Innovation in large lectures—teaching for active learning

The call for reform in science education stimulated by "A Nation at Risk" (National Commission on Excellence in Education 1983) is multifaceted and complex, as well as inclusive in scope, encompassing kindergarten through graduate school (AAAS 1990, NRC 1996a, 1996b, Project Kaleidoscope 1991). This national call for reform also has captured the attention of many university faculty nationwide (Gibbons 1994), who recognize the need to change how science is taught—especially at the undergraduate level, in courses such as introductory biology. Explicit in this call to action is a rethinking of the purpose of science courses in terms of "student outcomes"—that is, what do science educators want students to know and be able to do?

In the science education reform efforts that we have instituted at Northern Arizona University (NAU) and at the University of Montana (UM), our goal was for all of our students to become biologically literate, especially those not majoring in science, such as elementary and secondary education majors—that is, future teachers. As we define it, biological literacy includes not only understanding major biological concepts but also being able to use the process of inquiry to solve problems, to communicate effectively, and to develop positive attitudes toward and self-confidence in understanding biology. We focused our efforts on introductory biology courses because they enroll large numbers of majors and nonmajors, both groups whose biological literacy is in need of improvement (Sundberg et al. 1994). Moreover, introductory biology classes tend to be large lecture courses, which generally tend to reinforce students' roles as passive learners who absorb concepts and facts only long enough to get through the next test (Moore 1996, NRC 1996b). Thus, it is a special challenge for such courses to promote biological understanding and self-confidence in students.

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Our reform efforts emphasized active, inquiry-based learning because calls for reform in science education (NRC 1996b) recommend a shift in instructional focus to include the student "learner" in the educational process, thus reversing a trend of passive learning. Learning science at any level is a constructive process that requires active participation by both the student and teacher (Glasson and Lalik 1993). This concept is not new to educational researchers or to teachers at small liberal arts colleges, but science faculty at large universities have only recently begun to explore this approach. The fact that strategies are readily available for teaching with a focus on learning science by doing science (AAAS 1990, Project Kaleidoscope 1991) should be welcome news to faculty who want to reach more students in their classrooms.

At first glance, strategies to actively involve students in "doing" biology appear readily accessible for laboratories and classes with small numbers of students, whereas addressing this goal in science courses with large numbers of students might seem to be more problematic. However, as we detail in this article, we found that it is possible to implement strategies for active, inquiry-based learning and cooperative group interaction in large lecture classes. Courses at both universities were designed to personalize instruction, to incorporate cooperative learning, and to include student-centered, in-class experiences, simulations, and discussions. Our approaches offer both formal and informal models for modifying teaching strategies to involve the learner, especially in large courses. Most important, we show that cooperative learning combined with an inquiry-based approach to a lecture promotes more effective learning by more students.

Changing how we teach biology

Although the two cases we describe use different strategies for changing instruction, they are based on the same goal—teaching to involve active learning by all students. The NAU case describes an experiment that tested the relative effectiveness of inquiry-based instruction. The UM case illustrates how such teaching strategies can be easily incorporated into the largest lecture courses.

Case 1: Experimenting with faculty and students at NAU. At NAU we conducted a research study about biology instruction in an effort to test a new model for teaching science to undergraduates. This action research model informs decisions about teaching with both quantitative and qualitative evidence.

Experimental design. We compared the biological literacy of nonmajor students who had enrolled in a traditional introductory biology lecture class with that of nonmajors who had enrolled in an experimental class in which they took an active role in their own learning. The goals for all students were to demonstrate biological literacy by effectively communicating an understanding of and links among biological principles and concepts to peers and others; to use the process of scientific inquiry to think creatively and to formulate questions about real-world problems; to reason logically and critically to evaluate information; and to gain con-

Table 1. Instructions presented to students for effective interactions in cooperative groups and the types of responses expected from students. Modified from Johnson et al. 1991.

General instructions	Behavioral responses
Students think about and formulate an answer and consider how they arrived at that answer (30–60 seconds).	The entire room is quiet while students think about and process information.
At the signal, students form a small group (either an informal group made up of near neighbors who do not know one another or a formal group—that is, a permanent group whose members come to know one another during the semester).	Everyone participates.
Students share answers and listen carefully to others.	Each person talks without interruption for 30 seconds, and all group members listen. The instructor observes the groups, listening to their discussions and answering their questions.
Groups reach a consensus on a best answer.	Reporter uses group input to prepare a response, and recorder writes the response down.
Randomly selected groups report their answer to the class via the reporter.[a]	Within the group, individuals are accountable for their work as the reporter or recorder. The instructor can note participation for consideration when grading.
Groups quietly compare answers with those of surrounding groups in a process of intergroup cooperation.	Further student–student dialogue takes place, enhancing learning.
Students return to their seats and direct their attention toward the instructor.	Groups respond to the same signal readily.

