book Company.

Johnson, D. W., Johnson, R. T., & Smith, K. A. 2007. The State Of Cooperative Learning In Postsecondary And Professional Settings. Educational Psychology Review, 19(1), 15-29.

Johnson, D.W., Johnson, R.T., and Smith, K.A. 1998a. *Active learning: Cooperation in the college classroom* (Second Edition). Edina, MN: Interaction Book Company.

Johnson, D.W., Johnson, R.T., and Smith, K.A. 1998b. Cooperative learning returns to college: What evidence is there that it works? *Change*, *30* (4), 26-35.

Johnson, D.W., Johnson, R.T., and Smith, K.A. 1998c. Maximizing instruction through cooperative learning. *ASEE Prism, 7*(6), 24-29.

Johnson, D.W., Johnson, R.T., and Smith, K.A. 1991b. *Active learning: Cooperation in the college classroom*. Edina, MN: Interaction Book Company.

Johnson, D.W., Johnson, R.T., and Smith, K.A. 1991a. *Cooperative learning: Increasing college faculty instructional productivity*, ASHE-ERIC Reports on Higher Education.

Johnson, David W., Johnson, Roger T. 1989. *Cooperation and competition: Theory and research*. Edina, MN: Interaction Book Company.

Katzenbach, Jon R. and Smith, Douglas K. 1993. *The wisdom of teams: Creating the high-performance organization*. Cambridge, MA: Harvard Business School Press.

Kolb, David A., Rubin, Irwin M. and McIntyre, James M. 1984. *Organizational psychology: An experiential approach, 4th ed*. Englewood Cliffs, NJ: Prentice-Hall.

MacGregor, Jean, Cooper, James, Smith, Karl, and Robinson, Pamela. 2000. *Strategies for Energizing Large Classes: From Small Groups to Learning Communities:*. New Directions for Teaching and Learning, No. 81. San Francisco: Jossey- Bass

McKeachie, Wilbert. 1988. Teaching thinking. *NCRIPTAL Update, 2*(1), 1.

McKeachie, Wilbert; Pintrich, Paul; Yi-Guang, Lin; and Smith, David. 1986. *Teaching and learning in the college classroom: A review of the research literature*. Ann Arbor, MI: The Regents of the University of Michigan.

National Science Foundation. 1996. *Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering and Technology*. Washington, DC: Directorate for Education and Human Resources, NSF96-139.

Smith, Karl A. 2000a. Inquiry in Large Classes**.** *1999 Sigma Xi Conference Proceedings -- Reshaping Undergraduate Science and Engineering Education: Tools for Better Learning*, p. 53-64.

Smith, Karl A. 2000b. *Project management and teamwork*. New York: McGraw-Hill.

Smith, Karl A., and Starfield, Anthony M. 1993. Building models to solve problems. In J.H. Clarke & A.W. Biddle, (Eds.), *Teaching critical thinking: Reports from across the curriculum*. Englewood Cliffs, NJ: Prentice-Hall.

Springer, Leonard, Stanne Mary Elizabeth, and Donovan, Samuel S. 1999. Effect of small-group learning on undergraduates in science, mathematics, engineering and technology: A meta-analysis. *Review of Educational Research*, *69*(1), 21-51.

Starfield, Anthony M., Smith, Karl A., and Bleloch, Andrew L. 1994. *How to model it: Problem solving for the computer age*. Edina, MN: Burgess International Group, Inc.

Tinto, Vincent. 1994. *Leaving college: Rethinking the causes and cures of student attrition*. Second Edition. Chicago: University of Chicago Press.

Woods, Donald R. 1994. *Problem-based learning: How to gain the most from PBL*. Waterdown, Ontario: Donald R. Woods.