[a]Students use a hand-held microphone so that the large group can hear them. Although some students are initially afraid of speaking before a large group, we have found that in a safe learning environment, their fear quickly subsides.

fidence in their ability to write about, criticize, and analyze concepts in biology. The hypothesis was that students would learn science better by becoming engaged in the process of science in large lectures (Lawson et al. 1989).

The experiment was conducted during the spring semester of 1995, when we taught a total of 559 students in four lecture sections of approximately 140 students each. (The majority of students also were enrolled in an inquiry-based, investigative laboratory.) Two of the lecture sections were designated as controls, and two were experimental. Two faculty members each taught one experimental and one traditional (control) lecture section. Students were assigned into sections based on their course registration preferences, and written informed consent was obtained from all students participating in the experiment.

We assessed biological literacy in three different ways. First, we constructed a self-efficacy instrument for students to report their own confidence in various aspects of biology, including the ability to read and critique biology articles; to explain biological concepts to others; to write and reason scientifically; and to relate biological understanding to other aspects of their own life.[1] Second, we used a national test, the National Association of Biology Teachers (NABT)/National Science Teachers Association (NSTA) High School Biology Examination, to assess students' understanding of biological content (of all topics in biology) and the scientific process. Third, we designed a process skills instrument to assess students' abilities to understand conceptually a testable scientific question, to design a method for answering that question, to interpret quantitative relationships, and to explain results. All students enrolled in lecture sections completed each of the instruments at the beginning (pre-test) and at the completion (post-test) of the course. Data were analyzed with analysis of covariance (ANCOVA) using pre-test scores as covariates. We also conducted focus group interviews with randomly selected groups of students from each lecture section at the end of the semester to determine students' perceptions of the course design and of their learning accomplishments in the context of the course goals.

[1]J. Baldwin and D. Ebert-May, unpublished data.

Format for traditional and experimental lectures. Identical lecture notes were developed and used by each instructor in both lecture types, but the formats for the lectures differed substantially. Traditional lectures were instructor centered; faculty talked and students listened. Lectures were organized in an outline format and were taught with question–answer interactions between the instructor and individual students. Students did not work in cooperative groups during the lecture.

Experimental lectures were based on a learning cycle model of instruction (Allard and Barman 1994, BSCS 1993). The students were randomly assigned to permanent cooperative groups whose members were changed only if the group was not productive (i.e., if a member did not contribute to the group's efforts). The model consists of five phases: the engagement phase begins with a question to probe students' prior knowledge and organize their thinking for the activities during the lecture; the exploration phase provides students with a common basis for understanding the concepts, processes, and skills for a given topic; the explanation phase builds on the engagement and exploration phases so that students can demonstrate their understanding of concepts with additional examples; and the elaboration phase challenges students' conceptual understanding and skills. An individual or group quiz (short-answer format) was given daily to evaluate students' understanding.

Experimental lectures were organized with concept maps (Novak and Gowin 1984), which are intended to represent meaningful relationships between concepts in the form of propositions. Concepts are arranged hierarchically and provide a visual road map intended to benefit both faculty and students. These maps facilitate learning by helping faculty to organize their lectures and students to see connections among concepts.

In the NAU experiment, the key difference between a traditional lecture and a learning cycle lecture is the level of student involvement. Although both types of lectures were organized around an engagement question, an exploration question, and a daily quiz, students in the learning cycle lecture format participated in discussions that involved the entire class (not just a single student responding to a single teacher). In addition, peer teaching took place, and teams participated in writing and speaking activities. Simply put, more students were involved in active learning.

Formats and management techniques for cooperative groups. Although students came into the experimental sections expecting a traditional, passive lecture format, they quickly learned their new roles as active contributors to the class through their cooperative group. For two to three weeks at the beginning of the semester we repeatedly provided students with instructions and ideas for functioning in productive groups (Table 1). This guidance was critical because the majority of students entering our classes had minimal, if any, experience in working in successful cooperative groups. In addition, highly structured classroom management was necessary to facilitate group and individual interactions during class (Table 2). For example, when several hundred students were talking among themselves, the noise level in the room increased markedly. Thus, a signal was necessary (e.g., dimming the lights or ringing a bell) to end conversations so that instruction could proceed. By highly structuring the mechanical activities in our large courses (e.g., call to attention, collecting writing samples, distributing materials), we created an active learning environment that enabled students to think, speak, and question one another freely in an organized fashion without significant loss of time.

To facilitate effective cooperative learning and group interactions, students were assigned to permanent cooperative groups of four students

Table 2. Strategies for managing cooperative groups in a dynamic atmosphere in a large enrollment lecture course.

Management need	Possible strategy
Signal to end cooperative interaction	Dim the lights or ring a bell
A way to quickly gather handouts or other instructional material	Designate a "materials" person within each group
A way to collect and organize large numbers of writing samples, homework, and daily quizzes	Have students print name, section, group number, person letter, date, and quiz number on color-coded paper; collect in labeled boxes with drop slots
A safe environment for speaking in front of hundreds of peers	Allow students to pass when called on to speak in front of the class (e.g., "I'd like to think about that further"); respect student ideas and responses
Reduce the sheer volume of hundreds of conversations	Remind students to speak quietly
A way to overcome the barriers created by the fixed theater-style seating	Allow students to get up and move around to form groups
Groups that function effectively	Assign three or four students to each informal group (UM); assign four students to each permanent group (NAU)
Accountability of groups and individuals	Select students using random numbers generator; give group quizzes and reward individual students who contribute to discussion with "participation points"
A grading system to assess cooperative group work	Ask each group to turn in a quiz or writing sample; alternate between giving individual and group quizzes

by seat number and letter (i.e., 1A, 1B, 1C, 1D, 2A, 2B, 2C, 2D, 3A,...). Data collection was facilitated by developing a seating chart for each section, and attendance was taken daily. Members of groups were assigned rotating roles (e.g., reporter, recorder, and materials gatherer). Procedures for working in cooperative groups were outlined and, importantly, practiced daily. In truly cooperative groups, students promote one anothers' learning and share the work, while also assuming responsibility for their own learning (Johnson et al. 1991).

Our modified learning cycle lectures were designed around three questions (an example is presented in Table 3). The opening engagement question (Q1) recruited students as active learners. This question had dual purposes: it set the theme for the lecture, and it drew on student interest, experience, and prior knowledge to generate ideas and possible answers. Most engagement questions asked were "how," "what," or "explain" questions, although occasionally we used short activities (e.g., designing a scheme to classify types of fasteners). After seeing and hearing the question, students were asked to think about the question and possible answers for 30–60 seconds and then to discuss the question in their cooperative groups for 3–5 minutes (the time varied depending on the question). A reporter (person A, B, C, or D, depending on the rotation) chosen randomly from three to five groups, depending on the nature of responses and time available, presented the group's ideas to the class.

For example, in response to the engagement question (Q1) in Table 3, the reporter responded, "The additional weight of the tree came from the soil." To follow up, the instructor queried, "Based on how much soil was missing at the end of the experiment, what evidence can you provide that the additional mass came from the soil?" The reporter responded, "The soil actually lost very little weight, so carbon dioxide from the atmosphere must have something

Table 3. Example of questions used in a learning cycle lecture on photosynthesis. The engagement question elicited an oral response from cooperative groups, the exploration question elicited an oral and written response from groups, and the quiz was given to the group as a whole.

Stage in lecture	Sample questions
Engagement question (Q1)	Van Helmot planted a willow tree that weighed 5 lb in a tub containing 200 lb of dried soil. For five years, he added only rainwater to the tub of soil. At the end of that period, the tree weighed 170 lb, whereas the weight of the soil was almost unchanged, losing only 2 oz. What was the source of the new plant material?
Exploration/Explanation question (Q2)	A plant and a mouse are put into a bell jar. The plant is in a pot of moist soil. The entire bell jar is placed on a window sill. What happens to the mouse and plant after one day? After three days?
Evaluation/Quiz	Explain how photosynthesis was a critical event in the evolution of biodiversity?

to do with the weight gain." The instructor commented, "You are on the right track," and then asked a reporter from another group, "How does the carbon dioxide turn into plant matter?" We probed the responses of selected reporters with additional questions (asking questions such as "how could you test...?" or "what can be concluded from...?") that required elaboration to extend students' thinking about the concept. Answers prompted by higher-level thinking questions provided useful information about students' understanding and possible misconceptions.

Next, conceptual ideas embedded in the engagement question were the subject of a 15–20 minute lecture. The exploration–explanation phase then included posing another question (e.g., Q2 in Table 3) that built on the previous engagement segment and probed for higher-level thinking in terms of analyzing, applying, and synthesizing (Wiederhold 1991) the concepts. Students again worked on this question in cooperative groups, and a designated recorder wrote down the group's answer. A reporter was responsible for sharing the group's ideas with the class, which provided additional feedback to the instructor about the level of conceptual understanding. The question posed during the exploration–explanation phase was designed to facilitate greater student involvement in the discussion, to allow students to challenge the thinking and understanding of their peers, and to help them to recognize the importance of student-generated ideas. (Again, 15–20 minutes of lecture followed the discussion.) Finally, the topic was extended to new situations, conceptually returning to ideas and building a more in-depth understanding with new applications. Written answers to Q2 (one from each group) were collected daily and read quickly after each lecture to provide the instructor with formative feedback.

When questioning students, "wait time"—during which students have a chance to think and evaluate their ideas before answering a question or discussing a question in their group—is critical (Rowe 1974). Typically, faculty waited 30–60 seconds before rephrasing or answering questions or giving a signal for groups to work together. In addition, we redirected answers from one student to another student for additional clarification, examples, and applications. A substantive web of discussion took place in the class as students listened and responded to ideas of their peers. When answers and comments were shared through this process, misconceptions surfaced. It is critical for faculty to respond in such a way that further discussion is encouraged and students are not afraid to speak, yet misconceptions are addressed so that students do not learn inaccurate information.

Before the end of of each class, we announced a group or individual quiz, and then teams spent 1–5 minutes reviewing the main concepts of the class (Table 3). Approximately half of the quizzes administered during the semester were given to groups, and half were given individually. This approach nurtured both individual responsibility and group accountability. The quiz questions focused on synthesis, analysis, or application of concepts, and students were encouraged to use their books and notes to develop the most appropriate answer.

Comparing experimental and traditional lectures. The experiment described above is part of a much larger experiment to test which course design is most effective in both lecture and laboratory sections of introductory biology.[2] Results from the experimental lectures at NAU suggest that students who experienced the active-learning lecture format had significantly higher self-efficacy and process skills than students in the traditional course. A comparison of mean scores from the self-efficacy instrument indicated that student confidence in doing science, in analyzing data, and in explaining biology to other students was higher in the experimental lectures ($N = 283$, $DF = 3, 274$, $P < 0.05$). Moreover, students in the experimental lectures scored higher on the process questions from the NABT exam ($N = 341$, $DF = 1, 336$, $P < 0.005$). Therefore, we conclude that group inquiries in the experimental lectures provided students with additional opportunities to learn scientific process skills above and beyond the experiences provided for them in laboratories. Interestingly, student scores on the content portion of the NABT exam in the experimental lectures were not significantly different from scores of students in the traditional lectures, which suggests that allocating time to cooperative learning activities at the expense of delivering more content did not harm student learning or reduce knowledge acquisition.

Case 2: Personalizing the lecture experience in a large hall at UM. Students in any class, but especially in large science lecture classes, need a sense of identity and a comfortable learning environment to maximize learning. Their structure alone can make large science classes more intimidating than discussion-based science courses with only 25–30 stu-

[2]D. Ebert-May, unpublished data.

dents. The introductory biology course at UM serves 450 students at one time in a large lecture theater. This classroom has a larger population than some towns in Montana, and it is particularly intimidating to students from small, rural communities. In large lectures theaters like the one at UM, establishing formal permanent groups may prove a major challenge for instructors wishing to introduce new teaching methods. At UM, we adopted a more informal approach that also promoted active learning through student–student interaction and discussion but required less student management than the model presented for NAU. Johnson et al. (1991) provide many tips for working with "informal" cooperative groups. At UM, group membership changed daily according to the availability of open seats in the lecture hall when students arrived.

To personalize instruction, we infused cooperative learning into the traditional lecture format and included student-centered, in-class experiences, simulations, and discussions. A first step to personalize the large lecture classroom was to call on students by name. Because it is impossible to learn 450 names during one semester, we had students raise a large card or the back page of their notebook with their name written in large block letters when they wished to be called on. In particularly large lecture halls, the instructor may need field glasses to see cards at the back of the room!

Table 4. Students' responses (quotations are from different individuals) to focus interview questions (NAU) and course evaluations (UM) from those enrolled in both the experimental and traditional lecture course designs.

Category evaluated	Student responses (experimental courses at NAU and UM)	Student responses (traditional course at NAU)
Describing the learning environment	"This class was different from what I expected and I would have taken science earlier in my program had I known it was going to be like this"; "I was forced to think critically—more than I expected to"; "there were no stupid questions"; "a safe and encouraging environment"; "biology no longer intimidates me."	"The biology classes are a lot larger than most of the other classes at the University, so you don't actually get one-on-one instruction"; "...they walk up and down the aisles to ask you questions to keep you alert and thinking about the topic which you are discussing."
Working in cooperative groups	"We learned from each other and made friends; by getting to know each person, we began to study together"; "beneficial because you just did not sit there for the whole time."	"The class...was large, there are reasons that you couldn't get into a discussion and I understand that"; "...to me that was hard because the classes that I'm in are smaller...I tend to learn better there."
Biological understanding	"The material was made relevant to my life by working through examples"; "the major difference between me and a larch tree is the number and order of our nucleotides—we are really interconnected"; "everything changes through time"	"In the lecture they give you a bunch of information and try to apply it. But as far as how to apply it, nothing in the lecture."
Science as a way of knowing	"Scientists don't necessarily consider themselves to be the ultimate and defining authority on everything and I think I have learned how to be a better and more impartial 'viewer' of evidence"; "science is not black and white since their are uncertainties and data can be conflictive."	"... I got that knowledge mainly from biology lab...how you come up with your hypothesis, your question. How that's all worked out. And I think that was a big...that was a major help being in the biology lab."

Three strategies were used to promote discussion in the large lecture hall at UM. First, students interacted frequently with their nearest neighbors and in cooperative groups, and individual students from cooperative groups reported back to the class. At least once each lecture, students were asked to turn to a student seated next to them to complete a task, such as forming an answer to a question or problem from lecture material, developing an example of a concept, or formulating a question about something that they did not understand from the preceding lecture. This simple technique immediately infused cooperative learning and discussion into a large lecture-format course, and students enjoyed the opportunity to talk with one another. Answers were shared by students chosen randomly from the class roster. When students were not ready to share their answer, they responded, "I'd like some time to think about that further," and another student was selected.

A second strategy to promote discussion in the large class was used when a topic might best be addressed by an activity that would last a full lecture period. For example, to learn about gene flow in small populations, students conducted a simulation experiment using white and black beans.[3] Working in groups of three, the students counted beans to determine how many generations would be required for allele frequency to reach equilibrium in two small, interbreeding populations. Again, results of the classroom simulation experiment were shared by students chosen randomly from the class roster.

A third, especially effective strategy to generate discussion in the large lecture classroom was through debate on a particularly interesting issue that required conceptual understanding to make a well-articulated argument. One particularly successful debate topic was genetic engineering (Brewer and Ebert-May in press). After general background material had been presented, students prepared position statements arguing in favor of or in opposition to genetic engineering from the perspective of a particular interest group. To ensure a broad range of viewpoints, short, one-page articles (e.g.,

[3] C. A. Brewer and C. Zabinski, unpublished data.

from such publications as *Science, Nature, Science News,* and *Time*) that could be used to support the viewpoints of 12 different interest groups (e.g., lawyers, insurance agents, physicians, research scientists, concerned citizens, and philosophers) were shuffled and distributed in class. The debate followed the format of a hearing before a Congressional Subcommittee charged with developing regulations for the emerging field. Randomly chosen students had 90 seconds to present their positions. Nearly 100 students "testified" during a genetic engineering hearing. In this format, the amount of material covered was nearly identical to what would have been covered in a traditional lecture, but the student presentation resulted in a dynamic, exciting classroom atmosphere.

Qualitative assessments from redesigned courses

Focus group interviews and written student comments from NAU and UM indicated that students learned better by participating in a cooperative group, and they enjoyed the social interactions. When asked to describe the learning environment in their lectures, students in the experimental lectures usually characterized the classroom environment as friendly, nonthreatening, fun, and dynamic (Table 4). In addition, they reported a sense of belonging and camaraderie because they regularly interacted with peers and learned from each other. Qualitative observations indicated that attendance was higher in the experimental classrooms at NAU and UM than in lectures taught in the traditional format. Student desire to participate was also high. Instead of fewer than ten students raising hands to answer a question, scores of students regularly volunteered to provide answers. Students in the courses we have described also reported that they felt that they would remember the course material for a longer period of time because the information had been repeated and made relevant to their daily lives. They also felt that they had been stimulated to work harder and pay closer attention because they were frequently responsible for reporting to the class.

Once changes in student learning have been defined and implemented, all faculty must develop a broad range of assessment strategies to fairly critique student performance. Because we asked students in the newly designed lectures described here to critically evaluate information, to question one another for deeper understanding, to perform cooperative tasks and exercises, to use their knowledge to make inferences, and to write and speak about biology, we could not have used didactic multiple-choice tests to assess student learning and achievement of expected student outcomes. Although multiple-choice tests can be constructed to examine student learning and understanding, the information that faculty and students gain from these types of exams is, by design, limited. Therefore, greater use of "public hearings," group quizzes, in-class writing exercises, and essay questions on exams will enrich the data that faculty collect to assess student performance.

In particularly large classes, time may constrain the number of writing assignments (i.e., papers and essay questions) that an instructor can evaluate. Thus, innovation in assessment of written work is definitely needed. One promising possibility, which we are currently testing, is to have cooperative groups write papers. We are also experimenting with peer assessment of written work prior to submission to faculty and teaching assistants for evaluation. Greater use of scoring rubrics (Brewer and Ebert-May in press) also may facilitate scoring of hundreds of short and long writing assignments.

Final considerations

Qualitative evidence from student interviews and evaluations substantiate the positive nature of the cooperative learning environment in large lectures. Questions about the persistence of knowledge and process skills learned in the NAU course experiences are being addressed in a follow-up study that is now in progress. Evidence from the NAU and UM introductory biology cases suggests that innovative teaching strategies can improve students' understanding of the content and process of biology in courses with large enrollments. To improve biological literacy, educators must emphasize the process of knowing and depth of content rather than trying to cover as much information as possible.

We found that cooperative learning is the most effective strategy to shift responsibility for learning from the instructor to the students (Table 4). The more that students became active partners in the learning process, the more they took ownership of the course and of their learning. The time that we spent building cooperative teams in our large lectures did not decrease student performance on exams that focused on content. In classes featuring cooperative learning, students are asked to rush through less material and to think more deeply. Students responded to this style of learning by discussing biological concepts with confidence and by clarifying their understanding with their peers. Thus, the classroom environment became intellectually stimulating and challenging, as well as highly interactive.

We also found that learning and practicing questioning strategies facilitated class discussions (Wiederhold 1991). Students listened to their peers because their peers had something important to say. In the experimental, innovative lecture format, students shifted from asking predominantly content-, knowledge-, or clarification-type questions to asking application-, analysis-, and synthesis-type questions. Students began questioning the nature of the scientific evidence before them. Again, students were more likely to apply their understanding of biological concepts to personal, public, and ethical issues than if they had experienced the traditional lecture format. Students in our courses recognized that scientific evidence is not necessarily black and white. Such an understanding of the nature of scientific evidence will help students, as citizens, to make better decisions about many issues, such as how to sustain the environment or how to deal with new reproductive technologies. Moreover, they will influence future decisions about scientific issues, including allocation of resources, that will directly affect the scientific enterprise.

Why should college faculty change their teaching methods? Can the student outcomes that we describe here be accomplished via a traditional lecture mode? Perhaps for some students, but we want to increase learning of science by all students (NRC 1996a). Can faculty save time, take some risks in their teaching, and still gain adequate teaching evaluations? Our experience is that yes, we, as educators, can. Will success in research count more in faculty's overall evaluation than success in teaching? This question should be considered within the context of the specific educational institution and department peers. What we do know is that citizens and state legislatures are demanding higher standards of accountability for student learning than ever before. Consequently, faculty must facilitate more effective learning by more students. Our experiences indicate that a cooperative learning classroom emphasizing inquiry and depth of knowledge is one way to begin the process of reaching more students, especially in large-enrollment courses.

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